THE ORIGINS OF THE CIVILIZATION OF ANGKOR

VOLUME SIX

THE EXCAVATION OF BAN NON WAT

PART FOUR: THE IRON AGE, SUMMARY AND CONCLUSIONS



The Fine Arts Department, Thailand

THE ORIGINS OF THE CIVILIZATION OF ANGKOR

VOLUME VI

THE EXCAVATION OF BAN NON WAT: THE IRON AGE, SUMMARY AND CONCLUSIONS

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FOREWORD

In 1992, a major research project was initiated in the Amphoe Non Sung, Changwat Nakhon Ratchasima, entitled "The Origins of the Civilization of Angkor". It was conceived by Professor Charles Higham of the University of Otago, New Zealand, and Dr Rachanie Thosarat, of the Thai Fine Arts Department. The Fine Arts Department has been pleased to be associated with this research project and to be able to publish this, the sixth and final report of a series which promises to contribute a great deal to our understanding of Thai prehistory.

While it might be argued that the upper Mun Valley is relatively remote from the centre at Angkor, two important facts must be stressed. The first is that the Mun Valley, and particularly the area of Phimai, ancient Vimayapura, gave to the kingdom of Angkor its greatest kings in Suryavarman II and Jayavarman VII. These rulers belonged to the Mun Valley dynasty of Mahidharapura. At all times, the Mun Valley was a focus of major cultural developments leading to the early states of Angkor, as seen in the rich prehistoric cultures of the area, the early brick temples of Phimai, Phanom Rung and Phanom Wan, and the number of Chenla period monuments and inscriptions.

It is also noted that in the early 1990s, when this project was being formulated, it was impossible to envisage extensive archaeological fieldwork in Cambodia. The adjacent parts of Northeast Thailand, however, afforded a splendid opportunity to pursue this important topic.

Ban Non Wat is the fifth major excavation undertaken as part of this project, the others being at Non Muang Kao, Ban Lum Khao, Phimai and Noen U-Loke. It is a site of great importance because of its long occupation period, and the very large area opened by excavation over seven seasons of fieldwork. The site was initially occupied by hunter-gatherers, then by Neolithic rice farmers. By 1000 BC, this community began to cast bronzes, and six centuries later, the first iron was being forged. This volume describes the occupation of this site during the Iron Age. It covers the occupation of Ban Non Wat during the course of the Iron Age, beginning in the late fifth century and ending about one thousand years later. It then integrates the sequence at this site with the other Iron Age settlements excavated in the upper Mun Valley, and presents a synthesis of the findings from the entire project with reference to the origins of civilization with particular reference to the Kingdom of Angkor. I congratulate the authors of this volume in bringing their project to completion.

S. Leyavanija

Dr Somsuda Leyavanija
Director General
Fine Arts Department

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PREFACE

This is the sixth and final volume reporting on our research project entitled "The Origins of the Civilization of Angkor". In 1992, when Dr Rachanie Thosarat was appointed to the Phimai office of the Fine Arts Department, we resolved to consider the enigma presented by the many large, moated and banked settlements that are so prolific in the upper Mun Valley. Our initial model saw these sites as dating to the Iron Age, and as such, the immediate precursors to the early states of this area. The moated sites are densely distributed, and we mapped many. In 1995, we decided to begin our excavations at the site of Ban Lum Khao which is, paradoxically, one of the unmoated settlement so far examined. Our choice reflected the clear field evidence for a Bronze Age cemetery, a period we felt it necessary to consider as the precursor to any cultural changes noted in the ensuing Iron Age. Subsequently, we have excavated at Prasat Phimai and the moated sites of Non Muang Kao, Noen U-Loke and Ban Non Wat.

In this volume, we consider the Iron Age at Ban Non Wat and present a synthesis of all our findings made during 19 years of excavations and analyses. We are most grateful, therefore, to our colleagues for contributing their current findings in this part of our report series. The age and sex of the individuals whose graves we have excavated have been estimated by Dr N.G. Tayles and Dr S.E. Halcrow as part of their research on prehistoric human biology at Ban Non Wat.

Our research at Ban Non Wat proceeded with a permit issued by the National Research Council of Thailand, for which we are indebted. The backing of the Thai Fine Arts Department was also a vital prerequisite to our research. We are most grateful to all our colleagues who worked with us in the field, and who have contributed to this report. Without the good will of the villagers of Ban Non Wat, we could not have worked in their community, and we thank them for their welcome and cooperation. Dr Amphan Kijngam became the co-director of this project in place of Dr Rachanie Thosarat in 2007. I (C.H.) formatted this publication using the Indesign II program.

The Fine Arts Department of Thailand has been most supportive of this research programme, and we are most grateful to Dr Somsuda Leyavanija , the Director-General, for authorising the publication of this volume.

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I THE IRON AGE: INTRODUCTION

C.F.W. HIGHAM

INTRODUCTION

Ban Non Wat is a large, moated prehistoric site in the upper Mun Valley, Northeast Thailand at 15° 16'.03 16", 102° 16'.36 76" (Fig. 1:1). Excavations there between 2002-7 uncovered a cultural sequence that began with the flexed burials of probable hunter-gatherers, and then proceeded through two Neolithic, five Bronze and three Iron Age phases. This volume first reports on the Iron Age occupation of the site, and then presents a synthesis of the overall results of the research programme "The Origins of the Civilization of Angkor", which began in 1992 with site surveys in a study area west of the Angkorian centre of Phimai, and then proceeded through the excavations of the prehistoric settlements of Ban Lum Khao, Noen U-Loke, Non Muang Kao and Ban Non Wat (HIgham 2004, Higham and Thosarat 2005, Higham *et al.* 2007, Higham and Kijngam 2009, 2011). The last three of these sites were ringed by moats and banks during the Iron Age, and excavations have been undertaken across these features, and also at the sites of Non Ban Jak and Ban Makham Thae (McGrath and Boyd 2001). An excavation was also undertaken adjacent to the central shrine of the Angkorian temple at Phimai (Talbot and Janthed 2001).

CHRONOLOGY

As is always the case, it essential to outline the chronological framework. The cultural sequence at Ban Non Wat has been dated on the basis of 76 AMS radiocarbon determinations. Initially, we submitted charcoal samples from firm contexts, such as hearths or furnaces for heating copper. However, we then turned to dating the freshwater bivalve shells placed as mortuary offerings in inhumation graves in order to circumvent the problem of inbuilt age inherent in unspeciated charcoal. At Ban Non Wat, the transition from the Late Bronze Age into the first phase of the Iron Age cemetery fell in the second half of the first millennium BC, with *c* 420 BC as the most likely date. The overall chronology for the Iron Age in the Upper Mun Valley



FIG. 1:1 Air view of Ban Non Wat relative to other moated sites. A. Ban Non Wat, B. Noen U-Loke, C. Non Muang Kao, D. Ban Ko Hong



FIG. 1:2 Map of Southeast Asia, showing the study area in the upper Mun Valley and sites mentioned in the text
1. Sepon, 2. Ban Non Wat, Ban Lum Khao, 3. Noen U-Loke, Non Ban Jak, Ban Kho Hong, Ban Non Ngiu, 4. Non Muang Kao, 5. Khao Wong Prachan Valley, 6. Ban Don Ta Phet, 7. Khao Sam Kaeo, 8. Wat Phu, 9. Phimai, Ban Suai, 10. Ban Prasat, 11. Ban Chiang, 12. Wat Ban Song Puay, 13. Hin Khon, 14. Angkor, Ak Yum, 15. Phanom Wan, 16. Phanom Rung, 17. Khok Phanom Di, Ban Bon Noen, 18. Khok Charoen, 19. Tha Kae, 20. Sab Champa, 21. Non Pa Wai, Nil Kham Haeng, 22. Phung Nguyen, 23. Xom Ren, Go Bong, Dong Dau, Dong Den, 24. Ban Makham Thae, 25. Banteay Prei Nokor, 26. Isanapura, 27. Sdok Kak Thom, 28. Ban Na Di, 29. Non Nok Tha, 30. Mlu Prei, 31. Nong Nor, 32 Angkor Borei, 33. Ban Di Lung, 34. Prohear, Bit Meas, 35. Dong Son, 36. Don Khlang, 37. Giong Ca Vo, 38. Takua Pa, 39. Wat Ban Song Puay, 40 Khuan Lukpat, 41. Phum Snay

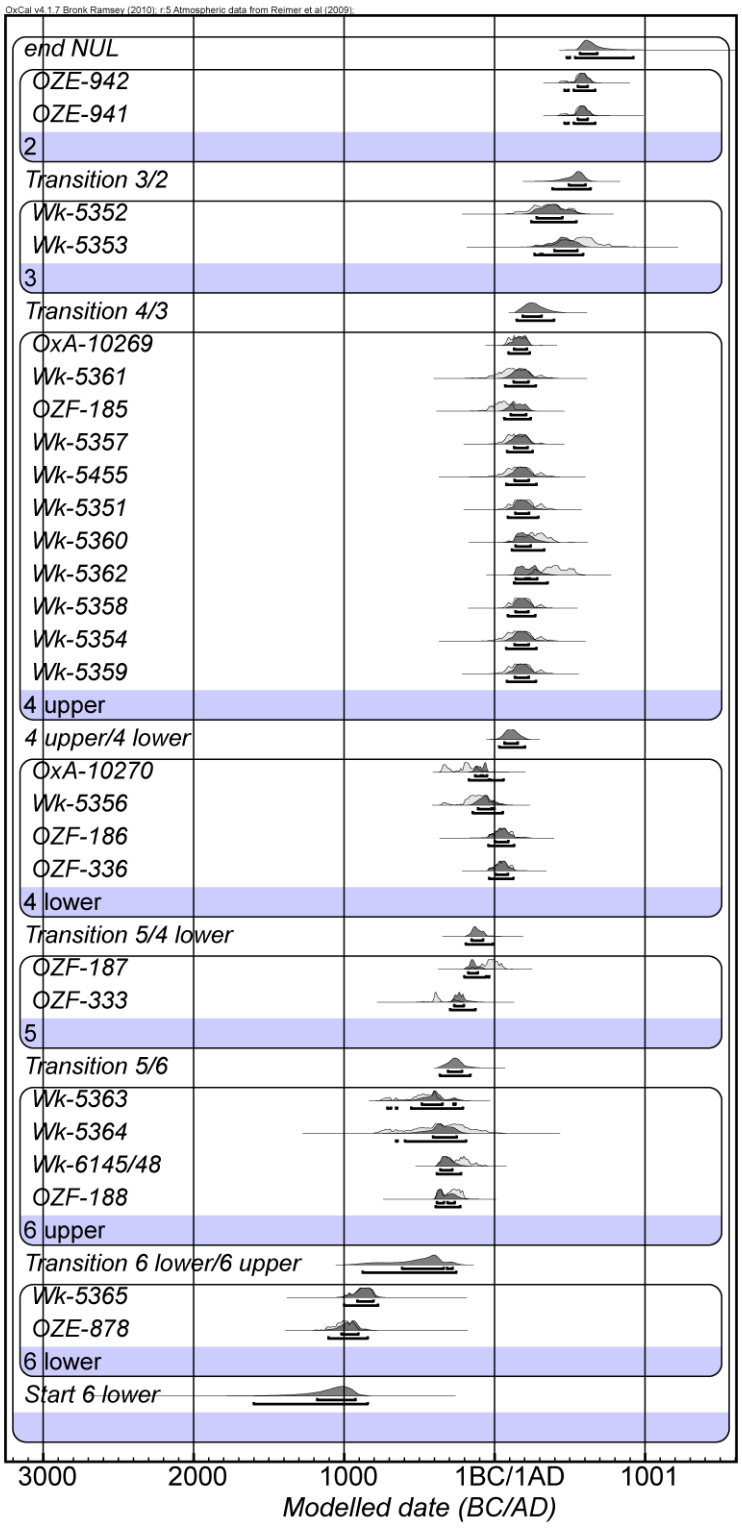


FIG. 1:3 Probability distribution of dates relating to the cultural sequence of Noen U-Loke (OxCal v4.0.5. Bronk Ramsey (2001), at 68.2%, and 191-10 BC at 95.4% probability. :5IntCal04 atmospheric curve (Reimer *et al.* 2004))

becomes clearer when incorporating the two other sites that we have excavated and it is necessary, before reviewing this period, to integrate and compare their sequences. Noen U-Loke is located 1.8 km southwest of Ban Non Wat, while Non Muang Kao is 5.4 km to the south (Fig. 1:1).

The Iron Age occupation of Noen U-Loke covers the entire Iron Age sequence and therefore provides the anchor chronology for the upper Mun Valley during this period. There are four mortuary phases, richly represented by burials and occupation remains. These are designated Iron Age (IA) 1-4. The occupation and mortuary sequence at this site has been dated on the basis of 27 radiocarbon determinations (Table 1:1, Fig. 1:3). Those dated in the Waikato laboratory come from mixed charcoal samples obtained from hearths and furnaces within the occupation layers, and must therefore be regarded as *termini post quem* due to the problem of unknown inbuilt age. The two Oxford dates come from resin that coated potsherds and are therefore more likely to be reliable. The Australian AMS series is derived from samples of charcoal extracted from the sections after the excavation was complete. These may also have inbuilt age. It is recognized in retrospect that these are less than satisfactory. They have, however, been evaluated using Bayesian methods with provision for the likelihood that the charcoal dates indeed have inbuilt age. The four IA mortuary phases are dated by relating the depth of the burials to the contexts of the ^{14}C determinations (Fig. 1:3). It is stressed that the burials of each phase could, and probably do, fall within only a part of the assigned span.

IA1 burials were found in layers 5 and 6. In the case of burials 26 and 27, the grave cuts were identified on the surface of layer 5, meaning that they belong to lower layer 4. The transition from layer 5 to lower layer 4 is dated to 154-76 cal BC at 68.2%, and 191-10 cal BC at 95.4% probability. The earlier part of the range is preferred given the similarity between the material items with the graves and the late 5th century BC date for the commencement of mortuary phase 1 at Ban Non Wat. However, there are many burials in the latter group and the later ones could well belong in the 3rd or 2nd centuries BC.

IA2 burials were laid out in tight clus-

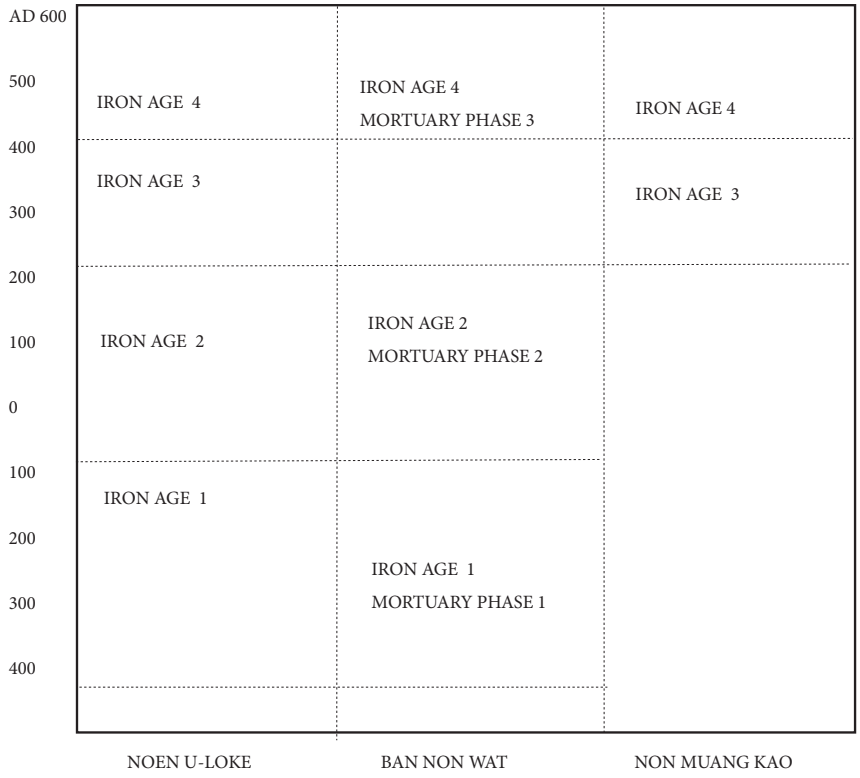


FIG. 1:4 The integration of the Iron Age phases at Ban Non Wat, Noen U-Loke and Non Muang Kao

ters, and found lying on the surfaces of layer 4:7-11. We did not identify any grave cuts, so there is no indication of the depth from which they originated. However, upper layer 4 is the most likely part of the sequence from which they were cut. The transition from lower to upper layer 4 is AD 66-155 at 68.2%, and AD 32-203 at 95.4% probability. The transition from upper layer 4 to layer 3 is dated to AD 188-313 at 68.2%, and AD 148-336 at 95.4% probability. Iron Age 2 thus probably dates within the period AD 100-300.

IA3 burials were found in upper layer 4. In the case of burials 75 and 105, the clay capping to the grave was recognized in lower layer 3. As we have seen, the transition from layer 4 into 3 has been dated between AD 148-336, meaning that the third mortuary phase can be placed in the third and fourth centuries AD. Finally, IA4 burials are found in upper layer 3, implying that the graves were cut from layer 2. The transition from layer 3 to 2 has been dated from AD 496-605 at 68.2% and AD 386-639 at 95.4% probability. It is therefore suggested that these burials belong within the span AD 400-600. The correlation between the IA1-4 at Noen U-Loke, the three mortuary phases at Ban Non Wat and the two at Non Muang Kao is set out in figure 1:4. It is emphasised that the actual date of the respective burial phases is seen as falling within rather than encompassing all the given spans.



FIG. 1:5 Massive socketed iron spears are found at Noen U-Loke and Ban Non Wat during the early Iron Age

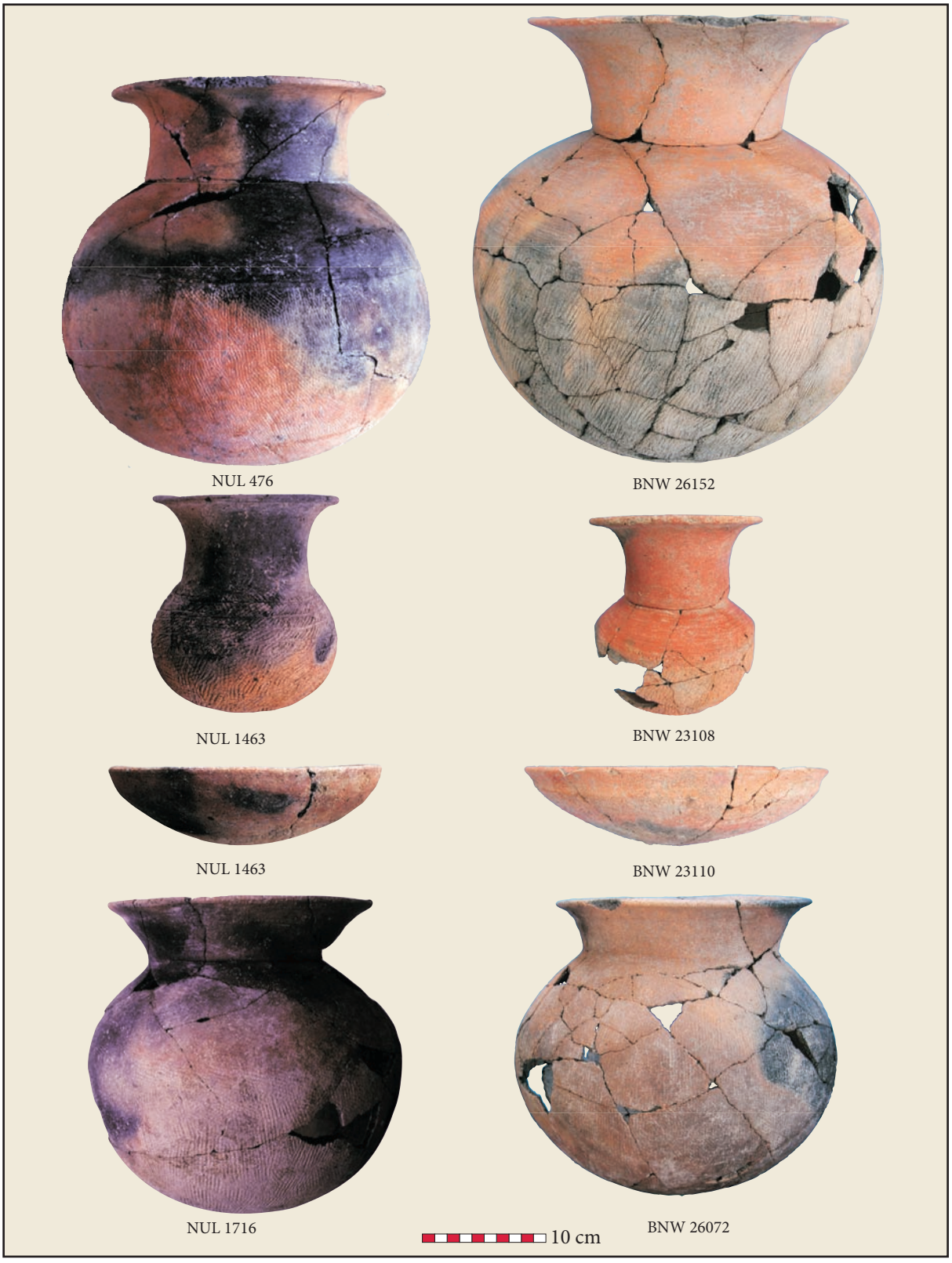


FIG. 1:6 A comparison between pottery vessel forms from Noen U-Loke Iron Age 1 and Ban Non Wat Mortuary Phase 1

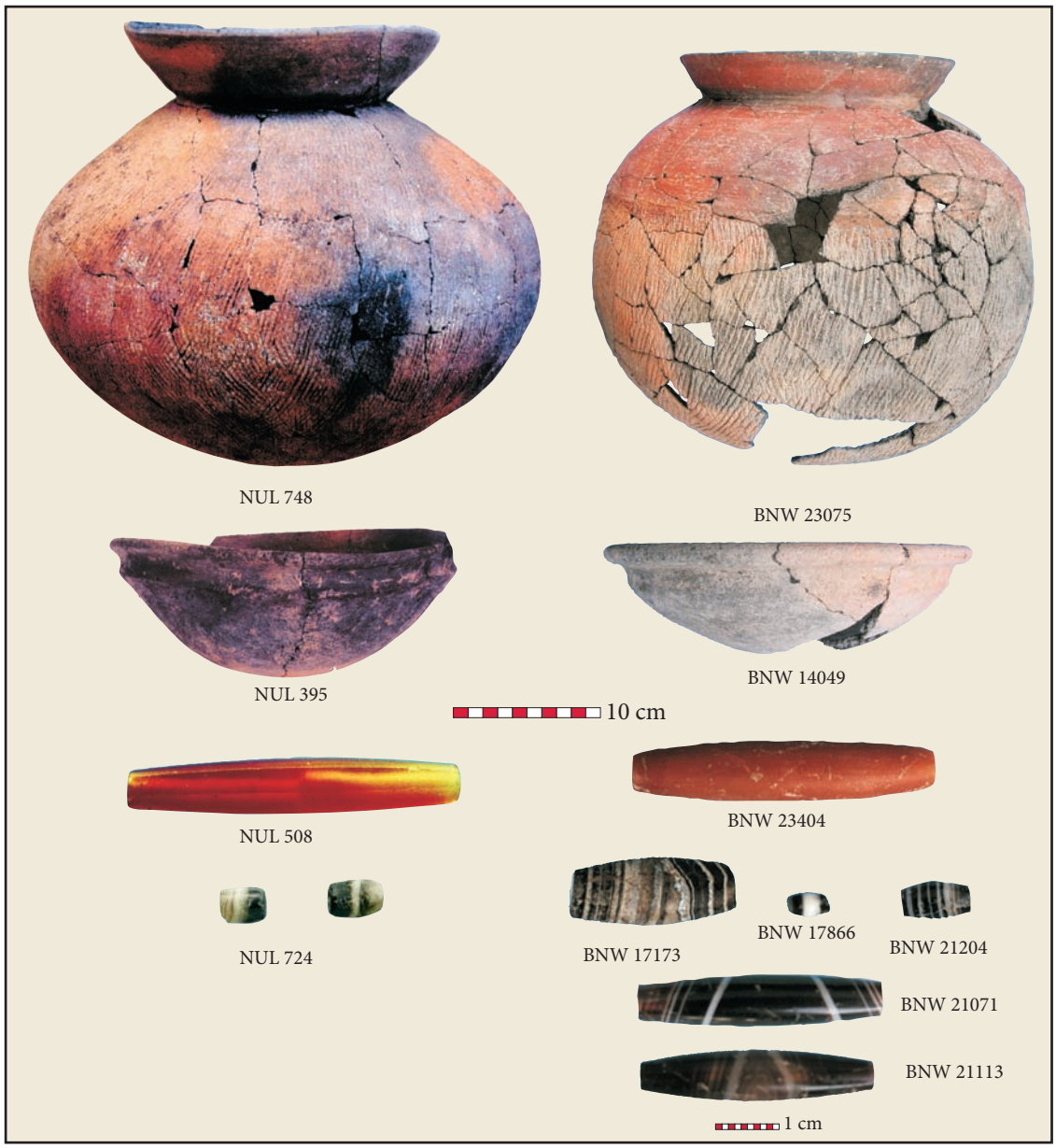


FIG. 1:7 A comparison between pottery vessel forms and exotic beads from Noen U-Loke Iron Age 2 and Ban Non Wat Mortuary Phase 1

THE MORTUARY SEQUENCES

Iron Age 1 at Noen U-Loke is represented by seven burials. Three are orientated on a north to south axis, the remaining four are east to west. There is no clear pattern to the burials except for two adult males, buried alongside each other, one with the head to the north, and the other to the south. Some of the grave goods found are distinctive only of this phase at Noen U-Loke. Two adult men, for example wore tiger and pig canines suspended as neck pendants. One wore round shell ornaments at the ears, presumably inserted into the lobes. A bronze spear was found, together with iron torcs and bangles. Other offerings were also found in later contexts at this site, such as the placement in the grave of pig bones, the provision of complete fish in mortuary vessels, and the presence of bivalve shellfish, spindle whorls, bronze bangles and iron spears and socketed hoes. The forging of large socketed iron spears at both sites during this early period in the Iron Age is particularly noted (Fig. 1:5). No glass, carnelian or agate were found in Noen U-Loke IA1 contexts.

The forms of ceramic vessel are illustrated in figure 1:6. These are compared with pots found in Iron Age 1 graves from Ban Non Wat. The similarities are so close, that the two phases are clearly at least in part, contemporary. There are no parallels between these early Iron Age assemblages with the sequence at Non Muang Kao.

IA2 at Noen U-Loke comprises two distinct tightly-defined clusters of burials. In both cases, the heads were orientated to the northeast. A remarkable feature of the

adult graves is the rarity of ceramic vessels. One infant was found in a lidded jar. These burials contained the first glass beads and earliest agate pendant found in mortuary contexts. There were also some shell disc beads and nine bronze finger rings with one person. No iron offerings were encountered. Two complete young pigs' skeletons were associated with this group.

The second IA2 group of burials was found a few metres to the south, one set being superimposed directly over earlier graves. They are probably later than the northerly cluster of burials. A startling innovation encountered with this group, was interring the dead in a grave filled with white, silicified rice. The grave goods reveal a lack of interest in pottery vessels, but necklaces made of glass and agate beads are regularly encountered. Virtually every carnelian bead found during the excavations was associated with this cluster. Some bronze bangles and finger or toe rings were present and spindle whorls were regularly found with the dead. The demographic structure reveals an approximate match between males and females, but the rarity of infants or children is particularly notable.

Identifying the correlation between IA2 at Noen U-Loke and the mortuary phase 1 burials at Ban Non Wat is not straightforward (Fig. 1:7). There are certain aspects in common, but not others. The very few pottery vessels from Noen U-Loke clearly match in form, those of mortuary phase 1 Ban Non Wat. Glass ornaments are found at both sites, but at Noen U-Loke there are beads, whereas the glass at Ban Non Wat comprises earrings. Agate pendants are found at Noen U-Loke, but agate beads at Ban Non Wat. One carnelian bead from Ban Non Wat is of similar form to those from Noen U-Loke IA2. Spindle whorls and pig remains were also common to both. However, we do not find bronze toe rings at Ban Non Wat, nor is there any hint of filling graves with rice. Three bimetallic spears were found at Ban Non Wat, but there were none at Noen U-Loke.

Naturally, some of these differences could reflect the personal preferences of contemporary social groups living at different sites. It might be that the rice burials of IA2 are indicative of a higher status for this group. On balance, however, the MP1 burials of Ban Non Wat are more closely related to the northern cluster of IA2 burials at Noen U-Loke although their longevity is also compatible with a chronological overlap with the southern group as well.

The IA1 cemetery at Ban Non Wat was a seamless extension to the east of the graves assigned to the terminal Bronze Age. The orientation of burials continued on a north to south axis, and the pottery vessels found in association are very similar in form and decoration. Spindle whorls, red ochre, caches of grey clay and bivalve shells continued to be placed with the dead. This transition according to the Bayesian analysis of the radiocarbon dates, fell in the second half of the 5th century BC. The structure of this Iron Age cemetery however, is striking: the graves fall into two spatial groups, with one set of graves having the head orientated to the north, and the other to the south.

Iron Age 2 at Ban Non Wat is represented only by a group of lidded infant jar burials, one very disturbed adult grave and a grave only partially found within the excavated area It is notable that the jar burials are of similar form to those of Noen U-Loke IA2, suggesting a chronological overlap. Burial 471 at Ban Non Wat contained a golden earring and an agate bead. This is the earliest discovery of gold in either site.

In many respects, IA3 at Noen U-Loke was the richest in terms of mortuary offerings. The graves were laid out in a series of tight clusters that incorporated the graves of men, women, infants and children. The pottery vessels now fall into the Phimai Black tradition, being constructed of clay heavily tempered with rice chaff. They were thin walled, burnished and fired to a lustrous black finish. The graves in IA3 cluster A were up to 90 cm deep, and where a cutting was identified, they originated from lower layer 3. The beds of most graves was filled with rice burnt to a white colour, and in some cases, there was evidence for a clay lining, including a cap or cover. The mortuary ritual included the placing of a bowl over the face of the dead. This was not found in any other cluster. It is clear that earlier graves were on occasion disturbed, and the bones were bundled and replaced, often in the grave fill of the subsequent interment. Infants were buried, often with a rich complement of grave goods, in the same manner as adults. No jar burials were encountered.

Intact cluster IA cluster A burials were accompanied by a wide range and considerable number of grave goods. These included jewellery of gold and silver, agate and glass. Bronzes included earrings, torcs, bangles, anklets, finger and toe rings, bells and belts. Iron was rare, however, and comprised three knives and a socketed hoe or axe. One knife was covered in pseudomorphic fabric, but only two spindle whorls were found, one with an infant and the other with a male.

There is no stratigraphic evidence to provide a relative chronology for IA3 clusters A and B. This reflects the absence of clay grave capping in cluster B graves, and hence difficulty in determining the depth from which the graves originated. The mortuary ritual remained basically similar in terms of orientation and the use of burnt rice husks to fill the base of the grave.

Fourteen of the 20 burials in this cluster come from infants or children, an extraordinarily high fraction even for prehistoric societies. Since there is only one female skeleton in the assemblage, it is considered probable that some, at least, of the three adults for whom it has not been possible to estimate the sex were also women. Unlike cluster 3A, there is no gold or silver jewellery, but other ornaments were similar, including the agate pendants, bronze bangles, ear and finger rings. This group, however, seemed to prefer placing the human head in or on a pottery vessel,



FIG. 1:8 Infant burial jars from Noen U-Loke MP5 and Ban Non Wat Iron Age 3

rather than using one to cover the head. Iron knife blades were found in four of the burials. The woman of burial 99, who attained an age of over 40 years, was buried with four spindle whorls, and ten in all accompanied cluster B graves. This is a much higher frequency than for cluster A. The impression gained from the distribution of the cluster B graves is of a small core of adults, and an exceptional level of infant mortality.

IA3 cluster C graves display the same proliferation of bronzes as was noted for clusters A and B. Burial 69 is prominent in this respect, with four bronze belts in addition to multiple bangles, finger and toe rings. It also has two bronze ear inserts. Iron knives were relatively frequent, and two further unique items were recovered, a spade and a set of possible iron neck ornaments. Only one spindle whorl was found in this group, and a small number of three agate

TABLE 1:1 *The radiocarbon dates from Non Muang Kao.*

Code		δC13	% modern	Result BP	2 σ calibration
NMK 32	WK-4512	-26.9 ± 0.2	80.4 ± 1.6	1750 ± 160	3 BC-AD 639
NMK 81	WK-4513	-24.0 ± 0.2	NA	1640 ± 70	AD 315-584
NMK 66	WK-4514	-25.3 ± 0.2	80.9 ± 0.9	1700 ± 90	AD 129-545
NMK 32	WK-4515	-26.2 ± 0.2	81.9 ± 0.6	1610 ± 60	AD 336-600
NMK 10	WK-5872	-27.1 ± 0.2	79.8 ± 0.5	1810 ± 60	AD 79-391
NMK 15	WK-5873	-27.3 ± 0.2	80.3 ± 0.7	1760 ± 70	AD 118-428
NMK 16	WK-5870	-24.2 ± 0.2	79.6 ± 1.0	1840 ± 110	45 BC-AD 428

pendants were present. There was also a unique globular carnelian bead. There is no stratigraphic evidence to place cluster 3C graves in a sequence relative to clusters 3A and 3B. In the case of burial 75, the clay capping to the grave was found at a depth of 2.01 m.

In terms of mortuary wealth, burial 14 of IA3 cluster D is the richest individual from Noen U-Loke IA3. The unparalleled weight of bronzes, in addition to the silver and gold ornaments reveal a further increase in mortuary wealth towards the end IA3. The infant burial 13 is also richly endowed, but unfortunately, the other interments in this cluster were disturbed in antiquity.

There are no burials at Ban Non Wat that are comparable in terms of mortuary rituals with those from Noen U-Loke IA3. However, with IA4, we encounter infant burials within large and distinctive jars that are precisely matched at Ban Non Wat during the third mortuary phase at this site (Fig. 1:7).

The spatial distribution of Noen U-Loke IA4 burials reveals far less of the tight nucleation evident in the preceding phase. However, there is some evidence for grouping, particularly in the case of six burials in the northeastern part of the excavated area, where four people were superimposed over a depth of 68 cm. There are other examples of such superpositions, while burials 4, 5, 9 and 12 might comprise a group, since all were interred at a similar depth and orientation. IA4 burials probably cover a reasonable period of time, since the lowest was found 1.77 m below datum, while the uppermost lay only .58 m below datum, which is effectively the present mound surface. It would seem highly likely that the earliest burials belong to upper layer 3 while the latest date to the highest of the prehistoric occupation in layer 2. It is noted that the orientation of the dead remained similar to that seen in IA3, but we lack the rice bed burials, and the grave goods, while still abundant, did not reach the heights seen in IA3 There were also changes in the nature of the offerings, seen in both the style of the ceramics and the range and number of iron implements. Thirty-one burials were recovered, comprising seven males, three females, seven adults, two children and 12 infants. This phase is dated within the period AD 400-600.

At Ban Non Wat, the IA4 is represented in square X. There is an infant burial of this period in square Y, and another in the main square, along with some badly disturbed graves of adults. For Noen U-Loke IA3-4, therefore, there is little comparative material.

NON MUANG KAO

Several samples from the two field seasons at Non Muang Kao were submitted to the University of Waikato radiocarbon laboratory. All were taken from secure contexts, but being unspeciated charcoal, they provide only a *terminus post quem*. These determinations also have large standard errors. (Table 1:1).

NMK 32 - (Wk 4512) - Charcoal sample from within a pot in Layer 2:1 Feature 1. This feature was sealed by a clay floor (Transition L1-2 Feature 4). This sample dates the use of the pot as a possible hearth base. 1.44 metres below datum (m bd).

NMK 81 - (Wk 4513) - Charcoal from the fill over a clay floor (Layer 2:5 Feature 15). The sample therefore postdates this floor and predates another clay floor (2:3 Feature 5). 1.54 m bd.

NMK 66 - (Wk 4514) - Charcoal from fill over a clay floor (Layer 2:5 Feature 15) therefore post-dating the floor and contemporary with pot scatters 2:3 Feature 7 and 2:3 Feature 8. 1.53 m bd.

NMK 32 - (Wk 4515) - Charcoal from Layer 2:1 Feature 1. The sample lay below a 'Phimai black' pot which contained sample Wk 4512. It should date the use of the hearth and predate the clay floor (Transition L1-2 Feature 4). 1.45 m bd.

NMK 10 - (Wk 5872) - Charcoal from a hearth (feature 1) located in Layer 3:11. This hearth was located 2.8 m bd.

NMK 15 - (Wk 5873) - Charcoal recovered from Layer 3:surface of spit 13 feature 1. This feature was a hearth found at a depth of 3.0 m bd.

NMK 16 - (Wk 5870) - Charcoal from feature 1 in Layer 4:surface of spit 3. This layer was the lowest and the sample dates the initial occupation of the site. The charcoal was located beside the remains of a ceramic vessel at a depth of 3.42 m bd.

The cultural sequence at Non Muang Kao equates

with the manufacture of Phimai Black pottery vessels. Determinations Wk 4513-5 come from layer 2, which contains a series of superimposed clay floors which contain pottery vessels of this ceramic tradition. These equate with BNW MP3 and NUL IA3-4. These and the dates from the lower contexts confirm a date in the period approximately 250-600 BC.

CHRONOLOGY: SUMMARY

Iron forging was adopted by late Bronze Age communities in the upper Mun Valley during the latter half of the 5th century BC. It is possible at Noen U-Loke to isolate four mortuary phases, and these can be approximately integrated with the three mortuary phases at Ban Non Wat, and the late Iron Age burials of Non Muang Kao. The obstacles to calibrating C14 determinations during the Iron Age rule out the precision increasingly provided by Bayesian analyses on identified sequences (Zaitseva *et al.* 2005). We date IA1 within the span 420-150 BC, IA2 to 150 BC - AD 200, IA3 to AD 200-400 and IA4 to AD 400-600. Thus IA3 corresponds to the period known as Funan in southern Cambodia, and IA4 partially overlaps the beginning of the Chenla period.

II THE IRON AGE: DOMESTIC OCCUPATION

C.F.W. HIGHAM

DOMESTIC OCCUPATION

The Iron Age occupation of Ban Non Wat corresponds to layers 2 and 3. The three IA mortuary phases (MP) integrate with the evidence for occupation identified within these layers. Layer 3 accumulated during the earlier part of the Iron Age. It contains superimposed clay floors sometimes containing the charred wooden sleeper beams for walls, and probably, collapsed fragments of walls themselves. There is little doubt that these document structures, probably domestic dwellings, that were on occasion burnt down. The floors continue into layer 2. By examining the pottery vessel fragments associated with these floors, and the contents of the graves that were cut through them, those found in layer 3 belong to Iron Age (IA) 1, dated between the mid fifth century BC and *c* 200 BC. There is no radiometric evidence for the latter date, which is based on reasoned guesswork after comparing the few IA2 pottery vessels with those from Noen U-Loke. With IA4, we are on firmer ground because it contains Phimai Black ceramics which belong to the 4th to the 6th centuries AD. The Iron Age sequence within the main square, therefore, was probably not uninterrupted. The best exposure of MP3 burials is found on the southern edge of the site, in area X.

Prehistoric domestic structures in Southeast Asia are virtually undocumented. However, in the upper Mun Valley there is a growing body of evidence for ground-level buildings constructed with timber sleeper beams to support wattle and daub walls, and clay-lined floors. This is clearly seen at the site of Non Muang Kao due to the excellent state of preservation there and the virtually complete absence of disturbance. Continuity of occupation there is seen in the superposition of at least eight such floors. The support beams for walls were also well preserved. At the same time, some inhumation graves were



FIG. 2:1 This image shows two clay floors, under part of a probable collapsed wall, in square F5 layer 3. A: upper floor, B: lower floor, C: collapsed wall



FIG. 2:2 This view of squares F5-7 looking south, shows floors and collapsed wall, through which graves for Iron Age 1 burials 312, 318, 314 and 321-3 have been cut

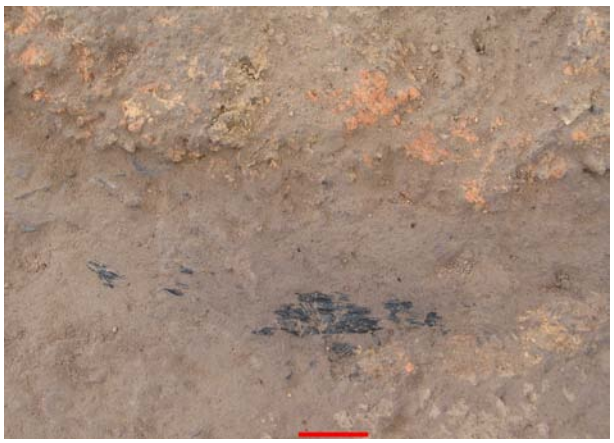


FIG. 2:3 A burnt timber sleeper beam and collapsed wall from G7 layer 3:2. Scale 5 cm

cut through floors, and the graves themselves were lined and capped with a layer of clay. It is possible that houses were abandoned and this part of the site was then converted into a cemetery.

The same features were identified in the eastern part of the main square at Ban Non Wat, although the floors were badly disturbed. As at Non Muang Kao, some of the floors were superimposed over earlier ones and severed by Iron Age burials (Figs. 2:1-2). We also found the charred remains of sleeper beams that probably had supported the walls of these structures (Fig. 2:3).

In some parts of the site, hard surfaces were encountered, but no evidence for discrete clay floors. These were covered with occupation remains such as broken potsherds and animal bones, but they were also associated with pits cut from them or into them. Figure 2:4 shows one such floor in square E2, which was associated with a pit containing broken ceramic vessels and a cache of clay mould inserts that may have been used in the casting of socketed implements.

The occupation evidence also included a number of discrete areas containing concentrations of butchered animal bones, stones that might have been used as anvils in the dismembering of cattle and pig carcasses, and iron implements such as knives that would have been used in the butchering process. That some of these floors belong to the early Iron Age is demonstrated by the presence of iron knives and the fact that Iron Age 1 burials were cut through them (Fig. 2:5-6). The results of butchering are found on the bones recovered from these floors, many of which bear cut marks (Fig. 2:7).

Other Iron Age occupation evidence comes from the



FIG. 2:4 An early Iron Age living surface in square E2 layer 3, incorporating A: a cache of socketed mould inserts, and B: a pit containing broken ceramic vessels

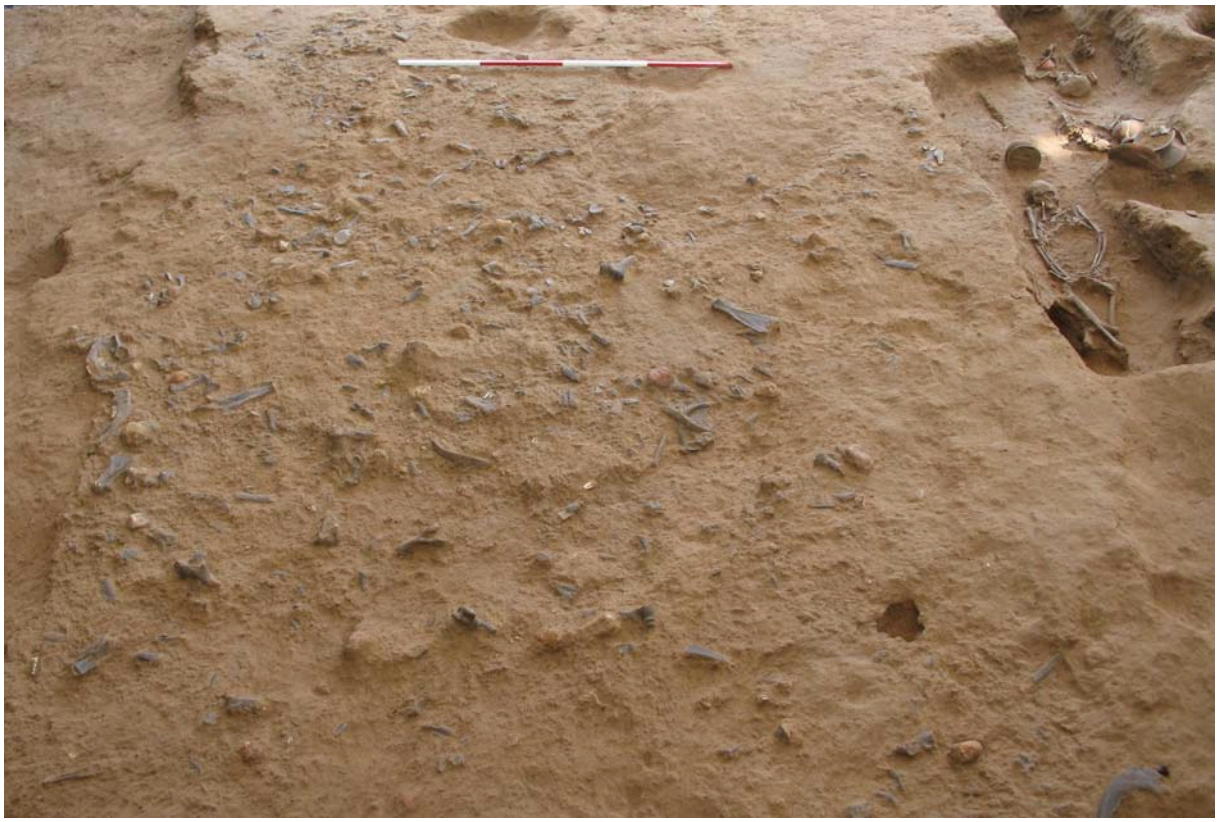


FIG. 2:5 The Iron Age butchery floor in squares D-E 8-9, showing Iron Age burials to the right



FIG. 2:6 Close up view of the Iron Age butchery floor in squares D-E 8-9

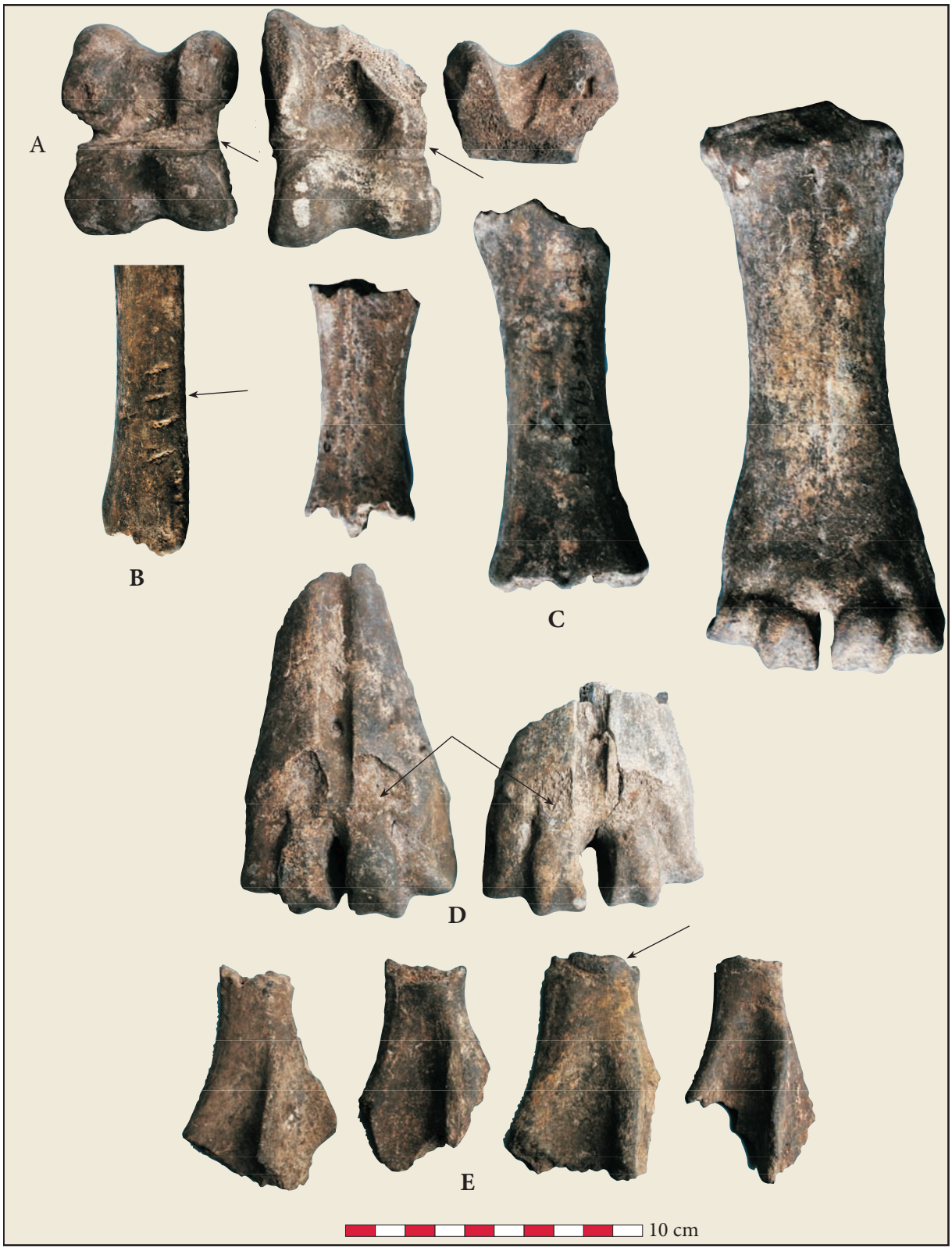


FIG. 2:7 Animal bones from D9 4:2 feature 1, an Iron Age butchering floor. A. Water buffalo astragali, showing the pattern of cut marks. B. Distal end of water buffalo tibia showing four parallel cut marks. C. Three age stages in water buffalo metacarpals. D. The distal ends of water buffalo metatarsals showing regular indentations from butchering. E. Four pig scapula showing cut marks and regular breakage pattern



FIG. 2:8 An Iron Age 1 midden containing clay mould inserts, into which the grave of burial 473 has been cut. Scale 10 cm

middens containing shellfish, many fish bones and broken pottery vessels. The midden illustrated in figure 2:8 also incorporated a further cache of mould inserts. Burial 473 was cut down into this particular midden.

The construction of clay floors, and presumably the structures associated with them, continued into layer 2. The concentrations of Phimai Black potsherds on these floors dates them to the later Iron Age. These floors were often associated with complete ceramic vessels. As at Non Muang Kao and Noen U-Loke, Phimai Black pots were found in pairs, placed one over the other. The purpose of positioning pots in this manner is not clear. Perhaps they were votive deposits placed with the construction of a new building. Again with the later Iron Age, we find concentrations of butchered animal bones.

PRODUCTION CENTRE

Shell ornaments

Shell was widely used in the Bronze Age at Ban Non Wat for a variety of personal ornaments, but became very rare with the Iron Age. In mortuary contexts, shell bangles were found in three, possibly four, burials. Burial 321 wore five bangles and there were two respectively with burials 315 and 331. A fragment of shell bangle was found in the grave fill of burial 314. However, unlike Bronze Age contexts, there is considerable evidence that tridacna, trochus and conus shell from remote marine sources were imported and converted into bangles. We find large pieces of tridacna shell that were cut to create bangles, and six specimens of the internal core (Fig. 2:9). The upper whorls of tridacna shells also concentrate in Iron Age contexts and two fragment of conus shell were recovered (Fig. 2:10). It is evident that the manufacture of marine shell bangles was undertaken at Ban Non Wat during the early Iron Age occupation of the site.

Iron smithing

The distribution of the 356 fragments of iron slag rose dramatically in the early and middle Iron Age contexts at the site. These are thought to reflect smithing, the forging of iron tools, weapons and ornaments. The iron artefacts themselves fall into three distinct groups (Fig. 2:11-15). There are a few iron bangles, weapons and tools. The weapons are dominated by socketed spears, three of which are bimetallic, having a bronze haft and an iron blade. There are also iron points, although their possible use as awls cannot be ruled out. A feature of the iron industry was the presence of tool kits which, to judge from the skeuomorphic weaving on the surface of some of the artefacts, were interred within a fabric container. The iron in question was severely corroded, and conservation involving the separation of the individual items was challenging However, it is evident that small knives and points were included. There are also socketed implements that take the form of chisels but these were not found in the

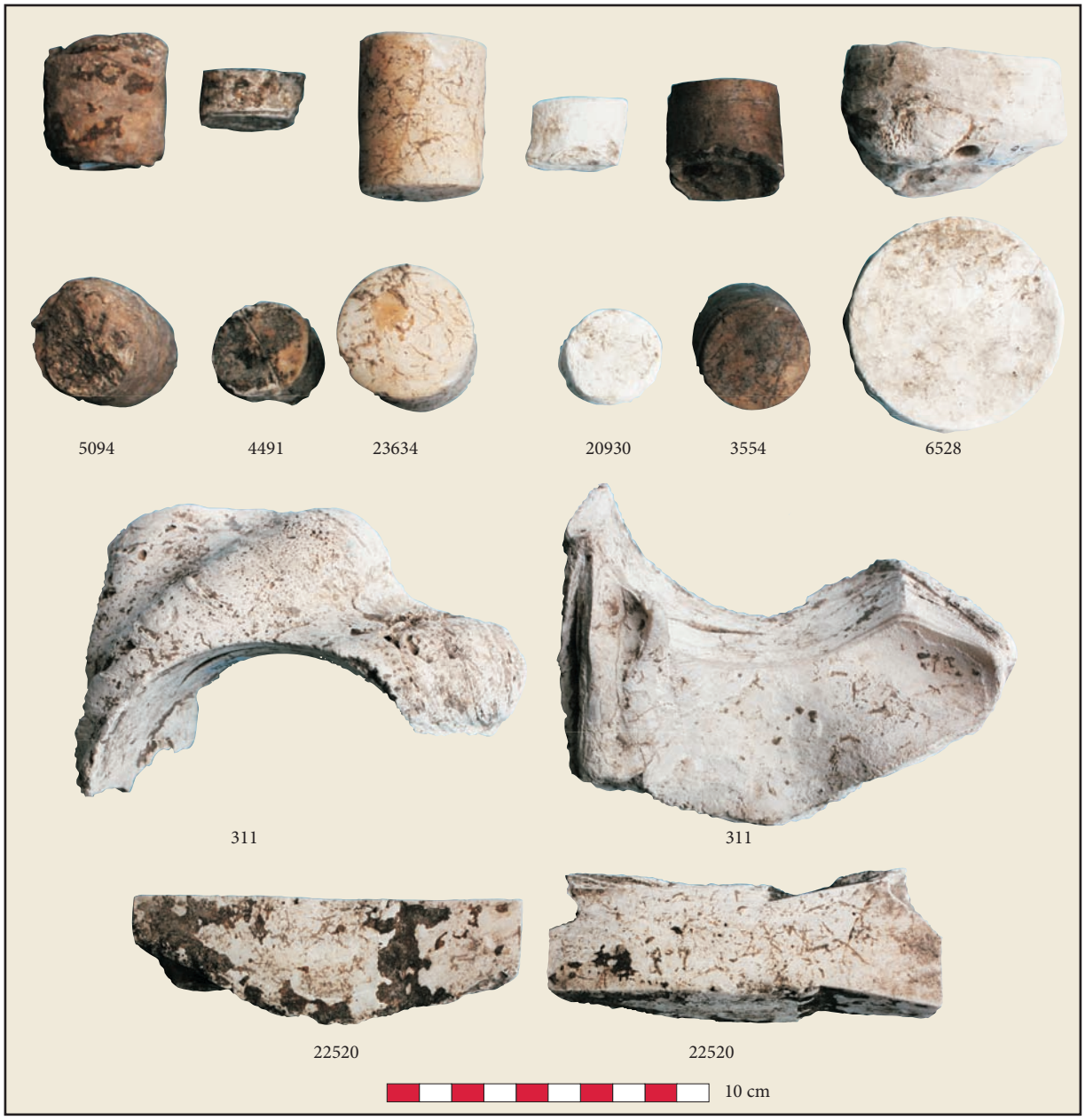


FIG. 2:9 Shell bangle manufacture. 1. Roundels taken from the centre of bangles. Cat. 5094 X1 2.11, cat. 4491 AA5 3:3, cat. 23634 E2 3:8, cat. 20930 D9 4:2 cat. 3554 B4 2:7, 6528 C3 2:4. 2. A large piece of cut tridacna shell cat. 311 A3 2:7 f.13, 3. A large pice of cut tridacna shell cat. 22520 D3 2:4



FIG. 2:10 Trochus shell whorls. A. E3 3:4 f.1, B. E2 3:3 f.8, C. cat. 23532 E2 3:2 f.5, D. A1 4:1, E. AA3 3:1, F. F2 3:3, G. F2 3:3, H. F2 3:5, I. cat. 24615 E4 3:8 f.4, J. cat. 22318 A4 3:2, K. cat. 22051 D2 3:2, L. cat. 551 C1 3:2 f.3, M. cat. 5552 C1 3:3 f.3, N. cat. 25055 F2 3:1 f.5. 2. Conus shell. O. F2 3:4 f.1, P. cat. 18103 E7 4:2



FIG. 2:11 Iron socketed ?chisels. B: burial, A:B: from Iron Age 1 group B burials



FIG. 2:12 Iron hoes, possible sickles and miscellaneous artefacts. B burials, A:B: from Iron Age 1 group B burials, A:A: from Iron Age group A burials



FIG. 2:13 Iron ?knives. B: burial, A:B: from Iron Age 1 group B burials, A:A: from Iron Age group A burials



FIG. 2:14 Iron and bimetallic spears and iron points. B: burial, A:B: from Iron Age 1 group B burials



FIG. 2:15 Iron artefacts from Ban Non Wat and Noen U-Loke

tool kits. Two items have the form of a curved sickle blade, and there are also some weighty socketed hoes.

When comparing this iron assemblage with that of Noen U-Loke, it is stressed that the majority of the artefacts from the latter site are later than those of the first Iron Age mortuary phase at Ban Non Wat. Therefore the point of comparison is between Ban Non Wat mortuary phase 1 and IA1 at Noen U-Loke. There are few iron artefacts in the latter, but the include a very large iron spear, iron bangles and iron torcs. Nevertheless, there are a number of similarities between the Ban Non Wat mortuary phase 1 and the later Iron Age at Noen U-Loke. Spears and points are also common to both, although there are no bimetallic spears at Noen U-Loke. Large hoes and sickles were forged at both sites, as were small tanged knives. The contrasts might be due to the difference in time between the two assemblages. At Noen U-Loke, there are ridged knives and a socketed spade, while the socketed chisels and tool kits are not found in any of the Noen U-Loke burials. It is concluded that while working in the same tradition, the smiths at Ban Non Wat also had a distinctive repertoire.

BRONZE CASTING

The issue of bronzes in Iron Age contexts in the upper Mun Valley is intriguing. From the initial familiarity with iron, we find a marked increase in the quantity of bronzes found accompanying the dead, an increase that accelerated with time. These bronzes at Noen U-Loke included torcs, belts, bangles, finger and toe rings and ear inserts. This increased availability of copper, it is suggested, is related to the surge in smelting activity seen in the Khao Wong Prachan Valley sites, particularly Non Pa Wai and Nil Kham Haeng. There is also the documented extraction of copper using sophisticated mining techniques at Sepon in Laos during the Iron Age. The casting of circular ingots there again harmonises with the presence of casting furnaces, moulds and crucibles at Ban Non Wat, albeit in reduced amounts compared with the Bronze Age (Figs. 2:16-17).

During Iron Age 1 at Ban Non Wat, as represented by the inventory from adult graves, bronzes comprised plain bangles, rings and the sockets for iron-bladed spears. Four ornaments with infants reveal a new expertise in casting when compared with the preceding Bronze Age. Two matching bangles were probably cast flat with the lost wax technique before being bent into shape. Decoration on the outer surface incorporates raised bands and nubbins (Fig. 2:18). A second infant wore matching anklets decorated in a related manner with raised nubbins. A hollow casting, the interior of each contained balls of clay that would have jingled with every movement of the legs (Fig. 2:18). When compared with the number of bronze ornaments found in IA3-4 at Noen U-Loke, however, bronzes in Iron Age 1 Ban Non Wat were sparse.



FIG. 2:16A clay-lined furnace, probably for bringing copper to melting point, from E2 3:6. Scale 10 cm



FIG. 2:17 A cache of socket moulds from E3 3:7 feature 1. Scale 10 cm

There is one further mystery surrounding copper-base metallurgy during this occupation phase. On two occasions, caches of clay cores thought to have been designed to form the socket of a cast bronze axe were found (Fig. 2:17). These cores were found in considerable numbers at a time when no bronze axes were identified. One of these was covered with a film of lead, and it is possible that this results from lost lead casting, whereby the lead having a lower liquefying temperature than copper, was replaced during the process of casting.

Two thin, socketed copper-base castings were found as mortuary offerings with burial 482 (Fig. 2:19). These enigmatic objects, variously described as arrowheads or ingots, precisely match the form of moulds from the Khao Wong Prachan Valley, and it would be most surprising were they not imported from that source

LEAD CASTING

One of the most unusual aspects of the metal industry at Ban Non Wat is the use of lead. It is seen as a thin film over clay moulds that were probably used to form the sockets of axes although the precise method remains unclear. Lead is also found in the form of winged axes, but the soft nature of this metal must have militated against



FIG. 2:18 Bronzes from Iron Age contexts at Ban Non Wat



FIG. 2:19 Bronze thin socketed implements from burial 482, and a corresponding mould from the Khao Wong Prachan Valley



FIG. 2:20 Clay casting moulds from Iron Age contexts at Ban Non Wat

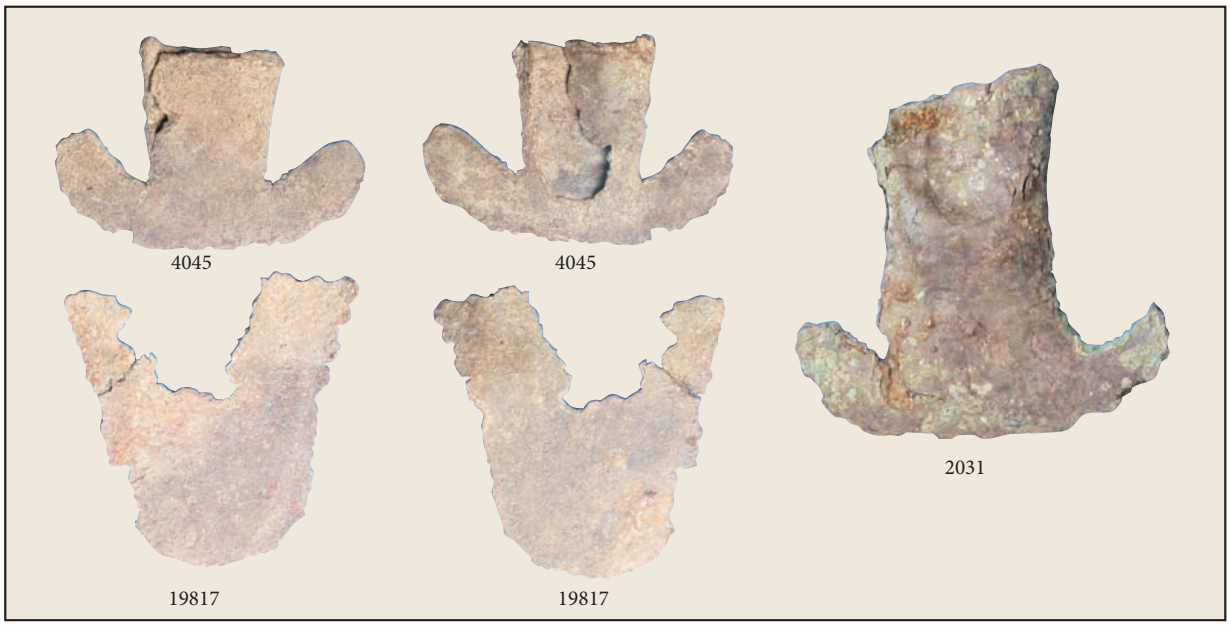


FIG. 2:21 Cast lead artefacts from Iron Age contexts at Ban Non Wat. Actual size

its use (Fig. 2:21).

CLAY ANVILS

Sarjeant and Geary (this volume) have shown that local clay sources were exploited in the manufacture of ceramic vessels at Ban Non Wat during the Iron Age. This is complemented by the recovery of the anvils used to shape vessels prior to firing (Fig. 2:23). These come in a variety of sizes, doubtless due to the different sizes of pots being formed.

WEAVING AND FABRIC

In both the late Bronze and early Iron Age graves mortuary offerings included spindle whorls often associated with lumps of grey clay. The spindle whorl was used in the production of the yarn needed for woven fabric, and the pseudomorphic remains of cloth on iron artefacts leaves no doubt that weaving took place at Ban Non Wat, as it did at the same time at Noen U-Loke (Figs 2:22-24). The clay was not identified at the latter site. However, the conjunction of these two offerings at Ban Non Wat suggests that clay was also used in the production of cloth. It is widely used today to colour cloth. While not a dye in the sense that it does not penetrate the fabric, it provides a permanent stain when the cloth is immersed in a clay slurry. Clay can also be used as a mordant in order to facilitate dyeing itself. The distribution of spindle whorls in the Iron Age 1 cemetery reveals that they were placed in graves of both the northern and southern groups of young individuals as well as adults.

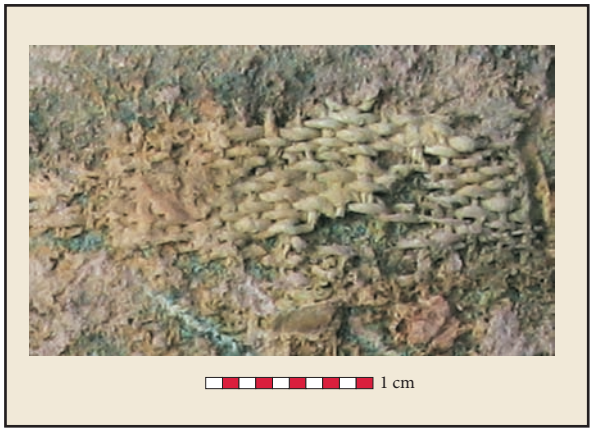


FIG. 2:22 Fabric pseudomorph on the surface of a bronze bangle from burial 382

CONCLUSIONS

The Iron Age inhabitants of Ban Non Wat constructed buildings with wattle and daub walls raised on timber sleeper beams. The floors within were made of clay. Several such clay floors were found superimposed as if the buildings were renewed periodically. Charred sleeper beams also suggest that there was a fire hazard. These floors might well represent domestic dwellings. Similar floors, but much better preserved, have been found at Non Muang Kao.

Evidence for domestic activities is seen in the presence of hard surfaces covered in fractured animal bones, particularly those of domestic cattle, pigs and water buffalo. These were associated with large stone anvils and iron knives. Butchering animals might have been undertaken for domestic consumption and the provision of feasts. There are also middens containing the remains of fish, shellfish and mammal bones. Both the butchering floors and middens were on occasion cut through when Iron Age graves were dug. Raising domestic stock received unusual supporting evidence when Chang (pers. comm.) found the floor of a pound for corralling cattle and water buffaloes on the western edge of the site, represented by a dense palimpsest of hoof prints. Rice was also cultivated.

There is much evidence for manufacturing. We find the residue left from making shell bangles. There are clay furnaces for heating copper to melting point prior to casting, and fragmentary moulds and crucibles. Iron slag from smithing is abundant. We find much evidence for weaving and probably dyeing fabric. Clay anvils were used to form ceramic vessels. The many prehistoric mounds in the upper Mun Valley resulting from processing salt suggests that salt was also a major industry during the Iron Age.



FIG. 2:23 Clay anvils from Iron Age contexts. Cat. 17794 burial 375, cat. 23551 E2 3:4, cat. 12650 AA5 3:6, cat. 19325 burial 390, cat. 20786 burial 583, cat. 4051 B5 3:5, cat. 4468 A1 3:4, cat. 14078 burial 231, cat. 21249 burial 367, cat. 7049 C4 2:7, cat. 18018 E7 2:9, cat. 3532 B4 2:6

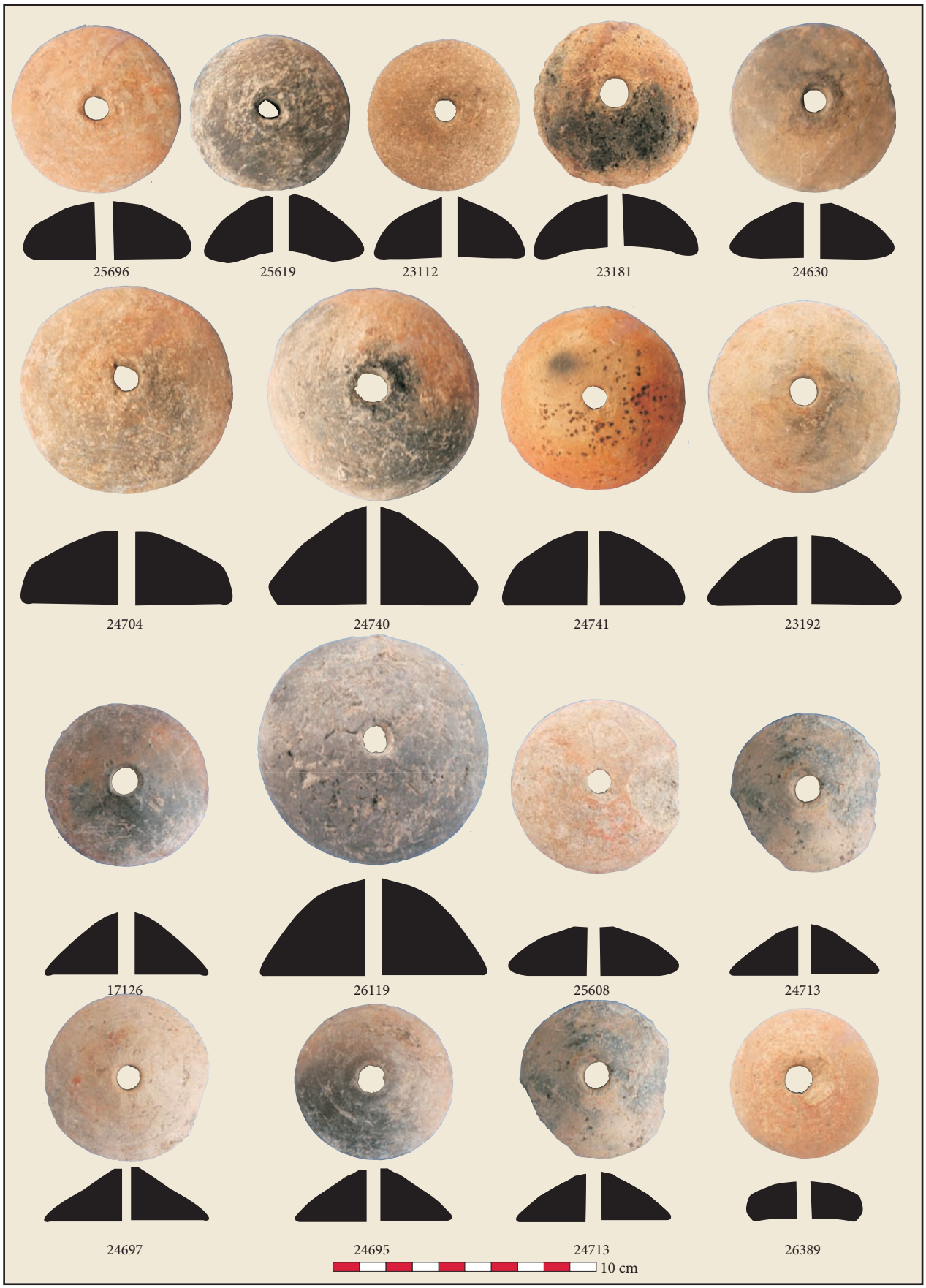


FIG. 2:24 The spindle whorls from the northern group of Iron Age 1 burials

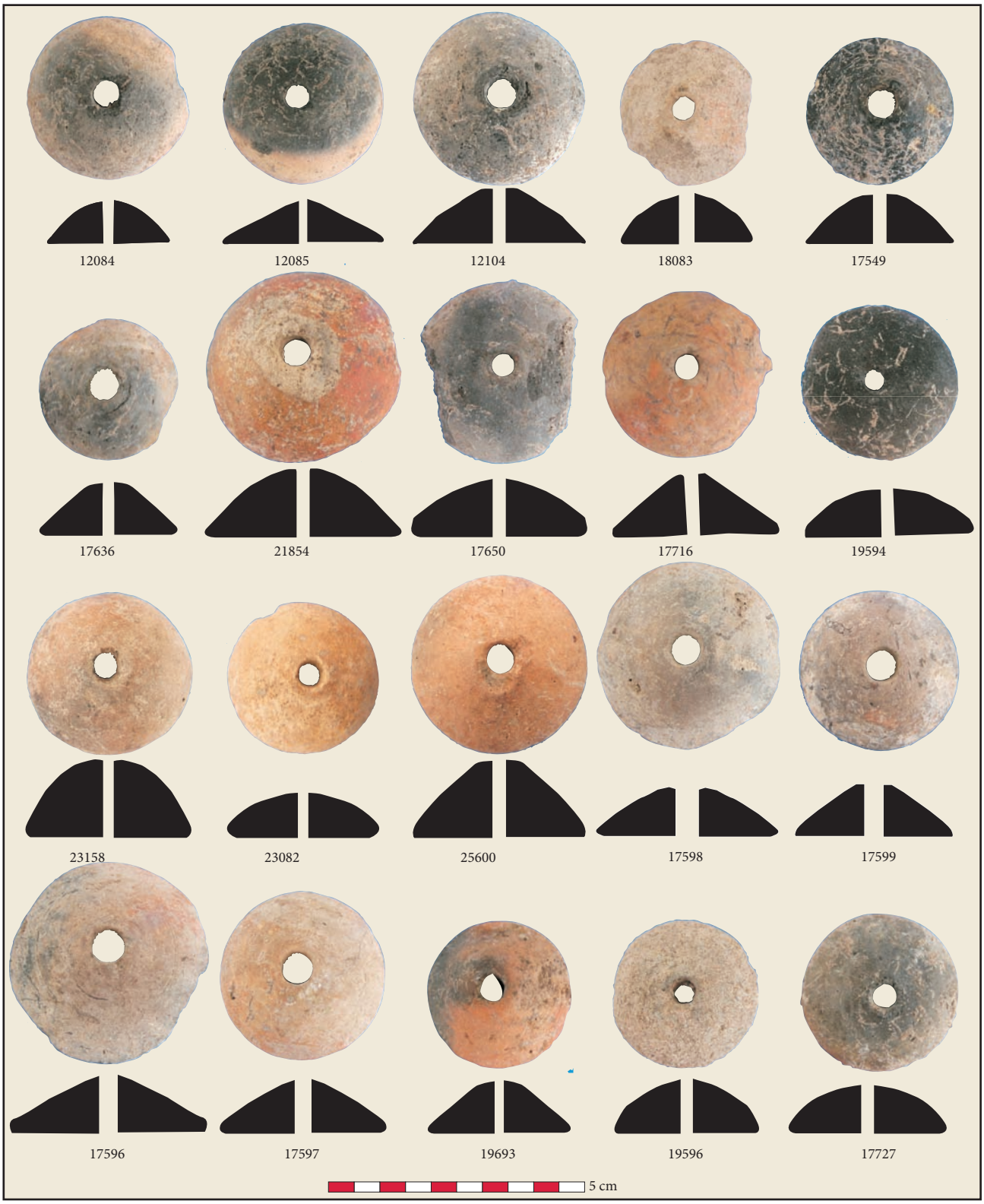


FIG. 2:25 The spindle whorls from the southern group of Iron Age 1 burials and infant or child burials

III THE IRON AGE OCCUPATION IN LAYER 3

ALLISON ISEPPY

The Iron Age layers at Ban Non Wat incorporate hard floors littered with butchered animal bones associated with iron knives and broken pottery. This chapter comprises a physical description of one of these identified in unit E3, surface of layer 3 (Fig. 3:1). This is based on a series of plans drawn during excavation and includes a description of a smaller, but related feature uncovered during the preceding fifth season. Layer 3 dates to the late Iron Age. Its expression is variable, but is generally first located about 1 m below datum and varies between 50 cm and 1 m in thickness. It includes dense concentrations of pottery sherds, ashy or burnt materials and pinkish coloured fine silty soils. Layer 3 also has evidence for mortuary, industrial and domestic activity. Pits, postholes, ash lenses, burnt floors, red clays, middens, complete pots, high concentrations of animal bones and stones attest to intense domestic and mortuary activity. Late Iron Age graves were cut through this layer. The feature in question accumulated over five phases.

The first represents the initial use of the underlying area (Fig. 3:2). It is stratigraphically earlier than the main feature and is associated with an accumulation of bones, stones and iron objects. The floor of the feature is clearly defined, and seems to continue from D5 into D4. This space may have been allocated for certain activities. The feature may also relate to the exposed burials as seen in E4 and E5. Squares D4 and E4 (underlying the main feature) are empty of activity apart from a number of postholes. This may indicate disturbance of lower material when the feature was constructed or indicate that the space was already reserved prior to the construction of the main feature. In the surrounding substrate, we see evidence of pits, postholes and a variety of disturbed hard floors and differing soils.

Figure 3:3 shows the main feature and areas to the north, west and east. It does not include the area overlying the related D5 feature. The feature measures approximately 4 by 8 m and has a distinct edge which slopes down into a lower base forming a shallow pit-like structure with a hard floor that might have been subjected to heat through burning. However, the artefacts scattered on this floor are not burnt, indicating they were disposed after the floor was established. Stones comprise the majority of material found on this feature. They are scattered across the floor, with the densest concentrated in the northeast. One explanation for this concentration may be that it is the result of sweeping within the feature. Three large laterite blocks were located in E3-4. Two were placed close together, whereas the largest lies in the southeast part of the feature (Fig. 3:1).

Surrounding the feature we see much evidence for possible industrial activity. Especially in square D2, hard clay floors, sandy soils and loose fills alternate along with many postholes and pits. In E2 and E3 large shell middens accumulated. Associated with the middens (at their base) is a concentration of clay socket moulds for bronze founding, an activity that may also be associated with the features in square D2. Pottery firing may also have occurred in this area. A wide variety of artefact types were found in the deposits surrounding the main feature. Also of interest is the relatively uncluttered area to the west of the main feature in squares D3 and D4. Again, this may represent a swept or otherwise clean area associated with the main feature, perhaps within a structure. Note also that burial 473 was cut into the substrate immediately north of the main feature. At this stage the exact stratigraphic relationship with the main feature is uncertain.

To the north of the main feature we see postholes, pits and various types of floors in squares D2 and E2 (Fig. 3:3). The associated soils are variously described as hard, ashy, black, clay and red streaked. This variability may indicate sweepings from various activities. The shell midden first seen in period 2 continues. Various artefacts are found in the areas surrounding the main feature including iron, daub, bangle fragments, clay objects and iron slag. Figs. 3:2-3 include the outlines of both the main feature of interest and the earlier D5 feature. Note that the outlines of the two features suggest a similar alignment and thus a probably continued use of this reserved space over time. It is also important to note that the longer edges of the main feature disappear at the southern end (squares D4 and E4). This indicates disturbance of the floor probably as a result of a number of burials that were later found at a lower level, but, it seems, cut from above the main feature.

During period 3 the feature was filled with 10-20 cm of clean silty soil incorporating few artefacts which explains the clear area at its northern end. The dense concentration of whole pots, pot sherds and stone generally sit on top of this clean fill. The three circled features roughly corresponding with the western margin of the main feature may be postholes suggesting an associated structure (Fig. 3:4).

The circled area in figure 3:6 overlies the main feature of interest during period 4. The edges of the hard floor are not as apparent, but the dense concentrations of pottery sherds clearly distinguish this area from its surroundings. This accumulation includes whole pots and iron knives. To the north, the numerous postholes and pits associated with a variety of soil types and hard floors continues from period 3. The adjacent shell midden also continues (square E2). Surrounding the feature, again, were found a variety



FIG. 3:1 The lower part of the feature under examination showing butchered animal bones and laterite and other stones

of artefacts including bronze fragments, iron slag, bangle fragments and a marine bivalve shell. A whole dog skeleton was located in D2. Again, there is a clear impression of industrial activities, perhaps cooking, pottery firing or bronze working, surrounding a cleared, perhaps swept, area coinciding with the main feature of interest.

Period 5: to the north of the main feature (E2, D2) various types of floors, pits and postholes are seen (Fig. 3:6). The associated soils are variously described as ashy, pink, clay and loose fill. The soils are similar to the other periods

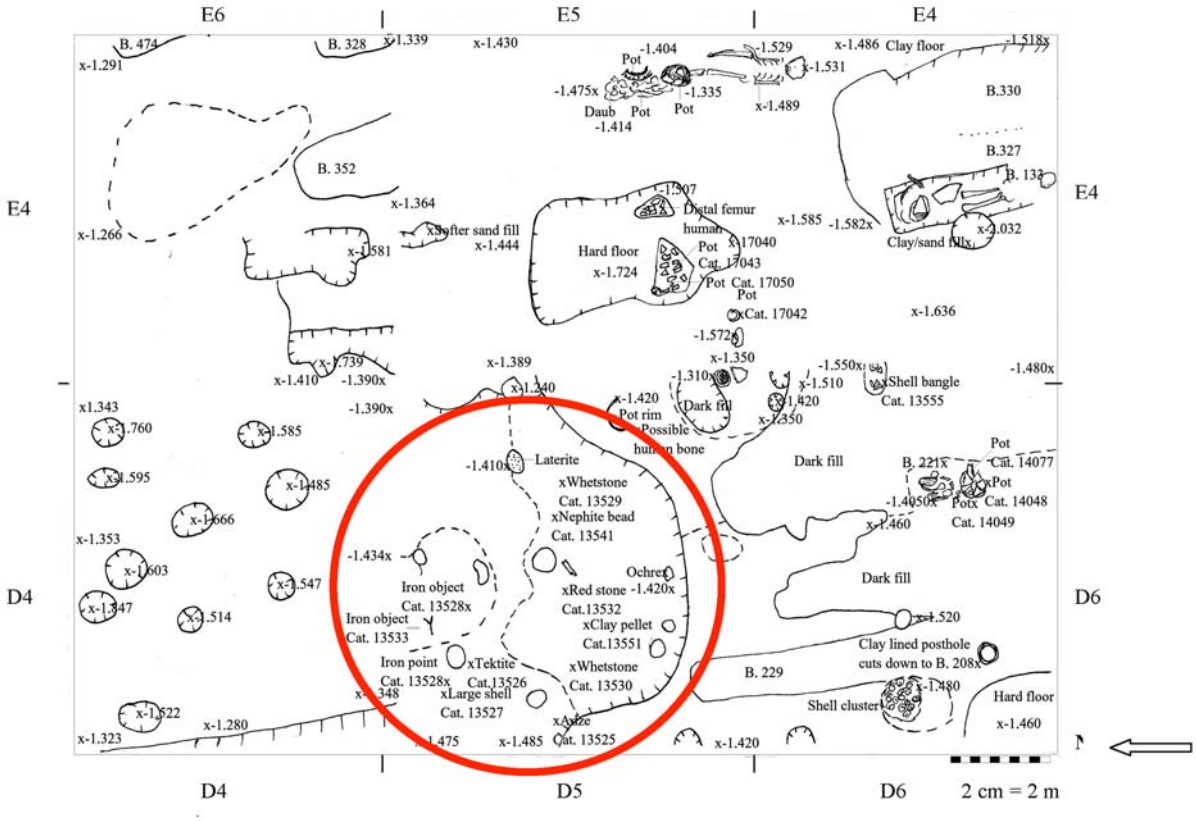


FIG. 3:2 Period 1. The figure shows the south section under the feature including previous excavation information.

discussed, suggesting several continued types of activities. Various types of artefacts are found surrounding the main feature including iron slag, iron tools, bronze fragments, shells and whole pots. Burial 471 was cut into the substrate west of the main feature, which continues in this period, and is marked by a faint edge. No cultural material is found within the space. Perhaps this area was kept clear, as mentioned earlier through sweeping.

The above discussion highlights the different periods of use of the feature/space. We find that a lens containing large stones, iron knives and butchered animal bones preceded the deposition of large quantities of broken pottery vessels.

THE MAMMALIAN BONES

The feature yielded a considerable number of mammalian bones permitting an insight into food choice and preparation practices of the inhabitants during the late Iron Age. Water buffalo, cattle and pigs dominate. The location of the mammalian remains was recorded *in situ*. Some were identified with the help of Prof. Charles Higham, the other remains were identified in comparison with literature. After identification the remains were individually examined using a hand-held microscope. A set of variables was established as a baseline for comparison. The criteria included cut marks, burning, preservation and modification. I also recorded the width and length of each cut or chop mark and its location on the bone, an interpretation and description of each cut or chop mark. The post-mortem treatment of each bone was examined for evidence of breakage, cracking, burning, polishing and scraping. Outside factors were taken into consideration such as natural processes, wear and tear and animal scavenging. Cut and chop marks were distinguished by their size configuration. Chop marks were characterised by a more rounded, expansive impression. The mark showed clear signs that the force of the blow was taken from an angle, leaving an uneven damaged surface. Cuts were distinguished by their clear indentation. The ends of the long bones were examined to see if any were snapped or chopped. This was investigated through examining the profile end of the bone. The evidence for snapping or breaking showed a rough, uneven profile. The chopping evidence was seen through a controlled, slightly uneven surface. The evidence for burning included signs of charcoal, black marks and grey or whitening of the bone (O'Connor 2000:45). Polishing was distinguished through the "shininess" of the bone.

The minimum number of individuals was identified for each species. An attempt was made to count left and right side specimens. To quantify the assemblage, the bones

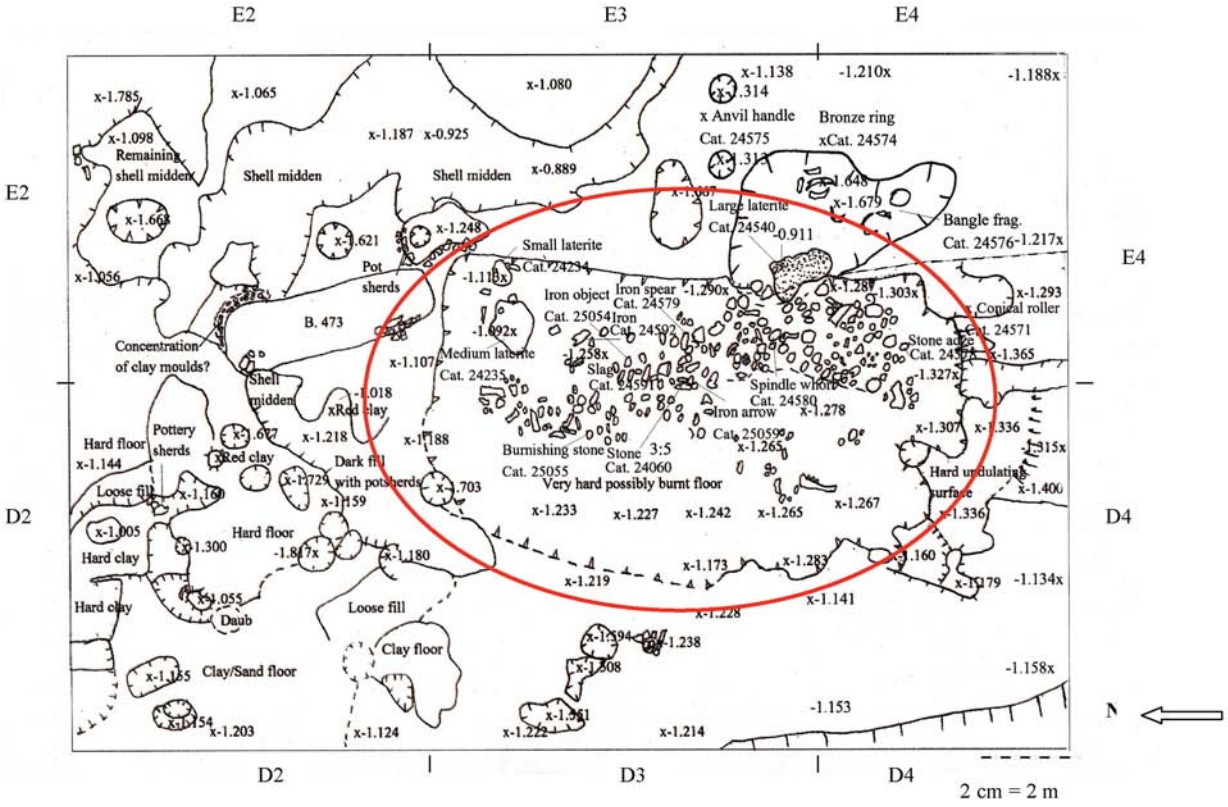


FIG. 3:3 Period 2. The feature in question showing it cut through a floor

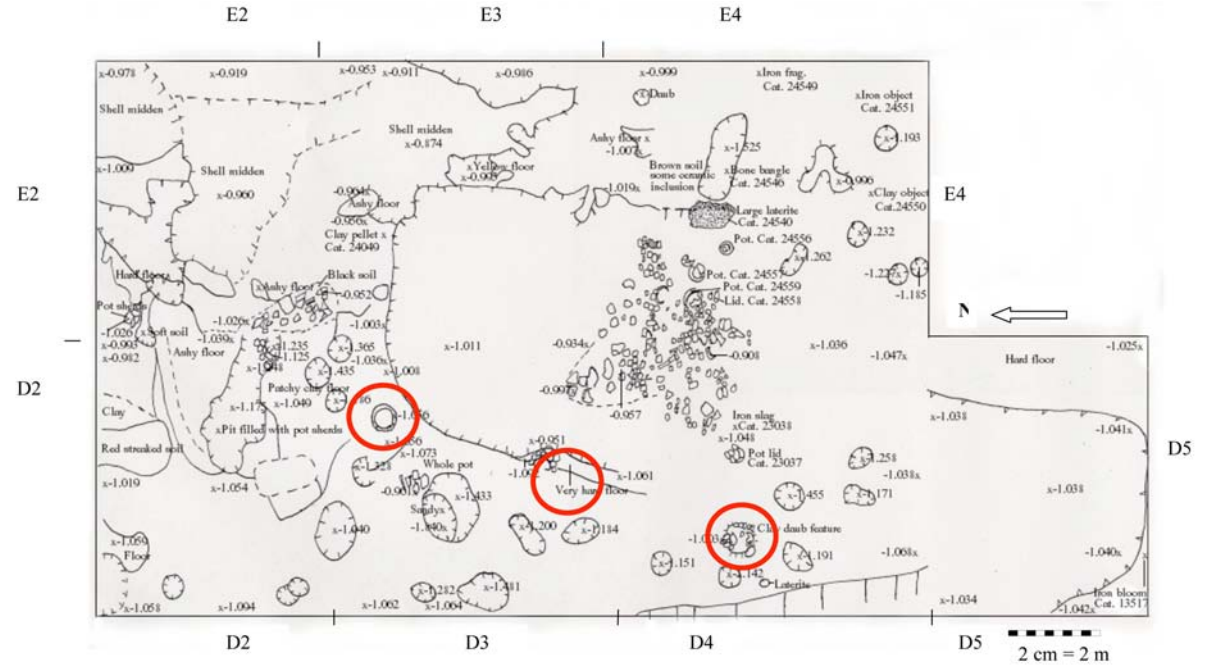


FIG. 3:4 Period 3

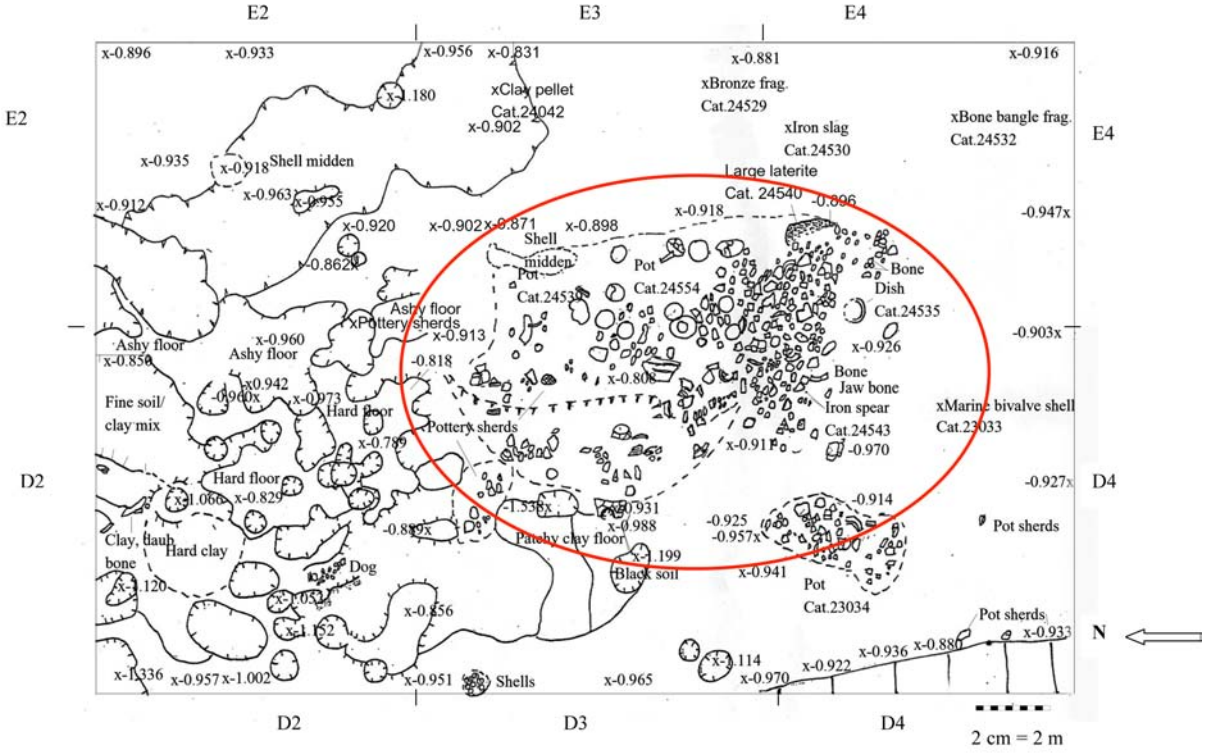


FIG. 3:5 Period 4

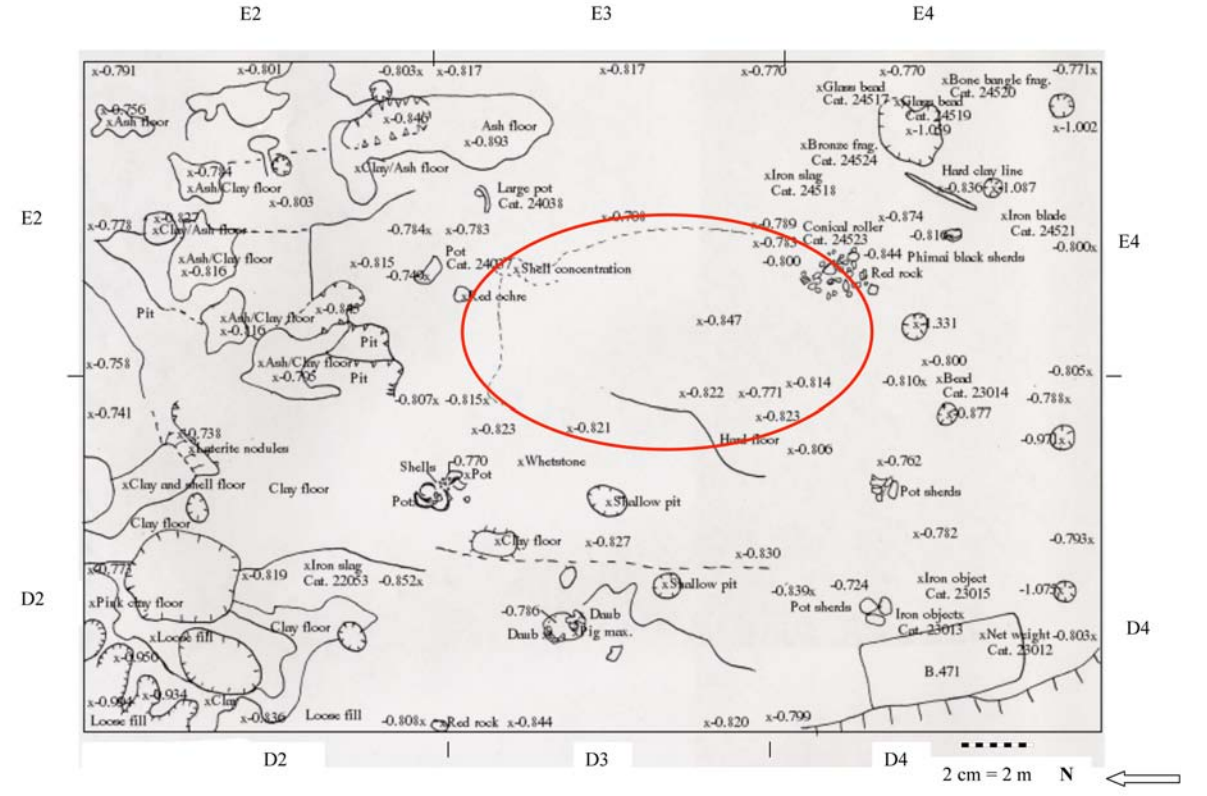


FIG. 3:6 Period 5

were divided into species, then bone type. The number of bone types needed to represent one individual was established.

The species represented are common throughout the site, and were incorporated as Iron Age mortuary offerings. They are also found in small quantities in pits.



FIG. 3:7 The feature under examination showing broken ceramic vessels and butchered animal bone

The bones of water buffaloes, cattle and pigs were found throughout the general floor, but are not represented on the same scale as within the feature. Small, fragmented bones are found on level 3 (the level of interest), but long bones such as femora are not commonly represented.

Distribution of the species throughout the feature.
We identified three individual cattle, four water buffaloes and five pigs. The water buffalo, native to Southeast Asia is commonly found throughout low-lying swamp areas during this period (Higham 2004). Their small size in the feature being examined reveals that they were domestic. It is noted that Chang discovered a layer bearing the hoof prints of both water buffaloes and cattle on the western edge of the site, suggesting the former presence of a stockade or pound for domestic stock.

Certain anatomical bones of the domestic *Bos taurus* may be distinguished from those of the water buffalo on the basis of size and shape. The specimens recovered from this feature are of domestic size. The pig is adaptable to different habitats, and young pig bones were placed with the dead throughout the prehistoric occupation of the site. Wild and domestic pigs are distinguished through the shape and size of the cranium and mandible. The domestic skull is shorter and the teeth are smaller and more crowded (Higham 2004:159).

Pigs are the most commonly represented species within the feature. The lower and upper jaws are the only part of the pig represented. This is interesting as in Neolithic China, pig mandibles played a large part in ritual and burial practices (Kim *et al.* 1994:119). One maxilla and five mandibles were located.

The majority of the bones identified showed strong cut marks, probably through the use of a sharp, straight instrument such as a knife (Fig. 3:10). In some circumstances chop marks were also evident, due to the effect of using a heavy instrument such as an axe. The location of the cut marks on the bones was not uniform and could occur at either the middle or the end of the bone. The chop marks regularly occurred in the centre and in one case, showed evidence for chopping at the end of the bone (Fig. 3:10). Cut marks can provide information on skinning, de-fleshing, marrow extraction and filleting (O'Connor 2000). Some of the bones may show evidence of marrow extraction. Almost half of the bones show evidence of breakage. This snap or break action occurs at the ends of the bones. In some cases it was impossible to tell due to preservation issues, but in other cases action was clear. One bone showed clear evidence that the bone was divided through a chopping action. The other remains are roughly snapped. Another bone showed evidence of cracking, and was not related to burning. The evidence for



FIG. 3:8 A tanged iron knife, cat. 24035. Scale 5 cm

cracking may have occurred from other pressures such as weight bearing and exposure to the elements.

A small percentage of the bones (7%) show evidence of burning. Clear and extreme burning marks are shown on 3% of these bones indicating that they may have been exposed to fire for a long period, whilst 4% of the bones show limited exposure to fire. The majority of the bones did not show any evidence of burning. Alternate cooking methods such as boiling or steaming may have been undertaken.

Indications of these cooking methods are usually discerned through shrinkage of the bone and a lower rate of preservation (O'Connor 2000). It is uncertain if this was the case. Alternatively meat could have been stripped off the bones and prepared elsewhere.

Two bones showed evidence of polishing and smoothing. One was modified and may have been used as some kind of cutting implement. The possible artefact shows evidence of discolouring in a small central section. It is



FIG. 3:10 Two water buffalo metacarpals. The bone on the left shows clear evidence for cutting, that on the right for bruising and snapping across the diaphysis



FIG. 3:9 A tanged iron knife, cat. 25453. Scale 5 cm

uncertain if this is burning, as the mark is a reddish colour. This may be due to contact with iron.

The majority of the bones show strong evidence of cut and chop marks. Half have been snapped or broken, which could reflect butchering practices. Similar butchering actions have been identified at Noen U-Loke.

THE SHELLFISH REMAINS

Shellfish remains were common throughout the feature and site. Shellfish can be a good indicator of diet, and the focus was upon the type and the number of individuals present. The species of shellfish found include members of the Bithyniidae and Iravadiidae. The former are found sporadically throughout Thailand, especially in the south, commonly found in swampy environments (Thosarat 2004). Iravadiidae were a popular inclusion in prehistoric diets, as they are abundant throughout Southeast Asia. They occupy mud flats, shorelines and rivers.

THE FISH REMAINS

Five fish species were found within the feature: *Clarias* sp., *Anabas testudineus*, *Mystus* sp., *Channa striatus* and *Ompok bimaculatus*. The fish were located within the feature through wet sieving. Identification to species was assisted by Dr. Rachanie Thosarat. The species and anatomical bone types were established. Some bones could not be identified; meaning the number of individuals is under represented. After identification the bones were photographed and weighed.

Clarias sp. is a popular food fish throughout Thailand. It dies without access to air. *Anabas testudineus* is a strong and adaptable fish that can survive outside water for long periods of time and is adapted to many fresh water environments including rivers, streams, canals and marshes (Thosarat 2004:171). *Mystus* sp. is widely consumed within Thailand and is found in all types of fresh water environments (Thosarat 2004:172). *Channa striatus* is the most widely-consumed fish species within Thailand. A large fish, it can survive for long periods without access to water (Thosarat 2004:172).*Ompok bimaculatus,* the sheatfish, is widespread and abundant in Thailand. It can reach a length of 40 cm The following individuals were identified:

Clarias sp. 11, *Anabas testudineus* 4, *Mystus* sp. 5, *Channa striatus* 10 and a single *Ompok bimaculatus*.

MATERIAL CULTURE

Ceramics

The pottery vessels and potsherds found in this feature are dominated by Phimai Black ceramics, and some virtually complete or reconstructible vessels were uncovered (Fig. 3:7).

Stone artefacts

Many stone types were identified that were probably obtained locally. These include: yellow siltstone, red siltstone, siltstone, grey sandstone, quartzite sandstone, red quartzite, pisolithic concentrations, volcanic rock, ironstone, granite and basalt. The methods undertaken during analysis will be described for both the unmodified stone and lithic artefacts. The results and discussion for both will be conducted separately.

The location of the stones was mapped, drawn and photographed *in situ*. Each stone was examined individually and identified with the help of Professor William Boyd. Immediate observations of the features were noted. Possible artefacts were examined closely with a 10x magnifying glass. The stones were weighed, photographed and in some cases measured. Alteration included grinding, polishing, chipping, scratch marks, evidence of heating or the presence of oils or other residues. Does the stone fit well in the hand, with a worn surface facing down?

Stones with no evidence of modification were not examined further. Literature was reviewed to develop an understanding of what functions the stones might have been served.

Unmodified stone

Most stones have no obvious evidence of modification. Many of the unmodified stone types can be made into lithic artefacts and vary in type. There is a large basalt resource in the immediate area. Sandstone, siltstone and clay are also locally obtainable, quartz is available approximately 20 km away, and granite, a little further. The unmodified materials represent a variety of different types of stone. The majority have the potential to be modified into stone tools. Perhaps the stones were used as tools in a minor way, making it difficult to see any evidence of use. Besides the assorted rock, the most prevalent type of material found was red siltstone. Red sandstone has been used to create whetstones at sites such as Ban Na Di (Higham and Kijngam 1984:187). Several types of stone occur once in the assemblage. The great variety of stone types as represented in the assemblage is uncommon. No other unmodified assemblage to this extent could be found in the literature.

Modified stone

Grindstones, hammerstones, a stone adze and a burnishing stone were identified. The specific purpose of grindstones is unclear (O'Reilly 1998:129), but wear on one or more sides indicate they were used as abraders. According to O'Reilly (1998) grindstones have one or more worn side, with one indicating greater wear than the others. They are U-shaped and fit comfortably in the hand when held. One such grinding stone was located (cat. 23562). Hammerstones are distinguished from grindstones as they have cracks, chips and scratches resulting from force. Three hammerstones were identified. The first, (cat. 23432) is made of granite and measures 41.3 x 42.4 mm. It shows some wear on one side, a degree of polish and fits comfortably in the hand with the worn surface facing down. There

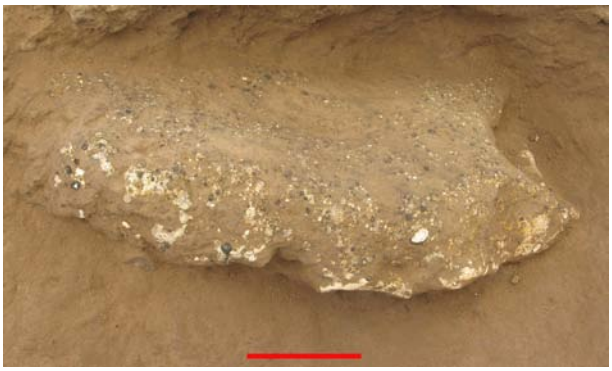


FIG. 3:11 A large block of laterite, cat. 25450. Scale 10 cm

are no chips or cracks on this artefact, but the worn surface shows moderate wear through scratches. Granite is not commonly used as a hammerstone, but the stone is hard, so it would be an adequate tool for a period. The second artefact (cat. 23421) is made of red sandstone. Sandstone is commonly used to sharpen tools such as adzes. This artefact shows strong evidence of use as a sharpening tool and as a hammerstone. It fits comfortably in the hand and has robust wear on a surface. The third hammerstone (cat. 23673) is made from basalt. This artefact has some chip marks on the surface and was possibly handled.

One stone adze (cat. 24578) was located within the feature. Basalt is a commonly used source for adzes at sites such as Noen U-Loke and Ban Non Wat (Higham 2004). The adze shows little evidence of use. The blade was not sharp and did not have strong evidence of scratch marks or wear.

One burnishing stone (cat. 25055) was located within the feature. These were used to burnish pottery to create lustre and for water retention (Higham 2004). Burnishing stones are a common find at Southeast Asian prehistoric sites.

Although the stones show little evidence of use, some of the materials could have been used in a minor way. Thus tools do not need to be modified in order to play a part in food preparation activities. A number of the stones also have the potential to be used as building materials

(sandstone, quartzite). The one ironstone piece could have also played a part in iron manufacture. Five modified lithic materials were located. The artefacts consisted of grindstones and hammerstones. They were not highly modified, but showed wear toward the bottom of the artefact. They also showed strong evidence of handling.

Fifty four laterite stones were found within the feature. The majority were small, cobble stone pieces, but there were also three large blocks of laterite. The first stone (cat. 24540; Fig. 3:11) measures 80 x 56 cm with a height of 18 cm. The side lying on the floor is very rough and does not show evidence of smoothing. The other side which was facing upwards, shows clear evidence of wear. The artefact is almost oval in shape and has a central hole which extends through to the other side. This artefact was extremely heavy and could not be moved easily.

The second laterite stone (cat. 24235) measures 60 x 60 cm and is 17.8 cm high. It is very similar to cat. 24540 in shape and also shows strong evidence of wear on the side facing upwards). The artefact also has a hole, but does not go all the way through to the other side. The smallest of the three (cat. 24234) measures 32 x 32 cm and is 9.6 cm. It weighs 9.3 kg. Again it shows strong wear on the surface.

Iron Artefacts

The iron tools were located, recorded, catalogued and bagged according to its location within the feature All have been conserved although corrosion is still present on most surfaces. Three tanged knives were found (Fig. 3:12), and five further iron artefacts which are not classifiable.

Other artefacts

The following artefacts were recovered from this feature: Two clay pellet bow pellets, one spindle whorl, four shell bangle fragments, a net weight and three pieces of petrified wood.

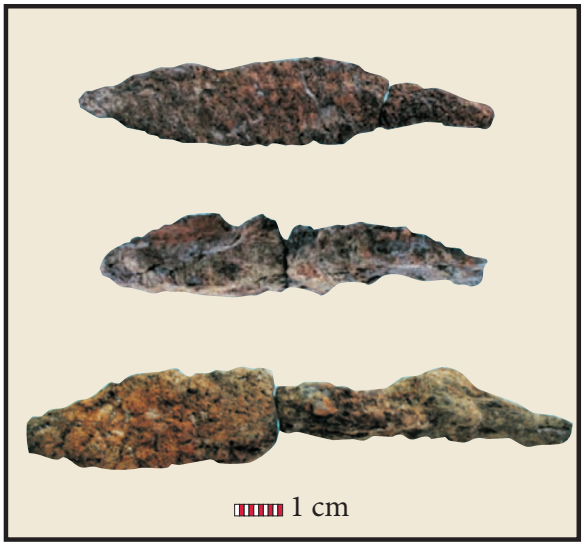


FIG. 3:12 Three iron knives from the floor

DISCUSSION

The feature under review comprises a layer of large stones and butchered animal bones, covered by broken pottery vessels. It might have resulted from a number of activities, including salt production, iron forging, butchering and food preparation and feasting. The clearest evidence for salt production at a site is large clay lined pits, high accumulations of dumped soil and pottery sherds. The feature that has been the subject of investigation was not clay lined, but did have evidence of large amounts of clean dumped soil and pottery sherds. The pottery used for salt production differs from the common domestic type in shape and size. However, Nitta (1997) noted that at Nong Tung Pie Pone "ordinary cord-marked vessels were…collected…with several sherds of Phimai Black" (Nitta 1997:158). Although this is the case, other aspects of salt production were not seen in the feature, which has no evidence of sockets and spaces, salt residues, tuyères, evidence of burning or any indication the pit was filled with water. It is thus highly unlikely that the feature was part of the salt making process.

Iron production can be clearly seen in the archaeological record. At Ban Dong Phlong, Nitta (1997) excavated several small iron-smelting furnaces, some ellipsoidal in shape, another oval. The furnaces, which are deep, contained pit-like structures, and in some cases, clear signs of burning. Tuyères were found, inserted into the walls (Nitta 1997:155). At Ban Di Lung, Suchitta (1992) found similar furnaces as well as tap pits, shafts, charcoal and burnt artefacts which are common products of iron production. The feature under investigation does not indicate any of these activities. There is no evidence of burning, nor are there tuyères, crucibles, clay moulds, tap pits or shafts. Further, the feature is not deep enough for iron production. However, some iron slag was found within the feature, indicating that iron forging occurred within or close to the site.

Artefacts found within secondary butchering areas are variable. In an ethnoarchaeological study of the Inupiat fish camp, Chang (1988) described a particular area set aside for the processing of caribou meat. She noted that after initial butchering, the meat is divided up on a piece of plywood. At this point, tools used for processing the meat are left in the area for the next carcass. All meat or remains of the animal are taken to a second location (Chang 1988:11). In contrast, at the Bronze Age (1900-1600 BC) site of Dinkha Tepe in Iran, it was found that very few upper limbs were bought into structures. The majority of the faunal remains in the structures were small bones such as carpals and tarsals, 89 showing heavy signs of butchering. Tools crafted from bone were also found in the structures (Gilbert and Steinfeld 1977). Kooyman (2006) has demonstrated the difference between primary and secondary butchery sites. At Head-Smashed-In Buffalo Jump in Canada he identified clear differences in bone

and stone tool distributions within the butchering area. Primary sites tend to be associated with a larger number of projectile points while in the secondary processing area he finds stone flakes that probably resulted from the sharpening of flint butchering tools. These are also associated with anvils, hammerstones and a hearth (Kooyman 2006:429-430).

Cut marks and scrapes on bone can also be used to distinguish between primary and secondary butchering practices. Cut marks, especially on smaller bones such as carpals, are argued to reflect secondary processing activities. This may also be associated with smashed and broken fragments of bone resulting from marrow extraction and scratch marks resulting from scraping the last of the meat off the bones (Reitz and Wing 1999:130, O'Connor 2000). The ambiguous feature at Ban Non Wat is not thought to represent primary butchering because large bones are not found. However, it should be noted that many knives and other butchering tools are associated with the feature. While this represents a parallel with the Inupiat Inuit fish camp, other features are quite dissimilar. Conversely, a secondary butchering hypothesis is more likely.

If we compare the feature at Ban Non Wat with the evidence from Dinkha Tepe for secondary butchering, we see the following similarities: the faunal remains are found in a contained area (perhaps a structure), the bones comprise both high meat bearing bones and small bones, and there is at least one possible bone tool associated with the feature. Other characteristics of the Ban Non Wat feature conform to Kooyman's (2006) definition of a secondary butchering site, for example, the direct association of butchering tools with bones and the confined distribution of the faunal remains – within the same space over time. Finally, the majority of the bones show evidence of clean cut marks on both small and large bones and long bones have had their ends removed (usually by snapping), probably for marrow extraction. Secondary butchering is a possible explanation for the use of the ambiguous feature at Ban Non Wat. It should be noted, however, that the literature predominantly discusses hunted fauna. The parallels with what are likely to be domestic butchering practices in Southeast Asia can only be indicative at best.

There are clearly-defined spaces for food processing activities within some sedentary societies. It may be argued that this is not universally so, and overlapping activities certainly occur within given spaces. However, materials and observed actions indicate some containment. In two ethnographic studies, food preparation occurred within structures (David and Kramer 2001, Watson 1979). In an ethnoarchaeological study of the Moro in Sudan, Hodder (1982) has identified food preparation within structures and further mentioned that houses were kept separate for this specific purpose (Hodder 1982:136). In these observations processing implements such as mortar and pestles, grinding tools, cooking pots and knives remained within this space. In an archaeological context, processing implements such as these are the prominent residue for this activity. Sung (1997) describes mortars and pestles found in central China. Dated to the Neolithic, these implements were crude and rough in form (Sung 1997:9). He also described other implements including pounders, choppers, dish-shaped vessels, metates, mortars, pestles and grinding trays at late Neolithic sites in the Yellow River basin. Although Sung (1997) does not indicate association, he does mention "three burnt soil pits filled with vessels" (Sung 1997:14).

Adams (1996) has confirmed close associations of processing tools within structures at a Point of Pines site, North America. She examined the surfaces of the 92 tools noting clear signs of wear. To confirm her observations that these may be food processing tools, she not only examined the residues on the surfaces of the tools, but compared the assemblage to ethnographic descriptions of pueblo life. She found that the Hopi and Zuni used similar grinding implements (Adams 1996:6; Adams 1999:7). Through these observations she notes that people often worked together when processing. In finding several implements associated together at Point of Pines, she argued that numerous people were involved in this activity (Adams 1996:3).

If we compare the feature at Ban Non Wat with all of these examples presented we see the following similarities: 1. Structures or spaces are allocated for processing activities and 2. lithic tools are found within these spaces. Another characteristic that conforms to the feature at Ban Non Wat is Sung's (1997) observation of crude and rough grinding implements. The majority of the stones found within the feature are rudimentary and may have been used for processing. Lithic artefacts such as hammerstones and grinding stones were observed in all the examples. One grindstone and three hammerstones were located in the feature. The laterite pieces may have been used as grinding stones, much like the metates observed by Sung (1997) and Adams (1996). Equally, the three large laterite boulders could have been used as anvils, against which bovid limbs were placed to facilitate butchering.

Thus food processing is certainly a possible explanation for the use of the ambiguous feature at Ban Non Wat. It should be remarked, however, that as in secondary butchering areas, the literature predominantly discusses mobile and semi-sedentary activity areas (Binford 1978 1984, Fukui 1993, O'Connell *et al.* 1991, Yellen 1977). The literature also only touches upon what was found (lithic artefacts, cooking implements, hearths), rather than describing associations and locations concerning sedentary societies. Nevertheless the examples provided show a parallel to artefact type and distribution at Ban Non Wat. Therefore, food processing activities may have occurred within the feature.

Feasting contexts show very similar features. In an archaeological study of the McPhee Village (AD 850-1275) in Colorado, Potter (2000) described a number of structures

with associated pits. The pits vary in size and show some evidence of ritual practice (special drums and holes for prayer sticks). He found large quantities of pottery vessels within these structures, arguing that a certain pottery form found within the structures reflects communal feasting (Potter 2000:22). Along a similar trajectory, Blitz (1993) demonstrated the difference between every day refuse and feasting refuse. At Lubbub Creek he demonstrated some differences in bone and ceramic distributions within refuse pits. A refuse pit containing high quantities of specific skeletal elements (meatier parts) was located centrally within the site. In contrast, the pits located near smaller structures, tended to contain a small amount of faunal remains and the parts were variable. Both of the pits contained a high number of pottery sherds and complete pots (Blitz 1993:84-90). The refuse pit that was centrally located may indicate communal consumption.

On a similar note, Hockett (1998) also examined the difference between every day food consumption and feasting event refuse from the analysis of distribution within structures. Similar to Blitz's (1993) description, the largest structure at the site contained large quantities of faunal remains (exotic species and large bones) and was not swept. The other structures contained small amounts of faunal remains and were regularly swept. Hockett (1998) argues the faunal remains in the smaller structures represent everyday consumption, whereas the faunal remains in the large structure represents a communal feasting event. To account for the high accumulation of faunal remains in the one place he argued that the bones represent a short-term consumption within the structure and the building was used as a trash deposit (Hockett 1998:11). For a similar study see Rosenswig (2006). Communal consumption of animals is also noted in ethnographic and ethnoarchaeological studies within Southeast Asia. In ethnographic studies of the Ta Oi and the Tana Toraja, Clarke (1998) and Volkman (1985) described the preferred food at feasting events. Buffaloes, pigs, chickens and rice were consumed communally in some cases. Although the animals were consumed in everyday life, the amount of animals slaughtered for these events certainly would show a variance in the archaeological record. Further, certain animals were specifically allocated outside everyday consumption for these events, such as those in the Philippines (Mudar 1997).

Several characteristics of the Ban Non Wat feature conform to Hockett's (1998) observation of feasting debris. If we compare the feature at Ban Non Wat with the evidence from Baker's Village we see the following similarities; 1. the area surrounding the feature may have been swept, perhaps confining the faunal remains to this space, 2. a large accumulation of bones was found within a given space, 3. the bones were deposited within a short period of time. Other aspects of the Ban Non Wat feature are similar to Blitz's (1993) analysis, for example, the direct association of faunal remains with pottery sherds and later, vessels within a confined area, as seen in Potter's (2000) analysis. Finally, the majority of the bones within the feature at Ban Non Wat represent high meat-bearing parts, which as seen here, a common aspect of feasting activities. Finally, ethnographic and ethnoarchaeological observations within the region note similar animal types are consumed at feasting events as those found in the feature. Bovidae and pigs were the predominant animals recovered and it is assumed rice may have played a role in the feasting events, as at Ban Non Wat and Noen U-Loke rice is included in some burials (Higham 2002, 2005). In conclusion, the faunal remains and pottery sherds found within the feature may be the remains of a feasting event. It should be noted, however, that the literature predominately discusses the social and political repercussions of feasting events, rather than spatial distributions of the associated material culture. The lack of solid discussion of distribution and eventual disposal, especially in ethnoarchaeological contexts certainly inhibits a good comparative analysis, especially conflicting observations.

CONCLUSIONS

Higham (2011) has already concluded that mortuary feasting played an important role in inducing social change during the early Bronze Age at Ban Non Wat. The capacity to produce more food, crafts, raw materials and labour are indicators of an increasingly complex political system (Arnold 1992:7; Hayden 1995:22; Kim *et al*. 1994:120). It is concluded that feasting also took place at Ban Non Wat during the Iron Age. With an increased social complexity, what were the consequences? Did individuals begin to exhibit power and control over others at this point? If so, what was the role of feasting in this society? Are we able to distinguish between various types of feasting activities? Hayden (1995) discussed two types of feasting: public feasting as a social strategy to create solidarity within a community, and competitive feasting as a social strategy for individuals to leverage power or influence. Adams (2004) argued that archaeologically, public feasting can be seen through high accumulations of faunal remains, little variation in animal species, domestic pottery and central distributions. In competitive events, archaeologically the opposite material remains are observed (Adams 2004, Hockett 1998, Kantner 1996). In ethnographic observations of competitive feasting in the Philippines and the Akha in North Thailand, pottery and meats are distinct from everyday contexts (Junker 1999:326; Hayden and Maneeprasert 1996:13). The feature shows little variation in species and the pottery is common throughout the site. Further, the feature in question is surrounded by numerous activities, perhaps indicating this area was accessable to several people. It is therefore supposed this was a communal feasting event.

Creating social cohesion and a sense of belonging may have ensured advancement of individuals within the soci-

ety. People organised these events. Who organised them? Did they have an ultimate strategy behind their actions? How did these practices affect the society as a whole? Did these practices affect the wider community? From these practices did they evolve into competitive feasting? Were other communities involved, such as Noen U-Loke? Did this increased solidarity within Ban Non Wat create a stronger society? What were the implications of this solidarity on a regional scale? Did this result in Ban Non Wat developing into a centralised society? In summary, cross-cultural comparisons with similar physical attributes as the feature noticed parallel distributions from secondary butchering, food preparation and feasting sites. An application of agency theory allowed an understanding of the role of the individual within and beyond these contexts. The implications of feasting activities were outlined and for now, gathered more questions than answers. Future work will grant a further insight into what was happening during this period.

The physical analysis of the feature, surrounds and the material culture indicate that numerous domestic and industrial activities were happening in and around the feature. It is argued that the feature itself was clearly marked (at least at one point) by perhaps a structure since post-holes were outlined in period 3 (Fig. 3:4). It is also noted in the analysis of the floors that sweeping may have cleaned and accumulated materials into restricted areas. This is certainly observed in the analysis of the site plans. The analysis of the material culture gave way to comparisons with ethnographic, ethnoarchaeological and archaeological observations and interpretations. Several possible explanations were addressed, including salt production, iron production, secondary butchering and food preparation and feasting. Salt and iron production were rejected as the materials and actions described did not conform to the physical analysis of the feature and the remains.

Secondary butchering activities, food preparation and feasting all show one common feature. The activities and therefore the materials arising from these activities are located within a contained area. This conforms to the distribution of remains contained within the feature. As well as containment of the materials found in these, the activities resulted in high meat bearing faunal remains, highly processed bones, large accumulations of bones and associated iron knives, small variations in species, grinding implements and hammerstones and broken pots. It is argued that these scenarios can be constructed to explain this feature. The most likely interpretation is that the floor was created by a structure within which food processing activities occurred including butchering. After the meat was removed from the bone, it was taken away to be cooked and consumed in a feast. The broken pots placed over the butchering floor may have been discarded after the feast was over.

It was argued that feasting provided the opportunity for individuals to organise and exert influence or power over others. It is in this milieu stressing charisma and leadership, that individuals negotiated their status within the society. In reconstructing the history of the feature itself, we may see variances in these actions. It is argued that it is through these variances that we can see not only the agent, but their response to societal structures.

Such evidence for everyday activities complements evidence for societal change seen in mortuary remains. A close examination of butchery marks using a practice approach may show a difference between everyday preparation of food and those for special occasions. A comparison of the faunal remains found within and outside the feature should be conducted. Further, this examination may also demonstrate differing technical skills of individuals. A comparison of artefacts between Ban Non Wat, Noen U-Loke and Ban Lum Khao (within the same period) may show variances in technical skills and choices. An analysis of the artefacts may further demonstrate the extent to which people conformed to specific rules or templates. Over time, people may conform to these rules and show little variance in artefact construction. A comparative analysis of these sites may reveal different rates of social complexity between the sites. Little variation exists within the literature concerning feasting practices. There is a strong emphasis on chiefdom societies. The concentration makes it difficult to compare well established chiefdoms to less complex societies. Ethnographic observation of societies should turn toward a greater variance from what is frequently examined.

IV THE FISH REMAINS

R. THOSARAT

INTRODUCTION

The identification of fish remains in the Iron Age is done by taking samples from only well provenenced contexts, for example, shell middens, pits, floors and lenses. The following were identified.

1. Order Osteoglossiformes
Family Notopteridae
Notopterus notopterus (Pallas, 1769)

These widely-consumed fish may reach a length of 35 cm. They enter swamps to spawn, then return to rivers. Many are smoked and marketed. Despite their name *pla chalat*, or clever fish, they are taken in nets and traps in considerable numbers.

2. Order Cypriniformes
Family Cyprinidae

Bones found from this family are mostly from lower pharyngeal bones. It is difficult to identify fish species except those from *Hampala* sp. However, most of them are similar to *Barbonymus* sp. (previousely *Barbodes*).

Hampala sp. There are two species, *Hampala dispar* Smith, 1934 and *H. macrolepidota* van Hasselt, 1823. The former are more abundant in the Phimai market today while the latter are hardly seen in the market. It is difficult to distinguish between these two species.

Hampala dispar prefers clear streams or rivers, but is adaptable and may invade flooded forest habitats to spawn. A fully grown specimen can reach a length of 35 cm. *H. macrolepidota,* the jungle perch, occurs mainly in clear rivers or streams with running water and sandy to muddy bottoms. It is widely consumed today. It can grow to a length of 70 cm and weigh 6.5 kg.

3. Order Siluriformes
Family Bagridae

Hemibagrus sp. Bones from this family are most likely to belong to *Hemibagrus filamentus* (Fang and Chaux, 1949). It is found in slow moving rivers with a muddy bottom, but it also inhabits large lakes, such as the Tonle Sap. The fish is widespread in Thailand, including the tributaries of the Mun River. It grows to a length in excess of 50cm.

Family Siluridae

Ompok bimaculatus (Bloch, 1794). The sheatfish, or *pla nua on*, is widespread in Thailand, and reaches a maximum size of 40 cm but is usually much smaller. It is present in large numbers and is often found in markets

Wallago sp. There are two species, *Wallago attu* (Schneider, 1801) and *W. leeri* (Bleeker, 1851) The former are abundant while the latter have never been found in the Phimai market today. A voracious and determined feeder, this catfish, known as *pla khao*, can reach nearly a metre in length. They live in larger streams or rivers

Family Pangasiidae
Pangasius larnaudii Bocourt, 1866
P. sanitwongsei Smith, 1931

These two species are only found in the upper layer. Only two left pectoral fin spines from each fish are found. *P. larnaudii* grows to a maximum length of 1.30 m, and can weigh up to 46 kg. It lives in medium to large rivers, where it is found in deep pools and rapids, and can invade flooded swamp forest. *P. sanitwongsei*, the giant catfish, can grow to a length of three metres and weigh nearly 300 kg. They occupy large rivers, are migratory, and spawn just before the monsoon season.

Family Clariidae

Clarias sp. It is difficult to identify the bones of *Clarias batrachus* (Linnaeus, 1758) from *C. macrocephalus* Günther, 1864. However, the supraoccipital bone is quite obviously distinct between these two species. The former has a pointed process while the supraoccipital process of the latter is quite round. Both characteristics are found from Ban Non Wat. These catfish breath air and without access to it, they perish. Members of this family are widespread and important in Thailand for food. *Clarias macrocephalus*, the broad-headed catfish, lives in shallow open water, freshwater rivers and canals, and extends into flooded fields during the wet season. It has the capacity to sink into mud to survive the dry season immobile.

4. Order Synbranchiformes
Family Synbranchidae

Monopterus albus (Zuiew, 1793), The swamp eel is prolific and widely consumed. It lives in a wide range of freshwater habitats, and is commonly found in wet rice fields during the rainy season. During the dry season, the eels survive in damp hollows with no surface water. They can be caught by hook in the wet season and by digging during the dry, and can survive for a long period out of water if kept moist. Large specimens can attain a length of 70 cm. They are known as *pla lai*.

5. Order Perciformes

Family Nandidae

Pristolepis fasciatus (Bleeker, 1851). This is not a large fish, a weight of 1 kg being most unusual. Its flat appearance and habit of sinking into the mud in stagnant swamps give it the name *pla chang yieb*, or flattened by an elephant.

Family Ananantidae

Anabas testudineus (Bloch, 1792). Members of this genus can breathe air, and are best known for their ability to traverse dry land and climb steep slopes or even trees. However, it is also one of the main food fishes of Thailand, adapted to fresh water rivers, streams, canals and marshes. A mature specimen will measure 10-15 cm and unusually large adults may attain a length of over 20 cm. It is known in Thai as *pla mor* (doctor fish).

Family Belontiidae

Trichogaster sp.

Family Channidae

Channa lucius (Cuvier (ex Kuhl & van Hasselt) in Cuvier & Valenciennes, 1831). The blotched snake-headed fish or *pla kasong* is found in streams and lakes in Northeast Thailand. It reaches a length of 35-40 cm but is normally half that size

C. micropeltes Cuvier (ex Kuhl & van Hasselt) in Cuvier & Valenciennes, 1831). The giant snake-headed fish or *pla chado*, is the largest species of *Channa*, reaching a maximum weight of 20 kg and a length of nearly a metre. It is a voracious feeder, and widely consumed. In Surin Province, Khmer speaking villagers regard this fish with reverence. It is commonly to be seen in Cambodian fish markets, and many are taken in the Tonle Sap.

C. striata (Bloch, 1793) Known as *pla chon*, this is probably the most popular and widely consumed fish in Thailand. It has been known to reach a length in the vicinity of a metre. It can be secured by trap or line, and survives for long periods without access to water. During the dry season, it can be cut out of the mud in which is takes refuge in dry lake beds. It is often dried and marketed.

THE ANATOMICAL BONES OF IRON AGE FISH REMAINS

E2 layer 4 surface 7 feature 1 shell midden

1. *Hemibagrus* sp. cleithrum 1L = 1
2. *Mystus* sp. dorsal spine 5 = 5
3. Bagridae pectoral spine 5L 3R = 6
4. *Ompok bimaculatus* pectoral spine 2L = 2
5. *Clarias* sp. sphenotic 1L, parasphenoid 1, cleithrum 2 fragments, pectoral spine 1L 2R =3
6. *Monopterus albus* dentary 1L, ectopterygoid 1L = 1
7. *Anabas testudineus* nasal 1L, lachrymal 1L, parietal 1L, posttemporal 1L, interopercular 1L, opercular 1L 1R, cleithrum 1L = 2
8. *Channa striata* supraoccipital 1, articular 1R, dentary 2L, palatine 1R, quadrate 1L, epihyal 1L 1R, lower pharyngeal 1L 1R, cleithrum 1L (ventral portion) = 2

C8/C9/D8/D9 layer 4 surface 2 feature 1 Iron Age floor

1. *Hemibagrus* sp. dentary 1R, pectoral spine 2L = 2
2. Bagridae cleithrum 1L, pectoral spine 4L 5R = 5
3. *Ompok bimaculatus* pectoral spine 1L 1R = 2
4. *Clarias* sp. derm-ethmoid 2, lateral ethmoid 1R, jugal 1L, articular 1L, dentary 1L, urohyal 1, cleithrum 1L 1R, pectoral spine 12L 15R = 17
5. *Monopterus albus* articular 4R, dentary 2L 1R, ectopterygoid 2L, cleithrum 3L 2R, supracleithrum 1L 1R = 4
6. *Anabas testudineus* lachrymal 2L 1R, suborbital 5 1R, posttemporal 1L, opercular 1L, cleithrum 1R, supracleithrum 1R = 3
7. *Channa striata* posttemporal 1L 1R, supraoccipital 1, basioccipital 2, dentary 4L 3R, maxilla 1L 1R, premaxilla 1L, quadrate 1L 5R, ceratohyal 1L 1R, epihyal 2L, lower pharyngeal 1R, cleithrum 2L 1R = 6

D2 layer 4 surface 1 feature 2 sandy pit

1. Bagridae basioccipital 1, pectoral spine 3L = 3
2. *Ompok bimaculatus* pectoral spine 1L = 1
3. *Clarias* sp. parasphenoid 1, articular 1R, epihyal 1L, cleithrum 2L, coracoid 1L, pectoral spine 4L 1R = 4
4. *Monopterus albus* basihyal 1, dentary 1R, cleithrum 2L = 2
5. *Anabas testudineus* nasal 2R, lachrymal 2L, pterotic 1, supraoccipital 1, basioccipital 1, dentary 1L, opercular 1L, supracleithrum 1R = 2
6. *Channa striata* pterotic 1L, scale bone 1L, supraoccipital 1, basioccipital 2, articular 3L, dentary 1L 3R, maxilla 1L, palatine 1L, premaxilla 1R, quadrate 2L, ceratohyal 1L 1R, lower pharyngeal 1L, cleithrum (dorsal end) 1L 1R, (ventral portion) 2L 1R, supracleithrum 1L = 3

D2 layer 4 surface 1 feature 11 hard clay floor

1. *Clarias* sp. sphenotic 1R, articular 1R, pectoral spine 1L 1R = 1
2. *Monopterus albus* dentary 1L, ectopterygoid 1R = 1
3. *Anabas testudineus* lachrymal 1L, parietal 1L, supracleithrum 2R = 2
4. *Channa striata* sphenotic 1L, ceratohyal 1L, epihyal 1R, cleithrum 1R = 2

E2 layer 3 surface 8 feature 1 hard floor

1. Cyprinidae lower pharyngeal 1L = 1
2. Bagridae pectoral spine 1R = 1
3. *Clarias* sp. frontal 1L 1R, supraorbital 1R, parasphenoid 1, articular 1L 1R, quadrate 1L, cleithrum 1R, pectoral spine 1L 2R = 2
4. *Anabas testudineus* nasal 1L 2R, lachrymal 1R, suborbital 3 2L, suborbital 4 2R, maxilla 1L, premaxilla 1L, cleithrum 1L 1R, supracleithrum 2L 1R = 3

5. *Channa striata* dentary 2L, maxilla 1L 2R, premaxilla 1L, palatine 1R, quadrate 3L 2R, ceratohyal 1L 1R, cleithrum 1L (ventral) 1R (dorsal), supracleithrum 1L 2R = 4

E2 layer 3 surface 8 feature 6 pit
1. *Wallago* sp. pectoral spine 1L = 1

E3 layer 3 surface 8 feature 1 hard floor
1. *Clarias* sp. pectoral spine 1L = 1
2. *Anabas testudineus* lachrymal 1R = 1
3. *Channa striata* basihyal 1, ceratohyal 1L = 2

E2 layer 3 surface 7 feature 2 hard floor
1. *Mystus* sp. supraoccipital 1 = 1
2. Bagridae pectoral spine 1L = 1
3. *Clarias* sp. sphenotic 1L, cleithrum 1L, pectoral spine 2R = 2
4. *Anabas testudineus* suborbital 3 1L, opercular 1L, subopercular 1R, supracleithrum 1R = 1
5. *Channa striata* nasal 1R, posttemporal 1L 1R, pterotic 1R, dentary 1L, maxilla 1R, palatine 1L, premaxilla 1L, ceratohyal 1L, interopercular 1L, lower pharyngeal 1L, upper pharyngeal 1R = 2

E2 layer 3 surface 7 feature 10 dark soil
1. *Notopterus notopterus* articular 1R, dentary 1R, maxilla 1L = 1
2. *Hemibagrus* sp. articular 1R, dentary 2R = 3
3. Bagridae cleithrum 1L 1R, pectoral spine 7L 3R = 7
4. *Ompok bimaculatus* articular 1L 2R, dentary 1L, quadrate 1L, cleithrum 3L 3R, pectoral spine 7L 5R= 7
5. *Clarias* sp. derm-ethmoid 1, lateral ethmoid 1R, frontal 1L, jugal 1L 1R, posttemporal 1L, supraoccipital 2, parasphenoid 1, articular 3L, dentary 1L 1R, opercular 2L 1R, quadrate 1R, urohyal 1, cleithrum (dorsal) 3L 2R, (ventral) 2L 1R, coracoid 3L 1R, pectoral spine 9L 11R = 11
6. *Monopterus albus* articular 2L, dentary 2R, ectopterygoid 2R, ceratohyal 3R, epihyal 1R, quadrate 1R, cleithrum 2L 1R = 3
7. *Pristolepis fasciatus* parasphenoid tooth patch 1 = 1
8. *Anabas testudineus* nasal 1L, frontal 3L, lachrymal 9L 6R, suborbital 4 1L 3R, suborbital 5 1R, sphenotic 3L 3R, supraoccipital 1, dentary 1R, hyomandibular 1L 4R, interopercular 1R, opercular 2L 6R, preopercular 1L 3R, subopercular 1R, lower pharyngeal 1R, cleithrum 5L 4R, supracleithrum 3L 1R = 9
9. *Channa lucius* supraoccipital 1, premaxilla 1L = 1
10. *Channa striata* nasal 1R, frontal 1L 4R, lachrymal 3L 4R, posttemporal 2L 2R, pterotic 2L 1R, scale bone 1L, sphenotic 1L, supraoccipital 1, parasphenoid 1, basioccipital 1, articular 5L 13R, dentary 6L 12R, maxilla 8L 7R, palatine 4L 4R, premaxilla 8L 7R, quadrate 11L 11R, basihyal 2, ceratohyal 8L 11R, epihyal 5R, interopercular 2L 1R, preopercular 3L 4R, lower pharyngeal 4L 5R, cleithrum (dorsal) 14L 4R, (ventral) 7L 6R, supracleithrum 4L 5R = 14

E3 layer 3 surface 7 feature 2 hard floor
1. *Hemibagrus* sp. basioccipital 1, dentary 1R = 1
2. *Mystus* sp. dorsal spine 1 = 1
3. Bagridae pectoral spine 1L 1R = 2
4. *Ompok bimaculatus* pectoral spine 2L 1R = 3
5. *Clarias* sp. derm-ethmoid 1, lateral ethmoid 1R, dentary 1L, urohyal 1, pectoral spine 1L = 1
6. *Monopterus albus* dentary 1L, ectopterygoid 1L, cleithrum 2L = 2
7. *Anabas testudineus* nasal 1L 1R, lachrymal 1L 1R, posttemporal 1L, opercular 1L, cleithrum 1L 2R, supracleithrum 1L = 2
8. *Channa striata* lachrymal 1L, dentary 3L, maxilla 3L, palatine 1L, premaxilla 3L 1R, quadrate 1R, ceratohyal 1R, preopercular 1L, lower pharyngeal 1L 1R, upper pharyngeal 1R, cleithrum 1R, supracleithrum 1R = 4

E3 layer 3 surface 7 feature 15 clay feature
1. *Hemibagrus* sp. dorsal spine 1 = 1
2. Bagridae pectoral spine 1R = 1
3. *Ompok bimaculatus* posttemporo-supracleithrum 1R, pectoral spine 1L 2R = 2
4. *Clarias* sp. jugal 1L, supraorbital 1L 1R, articular 1R, pectoral spine 1L 3R = 4
5. *Monopterus albus* articular 1L 1R, dentary 1L, ectopterygoid 1R, quadrate 1L, ceratohyal 1R = 2
6. *Anabas testudineus* posttemporal 1R, dentary 1R, premaxilla 1L, ceratohyal 1R, opercular 2R, cleithrum 1L = 2
7. *Channa striata* lachrymal 1L, posttemporal 1R, pterotic 1L, scale bone 1L, sphenotic 1L, supraoccipital 1, articular 1L 2R, dentary 3L 5R, maxilla 3L 1R, palatine 1L 1R, premaxilla 2L 1R, quadrate 2L 2R, ceratohyal 2L 3R, epihyal 1R, preopercular 1L, lower pharyngeal 1L 2R, upper pharyngeal 1L 1R, cleithrum (dorsal) 2L 1R, (ventral) 1L 3R, supracleithrum 1L = 6

D2 layer 3 surface 7 feature 4a shell midden
1. Cyprinidae lower pharyngeal 1R = 1
2. *Hemibagrus* sp. dorsal spine 1 = 1
3. Bagridae pectoral spine 1L 1R = 1
4. *Ompok bimaculatus* dentary 1L, quadrate 1L, pectoral spine 3L 1R = 3
5. *Clarias* sp. derm-ethmoid 1, lateral ethmoid 1R, frontal 2L, jugal 1R, supraorbital 1R, sphenotic 1R, parasphenoid 1, articular 1L 1R, dentary 1L, coracoid 1L 1R, pectoral spine 4L 3R = 5
6. *Monopterus albus* posttemporal 1L, articular 1R, basihyal 1, ceratohyal 3L 1R, epihyal 2R = 3
7. *Anabas testudineus* frontal 2L, lachrymal 2L, pterotic 2R, articular 1L, opercular 4R, subopercular 2R, lower pharyngeal 1R, supracleithrum 2L 1R = 4
8. *Channa striata* frontal 1R, lachrymal 1R, posttemporal 1L, pterotic 1L 2R, sphenotic 1, supraoccipital 3, articular 2L 2R, dentary 1L 2R, palatine 2L 1R, premaxilla 2L, quadrate 1L, ceratohyal 3L, epihyal 3R, lower pharyngeal 1R, cleithrum (dorsal) 1R, (ventral) 2L 2R = 3

D2 layer 3 surface 4 very hard floor

1. *Ompok bimaculatus* pectoral spine 1R = 1
2. *Clarias* sp. cleithrum 1R = 1
3. *Monopterus albus* ceratohyal 1L = 1
4. *Anabas testudineus* posttemporal 1R, supracleithrum 1L = 1

E5 layer 3 surface 6 feature 1 dark soil

1. Bagridae pectoral spine 1L = 1
2. *Clarias* sp. supraoccipital 1, dentary 2L, pectoral spine 2L 1R = 3
3. *Monopterus albus* articular 1L = 1
4. *Anabas testudineus* opercular 1L = 1
5. *Channa striata* frontal 1R, supraoccipital 1, maxilla 1L, palatine 1R, premaxilla 2R, lower pharyngeal 1L = 3

E3 layer 3 surface 5 feature 3 hard floor

1. Bagridae pectoral spine 1R = 1
2. *Monopterus albus* articular 1L = 1
3. *Channa striata* nasal 1L, dentary 1L, maxilla 1L = 2

E3 layer 3 surface 5 feature 4 ashy floor

1. Bagridae cleithrum 1R, pectoral spine 1R = 1
2. *Clarias* sp. lateral ethmoid 1R, articular 1L, cleithrum 1L, coracoid 1R, pectoral spine 1R = 2
3. *Monopterus albus* basihyal 1 = 1
4. *Anabas testudineus* preopercular 1L, cleithrum 1L, supracleithrum 1L = 1
5. *Channa striata* basioccipital 1, dentary 1R, quadrate 1R, supracleithrum 1L = 1

E2/E3 layer 3 surface 4 feature 1 shell midden

1. *Notopterus notopterus* parasphenoid tooth patch 1, articular 1L 1R, dentary 2L 1R, maxilla 1R, palatine 2 fragments = 2
2. Cyprinidae lower pharyngeal 2L 10R = 10
3. *Hemibagrus* sp. posttemporo-supracleithrum 2L, articular 3R, dentary 1L 1R, basihyal 1, pectoral spine 5L 1R, dorsal spine 5 = 7
4. *Mystus* sp. supraoccipital 1, dorsal spine 16 = 16
5. Bagridae cleithrum 14L 14R, coracoid 1R, pectoral spine 69L 68R = 69
6. *Ompok bimaculatus* posttemporo-supracleithrum 1L 1R, articular 3L 2R, cleithrum 10L 14R, pectoral spine 46L 45R = 46
7. *Wallago* sp. dentary 1R= 1
8. *Clarias* sp. derm-ethmoid 3, lateral ethmoid 2R, frontal 4L 8R, jugal 4L, dermosphenotic 2L 1R, supraorbital 14L 11R, posttemporal 3L 3R, pterotic 2L 1R, sphenotic 5L 7R, supraoccipital 4, articular 9L 7R, dentary 3L 9R, opercular 3L 4R, palatine 1R, urohyal 10, cleithrum (dorsal) 4L 7R, (ventral) 8L 5R, coracoid 7L 6R, pectoral spine 114L 117R = 117
9. *Monopterus albus* posttemporal 2L 5R, basioccipital 1, articular 4L 5R, dentary 2L, ectopterygoid 10L 6R, basihyal 7, ceratohyal 5R, epihyal 1R, quadrate 2L 6R, urohyal 4, cleithrum 5L 4R = 10
10. *Pristolepis fasciatus* parasphenoid tooth patch 3, basihyal tooth plate 3 = 4
11. *Anabas testudineus* frontal 4L 4R, lachrymal 22L 30R, suborbital 3 1L 1R, suborbital 4 5L 5R, suborbital 5 2L 2R, posttemporal 1L 3R, pterotic 14L 6R, scale bone 1L 1R, supraoccipital 3, articular 6L 1R, dentary 1R, maxilla 2L 2R, hyomandibular 4L 3R, interopercular 1L, opercular 8L 16R, preopercular 5L 6R, subopercular 2L 3R, urohyal 1, lower pharyngeal 5L 13R, cleithrum 13L 17R, supracleithrum 15L 17R = 30
12. *Trichogaster* sp. caudal vertebra (1 or 2) 1 = 1
13. *Channa lucius* posttemporal 2R, pterotic 2R, dentary 1L 2R, interopercular 1L, epihyal 1L 2R = 3
14. *Channa micropeltes* basioccipital 1 = 1
15. *Channa striata* prevomer 2, nasal 6L, frontal 2L 4R, lachrymal 7L 9R, epiotic 2R, posttemporal 9L 16R, pterotic 13L 13R, scale bone 5L 7R, sphenotic 3L 6R, supraoccipital 16, basioccipital 16, articular 22L 27R, dentary 42L 56R, maxilla 44L 48R, palatine 31L 27R, premaxilla 40L 42R, quadrate 39L 26R, ceratohyal 43L 48R, epihyal 16L 26R, hyomandibular 2L 2R, interopercular 7L 5R, opercular 5L 6R, preopercular 15L 20R, epibranchial 3 1L 1R, lower pharyngeal 25L 25R, upper pharyngeal 2L 1R, cleithrum (dorsal) 33L 27R, (ventral) 10L 15R, supracleithrum 17L 17R = 56

D2 layer 3 surface 4 feature 10 hard floor

1. Bagridae cleithrum 1L, pectoral spine 1R = 1
2. *Ompok bimaculatus* pectoral spine 1 = 1
3. *Clarias* sp. derm-ethmoid 1, articular 1L, pectoral spine 3R = 3
4. *Anabas testudineus* lachrymal 1L, suborbital 5 1R, parasphenoid 1, interopercular 1R, opercular 1R, cleithrum 1R = 1
5. *Channa lucius* scale bone 1L = 1
6. *Channa striata* lachrymal 1R, maxilla 1L, lower pharyngeal 1R, cleithrum 1L 2R, supracleithrum 1L 2R = 2

E2 layer 3 surface 3 feature 1 ashy floor

1. Bagridae cleithrum 1R = 1
2. *Ompok bimaculatus* articular 1R, pectoral spine 2R = 2
3. *Clarias* sp. jugal 1R, supraorbital 1L, corcoid 1L, pectoral spine 1L 2R = 2
4. *Monopterus albus* articular 1L = 1
5. *Anabas testudineus* parasphenoid 1L, opercular 1R, preopercular 1L, cleithrum 1L, supracleithrum 1R = 1
6. *Channa lucius* articular 1L = 1
7. *Channa striata* posttemporal 1L 1R, articular 1R, dentary 2R, palatine 1L 3R, premaxilla 1L, quadrate 1R, epihyal 1R, lower pharyngeal 2L 1R, upper pharyngeal 1R, cleithrum 1L, supracleithrum 1L = 3

E2 layer 3 surface 3 feature 2 ashy floor

1. *Ompok bimaculatus* articular 1R, pectoral spine 1L

= 1
2. *Clarias* sp. pterotic 1L = 1
3. *Anabas testudineus* suborbital 3 1R, preopercular 1R = 1
4. *Channa striata* basioccipital 1, cleithrum 1R = 1

E2 layer 3 surface 3 feature 3 ashy floor
1. *Notopterus notopterus* articular 1R = 1
2. *Hemibagrus* sp. dorsal spine 2 = 2
3. Bagridae articular 1R, cleithrum 1L, pectoral spine 4L 5R = 6
4. *Ompok bimaculatus* premaxilla 1L, pectoral spine 2L 2R = 4
5. *Clarias* sp. derm-ethmoid 1, frontal 1L 1R, supraorbital 2L, dermosphenotic 1L, dentary 1R, cleithrum 2L 2R, coracoid 1L 1R, pectoral spine 7L 12R = 12
6. *Monopterus albus* posttemporal 1L, ectopterygoid 1L, ceratohyal 1L, quadrate 1L 1R = 2
7. *Anabas testudineus* nasal 1R, frontal 1L, lachrymal 5L 2R, suborbital 4 3L 1R, posttemporal 4R, pterotic 1L, articular 1R, dentary 1R, maxilla 1L, hyomandibular 1R, interopercular 1L, opercular 1L 1R, subopercular 1R, lower pharyngeal 2L, cleithrum 3L, supracleithrum 3L 1R = 5
8. *Trichogaster* sp. caudal vertebra (1 or 2) 1 = 1
9. *Channa striata* lachrymal 2L, posttemporal 3L 1R, pterotic 1L 1R, scale bone 1L 1R, sphenotic 1L, articular 3L 4R, dentary 3L 6R, maxilla 7L 4R, palatine 2L 5R, premaxilla 4R, quadrate 3R, basihyal 2, ceratohyal 1L 3R, epihyal 1L 2R, interopercular 2L 1R, opercular 1L, lower pharyngeal 1R, cleithrum 2L 1R, supracleithrum 2L 2R = 7

E2 layer 3 surface 3 feature 4 ashy floor
1. *Hemibagrus* sp. frontal 1R, 2nd pterygiophore 1 = 1
2. Bagridae pectoral spine 1L 1R = 2
3. *Ompok bimaculatus* pectoral spine 1L = 1
4. *Clarias* sp. lateral ethmoid1L, frontal 1L, articular 2L, dentary 1R, opercular 1L, urohyal 1, cleithrum 1R, pectoral spine 7L 1R = 7
5. *Monopterus albus* articular 1R, quadrate 1L = 1
6. *Anabas testudineus* articular 1R, ceratohyal 1R, subopercular 1L, cleithrum 1L, supracleithrum 1L = 1
7. *Channa striata* lachrymal 1R, scale bone 1L, sphenotic 1L, basioccipital 1, dentary 1R, maxilla 1L, palatine 1R, premaxilla 1L, quadrate 1L 2R, ceratohyal 2R, epihyal 2R, supracleithrum 1L 2R = 3

E2 layer 3 surface 3 feature 5 ashy floor
1. Cyprinidae parasphenoid 1 = 1
2. *Hemibagrus* sp. dentary 1L 1R, dorsal spine 1 = 2
3. Bagridae cleithrum 1L, pectoral spine 1R = 1
4. *Ompok bimaculatus* pectoral spine 2L 2R = 3
5. *Clarias* sp. derm-ethmoid 1, supraorbital 2L 1R, dentary 1L, opercular 1R, cleithrum 1L, pectoral spine 2L 2R = 4
6. *Monopterus albus* basihyal 1, ceratohyal 1, hypoyal 1 = 2
7. *Anabas testudineus* nasal 1L, lachrymal 1L 1R, posttemporal 1L, articular 1L, premaxilla 1R, interopercular 1R, preopercular 1L 1R, cleithrum 1R = 2
8. *Channa lucius* epihyal 1R = 1
9. *Channa striata* posttemporal 1L 1R, basioccipital 1, articular 2L 1R, dentary 1R, maxilla 2L 3R, palatine 1R, premaxilla 1L 1R, quadrate 1L 1R, ceratohyal 2R, epihyal 1L, opercular 1L, preopercular 1L, cleithrum 1L, supracleithrum 1L = 4

E2 layer 3 surface 3 feature 6 ashy floor
1. *Ompok bimaculatus* cleithrum 1L = 1
2. *Clarias* sp. frontal 1L, suborbital 2R, sphenotic 1R, pectoral spine 3L 3R = 5
3. *Anabas testudineus* lachrymal 2R, suborbital 4 1R, posttemporal 1R, opercular 1L = 2
4. *Channa striata* lachrymal 1R, frontal 1L 1R, posttemporal 1L, dentary 1R, maxilla 1L 1R, palatine 3R, quadrate 1L, ceratohyal 1L 1R, hypoyal 1L, hyomandibular 1R, lower pharyngeal 1R, cleithrum 1R, supracleithrum 1R = 3

E2 layer 3 surface 3 feature 7 ashy floor
1. Bagridae pectoral spine 1L 1R = 2
2. *Ompok bimaculatus* pectoral spine 1R = 1
3. *Clarias* sp. suborbital 1R, cleithrum 1R, coracoid 1L, pectoral spine 1L 1R = 2
4. *Monopterus albus* posttemporal 1R = 1
5. *Channa striata* preopercular 1L = 1

E5 layer 3 surface 3 feature 1 dark soil
1. *Clarias* sp. pectoral spine 1L = 1

E2 layer 3 surface 2 feature 5 pit
1. Bagridae pectoral spine 1L 1R = 2
2. *Ompok bimaculatus* pectoral spine 1L 2R = 3
3. *Clarias* sp. derm-ethmoid 1, articular 1R, palatine 1L, urohyal 1, cleithrum 1L, coracoid 1L, pectoral spine 2R = 3
4. *Anabas testudineus* lachrymal 1L 1R, suborbital 3 1R, posttemporal 1L 1R, pterotic 1R, parasphenoid 1, premaxilla 1R, opercular 1L, cleithrum 1L, supracleithrum 2L 1R = 3
5. *Channa lucius* scale bone 1R = 1
6. *Channa striata* pterotic 3R, sphenotic 1L, basioccipital 1, maxilla 2L 1R, quadrate 1R, ceratohyal 1L, epihyal 1L, lower pharyngeal 1R, supracleithrum 1L = 3

E9 layer 3 surface 2 feature 1 large pit
1. Bagridae cleithrum 1R = 1
2. *Ompok bimaculatus* pectoral spine 1L = 1
3. *Wallago* sp. premaxilla 1L = 1
4. *Clarias* sp. cleithrum 1L = 1
5. *Monopterus albus* posttemporal 1L = 1
6. *Anabas testudineus* cleithrum 1R = 1
7. *Channa lucius* dentary 1R = 1
8. *Channa striata* articular 1L 1R, maxilla 1L 1R, pala-

tine 1L 1R, premaxilla 1L 1R, opercular 1L, cleithrum 1R, supracleithrum 1L 1R = 3

E9 layer 3 surface 2feature 2 large pit

1. *Clarias* sp. fragment of frontal 1 piece, cleithrum 1R, pectoral spine 1R = 2

2. *Channa striata* articular 1L = 1

E3 layer 3 surface 1 feature 1 pit

1. Bagridae cleithrum 2R, pectoral spine 2L 1R = 2

2. *Ompok bimaculatus* pectoral spine 1L = 1

3. *Clarias* sp. supraorbital 1L, articular 1R, cleithrum 1L, pectoral spine 1L 1R = 2

4. *Monopterus albus* ectopterygoid 1R, quadrate 1R = 1

5. *Anabas testudineus* frontal 1L 1R, supracleithrum 1L 1R = 2

6. *Channa striata* dentary 1L, maxilla 2L, palatine 2L 2R, premaxilla 2L 1R, ceratohyal 3R, lower pharyngeal 1L = 3

E3 layer 3 surface 1 feature 4 pit

1. Cyprinidae lower pharyngeal 1L = 1

2. *Hemibagrus* sp. dentary 1R, dorsal spine 1 = 1

3. Bagridae cleithrum 1L = 3

4. *Ompok bimaculatus* pectoral spine 2L 2R = 3

5. *Clarias* sp. supraorbital 1L 3R, pterotic 1R, articular 1L, dentary 1L, urohyal 1, coracoid 1L 1R, pectoral spine 2R = 3

6. *Anabas testudineus* frontal 1R, lachrymal 1L, suborbital 3 1R, posttemporal 1L, subopercular 1L, lower pharyngeal 1L 1R, cleithrum 1R, supracleithrum 1L = 1

7. *Channa striata* pterotic 1R, supraoccipital 1, basioccipital 1, articular 1L 1R, dentary 5L 2R, maxilla 2L 2R, palatine 5L 3R, premaxilla 2L 1R, quadrate 2L 4R, ceratohyal 4L 3R, epihyal 2L 2R, lower pharyngeal 2L 2R, upper pharyngeal 3R, cleithrum 1L 4R, supracleithrum 2L 2R = 6

D2/E2/F2 layer 3 surface 1 feature 6 loose soil

1. *Notopterus notopterus* articular 1R, dentary 1R, maxilla 1R = 1

2. *Hampala* sp. maxilla 1L, quadrate 1R = 1

3. Cyprinidae articular 1R, quadrate 2L, lower pharyngeal 6L 6R = 6

4. *Hemibagrus* sp. mesethmoid 1, supraoccipital 1, articular 2R, coracoid 1R, dorsal spine 4 = 4

5. *Mystus* sp. dorsal spine 3 = 3

6. Bagridae cleithrum 2L, pectoral spine 44L 39 R = 44

7. *Ompok bimaculatus* articular 2L 1R, cleithrum 3 R, pectoral spine 14L 30R = 30

8. *Wallago* sp. cleithrum 1L = 1

9. *Clarias* sp. frontal 3L 1R, lateral ethmoid 4L, jugal 4R, suborbital 11L 2R, dermosphenotic 2L, posttemporal 3L, pterotic 3L 1R, sphenotic 3L 2R, supraoccipital 9, parasphenoid 1, articular 7L 4R, dentary 6L 4R, opercular 2L, urohyal 5, cleithrumn7L 8R, coracoid 8L 2R, pectoral spine 93L 78R = 93

10. *Monopterus albus* posttemporal 1L, articular 1L, dentary 2L 1R, ectopterygoid 1L, quadrate 3R, basihyal 1, ceratohyal 3R, urohyal 1, cleithrum 1L = 3

11. *Anabas testudineus* nasal 3L 2R, frontal 7L 5R, lachrymal 25L 21R, suborbital 3 2L 2R, suborbital 4 4L 3R, suborbital 5 3L 4R, parietal 1L 1R posttemporal 6L 3R, pterotic 2L 5R, supraoccipital 4, parasphenoid 1, articular 4L 5R, dentary 1R, maxilla 2L 2R, premaxilla 1R, hyomandibular 4L 4R, urohyal 3, opercular 6L 9R, preopercular 3L 5R, subopercular 1R, lower pharyngeal 2L 11R, cleithrum 22L 12R, supracleithrum 15L 23R = 25

12. *Trichogaster* sp. caudal vertebra (1) 2 = 2

13. *Channa lucius* basioccipital 1, quadrate 2R, preopercular 1R = 2

14. *Channa striata* nasal 1L 5R, frontal 4L 2R, lachrymal 1L 1R, posttemporal 7L 7R, pterotic 10L 12R, scale bone 8L 5R, sphenotic 8L 4R, supraoccipital 9, basioccipital 15, articular 12L 22R, dentary 35L 31R, maxilla 47L 48R, palatine 21L 21R, premaxilla 30L 41R, quadrate 34L 24R, ceratohyal 37L 23R, epihyal 15L 23R, hyomandibular 4R, interopercular 1L 2R, opercular 2L 1R, preopercular 9L 15R, lower pharyngeal 35L 38R, upper pharyngeal 8L 6R, cleithrum (dorsal) 27L 20R, (ventral) 27L 24R, supracleithrum 14L 17R = 48

E6 layer 2 surface 9 feature 1 burnt clay and pottery concentration

1. *Hampala* sp. quadrate 1R = 1

2. Bagridae cleithrum 1R, pectoral spine 1L 2R = 3

3. *Ompok bimaculatus* pectoral spine 2L 1R = 2

4. *Clarias* sp. frontal 3R, lateral ethmoid 1L, supraorbital 2L, posttemporal 1R, cleithrum 2L, pectoral spine 1L 3R = 3

5. *Anabas testudineus* lachrymal 1L, suborbital 5 1R, parietal 1R, articular 2L, opercular 2R, preopercular 1L, cleithrum 3L 2R, supracleithrum 1L 1R, = 3

6. *Channa striata* nasal 1R, posttemporal 2L, pterotic 1R, supraoccipital 1, articular 1R, dentary 3L 1R, maxilla 1L, palatine 4L, ceratohyal 4L 3R, epihyal 3L, hyomandibular 1R, preopercular 1L, lower pharyngeal 1L 1R, upper pharyngeal 1L, cleithrum 2L 2R, supracleithrum 1L = 4

E7 layer 2 surface 4 feature 1 clayey floor

1. *Clarias* sp. supraoccipital 1, cleithrum 1L, pectoral spine 2R = 2

2. *Channa striata* maxilla 2R, premaxilla 1L, lower pharyngeal 1L = 1

E7 layer 2 surface 3 feature 1 dark soil

1. Cyprinidae lower pharyngeal 5L 2R = 5

2. *Hemibagrus* sp. articular 2R, dentary 1R, quadrate 1L, cleithrum 5L 1R, coracoid 2L 2R, dorsal spine 4 = 5

3. *Mystus* sp. dorsal spine 2 = 2

4. Bagridae cleithrum 1L 2R, pectoral spine 12L 16R =

16

5. *Ompok bimaculatus* articular 1L, dentary 1L, pectoral spine 2L 1R = 3

6. *Wallago* sp. dentary 1L = 1

7. *Clarias* sp. derm- ethmoid 2, frontal 3L 1R, lateral ethmoid 1R, supraorbital 4L 3R, posttemporal 2L, supraoccipital 3, articular 1L 1R, dentary 1L, cleithrum 4L 2R, coracoid 1L 2R, pectoral spine 3L 7R = 7

8. *Monopterus albus* articular 1L, dentary 2L 2R, ectopterygoid 1R, basihyal 1, ceratohyal 1L, cleithrum 1L 1R, supracleithrum 1R = 2

9. *Pristolepis fasciatus* basihyal tooth plate 1, preopercular 1R = 1

10. *Anabas testudineus* frontal 2L 3R, lachrymal 2L 3R, suborbital 3 1L 1R, suborbital 4 1L, pterotic 2L 6R, supraoccipital 1, articular1L 1R, hyomandibular 2L 2R, opercular 3L 7R, preopercular 2L 4R, cleithrum 3L 4R, supracleithrum 2L 1R = 7

11. *Trichogaster* sp. caudal vertebra (1) 2 = 2

12. *Channa lucius* parietal 1L = 1

13. *Channa striata* nasal 3L 3R, prevomer 2, frontal 3L 4R, lachrymal 1R, posttemporal 3L 7R, pterotic 2L 1R, sphenotic 4L 2R, supraoccipital 4, basioccipital 14 articular 14L 6R, dentary 10L 6R, maxilla 4L 10R, palatine 4L 5R, premaxilla 6L 3R, quadrate 7L 6R, ceratohyal 17L 15R, epihyal 7L 5R, hyomandibular 3R, hypoyal 3L, interopercular 2L 3R, opercular 3L 3R, preopercular 8L 6R, lower pharyngeal 7L 4R, upper pharyngeal 3L 5R, cleithrum (dorsal) 10L 12R, (ventral) 13L 6R, supracleithrum 5L 4R = 17

D8 layer 2 surface 2 feature 1 yellow/ ashy floor

1. Bagridae cleithrum 1L = 1

2. *Clarias* sp. parasphenoid 1 = 1

3. *Monopterus albus* cleithrum 1L = 1

4. *Anabas testudineus* frontal 1L = 1

5. *Channa striata* lower pharyngeal 1R, cleithrum 2L = 2

D9 layer 2 surface 2 feature 1 yellow/ ashy floor

1. *Ompok bimaculatus* pectoral spine 1L = 1

2. *Clarias* sp. supraorbital 1R = 1

3. *Monopterus albus* supracleithrum 1 = 1

E9 layer 2 surface 2 feature 1 yellow/ ashy floor

1. *Hemibagrus* sp. mesethmoid 1 = 1

2. *Clarias* sp. frontal 1L, cleithrum 1R, pectoral spine 1L = 1

3. *Monopterus albus* ceratohyal 1R = 1

4. *Channa striata* pterotic 1R, maxilla 1R, premaxilla 2 = 2

G5/G6/G7 layer 2 surface 1 feature 1 pit

1. *Notopterus notopterus* dentary 1R, maxilla 1L= 1

2. Cyprinidae lower pharyngeal 6L 7R = 7

3. *Hemibagrus* sp. frontal 1L 2R, posttemporo-supracleithrum 1L, basioccipital 2, articular 1R, dentary 1L 1R, ceratohyal 1L, coracoid 1L, dorsal spine 6 = 6

4. *Mystus* sp. dorsal spine 1 = 1

5. Bagridae cleithrum 2L 6R, pectoral spine 12L 17R = 17

6. *Ompok bimaculatus* posttemporo-supracleithrum 1L, basioccipital 1, cleithrum 4R, pectoral spine 2L = 4

7. *Wallago* sp. pectoral spine 1R = 1

8. *Pangasius larnaudii* pectoral spine 1L = 1

9. *Pangasius sanitwongsei* pectoral spine 1L = 1

10. *Clarias* sp. frontal 5L 4R, posttemporal 1L, pterotic 1R, sphenotic 1R, supraoccipital 1, articular 1R, dentary 1L, cleithrum 6L 5R, coracoid 2L 1R, pectoral spine 10L 11R = 12

11. *Monopterus albus* parasphenoid 1, articular 3R, dentary 1L 2R, ectopterygoid 2L 1R, ceratohyal 2L, urohyal 1, cleithrum 1R = 3

12. *Pristolepis fasciatus* basihyal tooth plate 3 = 3

13. *Anabas testudineus* frontal 1R, lachrymal 2R, pterotic 1L, opercular 1L 1R, ceratohyal 1R, urohyal 1, cleithrum 2L = 2

14. *Channa lucius* quadrate 1L = 1

15. *Channa micropeltes* palatine 1L = 1

16. *Channa striata* nasal 1L 1R, frontal 2L 4R, lachrymal 1R, posttemporal 1R, pterotic 1L 2R, scale bone 2L 1R, sphenotic 2L 1R, supraoccipital 9, basioccipital 12, parasphenoid 1, articular 6L 2R, dentary 8L 8R, maxilla 5L 4R, palatine 5L 5R, premaxilla 3L 3R, quadrate 5L 1R, basihyal 1, ceratohyal 15L 20R, epihyal 3L 8R, hyomandibular 3L 3R, interopercular 1R, opercular 2R, preopercular 2L 2R, lower pharyngeal 6L 5R, upper pharyngeal 2L 1R, cleithrum (dorsal) 8L 7R, (ventral) 3L 9R, supracleithrum 4L 2R = 20

THE FISH REMAINS FROM SQUARE X1

Square X1 is located near the southern edge of Ban Non Wat, and was occupied only during the Iron Age.

Layer 4:4

1. Bagridae pectoral spine 1R = 1

2. *Channa striata* lower pharyngeal 1L = 1

Layer 4:3

1. *Hemibagrus* sp. pectoral spine 1L = 1

2. Bagridae pectoral spine 1L = 1

3. *Ompok bimaculatus* pectoral spine 3R = 3

4. *Clarias* sp. frontal 1R, pectoral spine 1R = 1

5. *Anabas testudineus* lachrymal 2R = 2

6. *Channa striata* preopercular 1L, cleithrum 1R, supracleithrum 1L = 1

Layer 4 surface 3 feature 1 dark soil

1. *Channa striata* ceratohyal 1L = 1

Layer 4 surface 3 feature 2 black soil

1. Bagridae pectoral spine 1R = 1

2. *Ompok bimaculatus* cleithrum 1R = 1
3. *Clarias* sp. supraorbital 1L, pectoral spine 1L 1R = 1
4. *Anabas testudineus* lachrymal 1R, supracleithrum 1L = 1
5. *Channa striata* dentary 1L, quadrate 1R, ceratohyal 1L 1R, epihyal 2L 1R = 4

Layer 4 surface 3 feature 3 black soil
1. *Channa striata* sphenotic 1R, dentary 1L, cleithrum 1R, supracleithrum 1R = 2

Layer 4:2
1. *Hemibagrus* sp. dorsal spine 1 = 1
2. *Ompok bimaculatus* pectoral spine 1L 1R = 2
3. *Clarias* sp. pectoral spine 2L 1R = 3
4. *Anabas testudineus* lachrymal 1L, supracleithrum 1L = 1
5. *Channa striata* ceratohyal 1R =1

Layer 4:1
1. Bagridae pectoral spine 1L 1R = 1
2. *Ompok bimaculatus* pectoral spine 1R = 1
3. *Clarias* sp. derm-ethmoid 1, pectoral spine 1L = 1
4. *Anabas testudineus* subopercular 1L, lower pharyngeal 1L = 1
5. *Channa striata* basioccipital 1, pterotic 1R, ceratohyal 1R, cleithrum 1R, supracleithrum 1L = 1

Layer 3:3
1. *Clarias* sp. parasphenoid 1 = 1
2. *Anabas testudineus* supracleithrum 1L = 1

Layer 3:2
1. Bagridae cleithrum 1L = 1
2. *Clarias* sp. suborbital 1R = 1
3. *Anabas testudineus* hyomandibular 1L, interopercular 1R, cleithrum 1R = 1

Layer 3 surface 1 feature 7 black soil
1. Bagridae pectoral spine 3R = 3
2. *Clarias* sp. supraorbital 1L 1R, posttemporal 1L, articular 1R, urohyal 1, cleithrum 2R, pectoral spine 4L 1R = 5
3. *Anabas testudineus* supraorbital 5 1R, posttemporal 1L, maxilla 1L, quadrate 1R, ceratohyal 1R, supracleithrum 1R = 2
4. *Channa striata* lachrymal 1L, posttemporal 1L, articular 1R, maxilla 1R, premaxilla 1R, cleithrum 1L 1R = 2

Layer 2:14
1. *Anabas testudineus* lachrymal 1R = 1

Layer 2:13
1. *Channa striata* basioccipital 1, lower pharyngeal 1L = 1

Layer 2:12
1. *Anabas testudineus* supracleithrum 1R = 1
2. *Channa striata* cleithrum 1L = 1

Layer 2:10
1. Bagridae pectoral spine 1L = 1

Layer 2:8
1. *Clarias* sp. pectoral spine 1R = 1
2. *Anabas testudineus* supracleithrum 1L = 1
3. *Channa striata* ceratohyal 1R = 1

Layer 2:7
1. *Clarias* sp. pectoral spine 1R = 1
2. *Anabas testudineus* frontal 1L, parietal 1L = 1
3. *Channa lucius* quadrate 1L, cleithrum 1L = 1

Layer 2:6
1. *Hemibagrus* sp. dentary 1L = 1
2. Bagridae pectoral spine 1L = 1
3. *Anabas testudineus* lachrymal 1L, opercular 1L = 1

THE IRON AGE FISH REMAINS FROM SQUARE Y2

Layer 5:6
1. Bagridae cleithrum 1R = 1
2. *Clarias* sp. frontal 1R, pectoral spine 1R = 1
3. *Monopterus albus* skull fragment 1 = 1
4. *Anabas testudineus* parietal 1R, hyomandibular 1R, opercular 1L = 1
5. *Channa striata* dentary 1L, maxilla 1R, quadrate 1L, ceratohyal1L, epihyal 1R, lower pharyngeal 1R = 2

Layer 5:5
1. *Channa striata* dentary 1L = 1

Layer 5:3
1. *Channa striata* basioccipital 1 = 1

Layer 5:2
1. *Clarias* sp. frontal 1L, cleithrum 1R, pectoral spine 1L = 1

Layer 2:5
1. *Clarias* sp. derm-ethmoid 1, supraoccipital 1, cleithrum 1R, coracoid 2R = 2
2. *Monopterus albus* dentary 1L = 1
3. *Anabas testudineus* lachrymal 1L, ceratohyal1L, supracleithrum 1R = 1
4. *Channa striata* articular 1L 1R, quadrate 1L 1R, ceratohyal1L, lower pharyngeal 2L 1R, supracleithrum 1R = 2

Layer 2:2
1. *Anabas testudineus* pterotic 1R, cleithrum 1R = 1

TABLE 4:1 *The number of individual fish identified in each Iron Age context*

		Osteoglossiformes	Cypriniformes		Siluriformes	
Layer	Context	Notopteridae *Notopterus notopterus*	Cyprinidae *Hampala* sp.	Cyprinidae	Bagridae *Hemibagrus* sp.	Bagridae *Mystus* sp.
1. E2 4 surface7 f.1	shell midden				1	5
2. C8/C9/D8/D9 4 sf.2 f.1	Iron Age floor				2	
3. D2 4 sf.1 f.2	sandy pit					
4. D2 4 sf. 1 f.11	hard clay floor					
5. E2 3 sf.8 f.1	hard floor			1		
6. E2 3 sf. 8 f.6	pit					
7. E3 3 sf. 8 f.1	hard floor					
8. E2 3 sf.7 f.2	hard floor					1
9. E2 3 sf.7 f.10	dark soil	1			3	
10. E3 3 sf.7 f.2	hard floor				1	1
11. E3 3 sf.7 f.15	clay feature				1	
12. D2 3 sf.7 f.4a	shell midden			1	1	
13. D2 3 sf.6 f.4	hard floor					
14. E5 3 sf.6 f.1	dark soil					
15. E3 3 sf.5 f.3	hard floor					
16. E3 3 sf.5 f.4	ashy floor					
17. E2/E3 3 sf.4 f.1	shell midden	2		10	7	16
18. D2 3 sf.4 f.10	hard floor					
19. E2 3 sf.3 f.1	ashy floor					
20. E2 3 sf.3 f.2	ashy floor					
21. E2 3 sf.3 f.3	ashy floor	1			2	
22. E2 3 sf.3 f.4	ashy floor				1	
23. E2 3 sf.3 f. 5	ashy floor			1	2	
24. E2 3 sf.3 f.6	ashy floor					
25. E2 3 sf.3 f.7	ashy floor					
26. E5 3 sf.3 f.1	dark soil					
27. E2 3 sf.2 f.5	pit					
28. E9 3 sf.2 f.1	large pit					
29. E9 3 sf.2 f.2	large pit					
30. E3 3 sf.1 f.1	pit					
31. E3 3 sf.1 f.4	pit			1	1	
32. D2/E2/F2 3 sf.1 f.6	loose soil	1	1	6	4	3
33. E6 2 sf.9 f.1	burnt clay/ pottery		1			
34. E7 2 sf.4 f.1	clayey floor					
35. E7 2 sf.3 f.1	dark soil			5	5	2
36. D8 2 sf.2 f.1	yellow/ashy floor					
37. D9 2 sf.2 f.1	yellow/ashy floor					
38. E9 2 sf.2 f.1	yellow/ashy floor				1	
39. G5/G6/G7 2 sf.1 f.1	pit	1		7	6	1
Total		6	2	32	38	29

TABLE 4:1 *The number of individual fish identified in each Iron Age context* (cont.)

		Siluriformes					
Layer	Context	Bagridae	Siluridae		Pangasiidae		Clariidae
			Ompok bimaculatus	*Wallago* sp.	*Pangasius larnaudii*	*Pangasius sanitwongsei*	*Clarias* sp.
1. E2 4 surface7 feature1	shell midden	6	2				3
2. C8/C9/D8/D9 4 sf.2 f.1	Iron Age floor	5	2				17
3. D2 4 sf.1 f.2	sandy pit	3	1				4
4. D2 4 sf. 1 f.11	hard clay floor						1
5. E2 3 sf.8 f.1	hard floor	1					2
6. E2 3 sf. 8 f.6	pit			1			
7. E3 3 sf. 8 f.1	hard floor						1
8. E2 3 sf.7 f.2	hard floor	1					2
9. E2 3 sf.7 f.10	dark soil	7	7				11
10. E3 3 sf.7 f.2	hard floor	2	3				1
11. E3 3 sf.7 f.15	clay feature	1	2				4
12. D2 3 sf.7 f.4a	shell midden	1	3				5
13. D2 3 sf.6 f.4	hard floor		1				1
14. E5 3 sf.6 f.1	dark soil	1					3
15. E3 3 sf.5 f.3	hard floor	1					
16. E3 3 sf.5 f.4	ashy floor	1					2
17. E2/E3 3 sf.4 f.1	shell midden	69	46	1			117
18. D2 3 sf.4 f.10	hard floor	1	1				3
19. E2 3 sf.3 f.1	ashy floor	1	2				2
20. E2 3 sf.3 f.2	ashy floor		1				1
21. E2 3 sf.3 f.3	ashy floor	6	4				12
22. E2 3 sf.3 f.4	ashy floor	2	1				7
23. E2 3 sf.3 f. 5	ashy floor	1	3				4
24. E2 3 sf.3 f.6	ashy floor		1				5
25. E2 3 sf.3 f.7	ashy floor	2	1				2
26. E5 3 sf.3 f.1	dark soil						1
27. E2 3 sf.2 f.5	pit	2	3				3
28. E9 3 sf.2 f.1	large pit	1	1	1			1
29. E9 3 sf.2 f.2	large pit						1
30. E3 3 sf.1 f.1	pit	2	1				2
31. E3 3 sf.1 f.4	pit	3	3				3
32. D2/E2/F2 3 sf.1 f.6	loose soil	44	30	1			93
33. E6 2 sf.9 f.1	burnt clay/ pottery	3	2				3
34. E7 2 sf.4 f.1	clayey floor						2
35. E7 2 sf.3 f.1	dark soil	16	3	1			7
36. D8 2 sf.2 f.1	yellow/ashy floor	1					1
37. D9 2 sf.2 f.1	yellow/ashy floor		1				1
38. E9 2 sf.2 f.1	yellow/ashy floor						1
39. G5/G6/G7 2 sf.1 f.1	pit	17	4	1	1	1	12
Total		201	129	6	1	1	341

TABLE 4:1 *The number of individual fish identified in each Iron Age context* (cont.)

Layer	Context	Synbranchiformes	Perciformes				
		Synbranchidae	Nandidae	Anabantidae	Belontiidae	Channidae	
		Monopterus albus	*Pristolepis fasciatus*	*Anabas testudineus*	*Trichogaster* sp.	*Channa lucius*	*Channa micropeltes*
1. E2 4 surface 7 feature1	shell midden	1		2			
2. C8/C9/D8/D9 4 sf.2 f.1	Iron Age floor	4		3			
3. D2 4 sf.1 f.2	sandy pit	2		2			
4. D2 4 sf. 1 f.11	hard clay floor	1		2			
5. E2 3 sf.8 f.1	hard floor			3			
6. E2 3 sf. 8 f.6	pit						
7. E3 3 sf. 8 f.1	hard floor			1			
8. E2 3 sf.7 f.2	hard floor			1			
9. E2 3 sf.7 f.10	dark soil	3	1	9		1	
10. E3 3 sf.7 f.2	hard floor	2		2			
11. E3 3 sf.7 f.15	clay feature	2		2			
12. D2 3 sf.7 f.4a	shell midden	3		4			
13. D2 3 sf.6 f.4	hard floor	1		1			
14. E5 3 sf.6 f.1	dark soil	1		1			
15. E3 3 sf.5 f.3	hard floor	1					
16. E3 3 sf.5 f.4	ashy floor	1		1			
17. E2/E3 3 sf.4 f.1	shell midden	10	4	30	1	3	1
18. D2 3 sf.4 f.10	hard floor			1		1	
19. E2 3 sf.3 f.1	ashy floor	1		1		1	
20. E2 3 sf.3 f.2	ashy floor			1			
21. E2 3 sf.3 f.3	ashy floor	2		5	1		
22. E2 3 sf.3 f.4	ashy floor	1		1			
23. E2 3 sf.3 f. 5	ashy floor	2		2		1	
24. E2 3 sf.3 f.6	ashy floor			2			
25. E2 3 sf.3 f.7	ashy floor	1					
26. E5 3 sf.3 f.1	dark soil						
27. E2 3 sf.2 f.5	pit			3		1	
28. E9 3 sf.2 f.1	large pit	1		1		1	
29. E9 3 sf.2 f.2	large pit						
30. E3 3 sf.1 f.1	pit	1		2			
31. E3 3 sf.1 f.4	pit			1			
32. D2/E2/F2 3 sf.1 f.6	loose soil	3		25	2	2	
33. E6 2 sf.9 f.1	burnt clay/ pottery			3			
34. E7 2 sf.4 f.1	clayey floor						
35. E7 2 sf.3 f.1	dark soil	2	1	7	2	1	
36. D8 2 sf.2 f.1	yellow/ashy floor	1		1			
37. D9 2 sf.2 f.1	yellow/ashy floor	1					
38. E9 2 sf.2 f.1	yellow/ashy floor	1					
39. G5/G6/G7 2 sf.1 f.1	pit	3	3	2	1	1	
Total		52	9	122	7	13	1

TABE 4:1 *The number of individual fish identified in each Iron Age context* (cont.)

		Channidae	
Layer	Context	*Channa striata*	Total
1. E2 4 surface7 f.1	shell midden	2	22
2. C8/C9/D8/D9 4 sf.2 f.1	Iron Age floor	6	39
3. D2 4 sf.1 f.2	sandy pit	3	15
4. D2 4 sf. 1 f.11	hard clay floor	2	6
5. E2 3 sf.8 f.1	hard floor	4	11
6. E2 3 sf. 8 f.6	pit		1
7. E3 3 sf. 8 f.1	hard floor	2	4
8. E2 3 sf.7 f.2	hard floor	2	7
9. E2 3 sf.7 f.10	dark soil	14	57
10. E3 3 sf.7 f.2	hard floor	4	16
11. E3 3 sf.7 f.15	clay feature	6	18
12. D2 3 sf.7 f.4a	shell midden	3	21
13. D2 3 sf.6 f.4	hard floor		4
14. E5 3 sf.6 f.1	dark soil	3	9
15. E3 3 sf.5 f.3	hard floor	2	4
16. E3 3 sf.5 f.4	ashy floor	1	6
17. E2/E3 3 sf.4 f.1	shell midden	56	373
18. D2 3 sf.4 f.10	hard floor	2	9
19. E2 3 sf.3 f.1	ashy floor	3	11
20. E2 3 sf.3 f.2	ashy floor	1	4
21. E2 3 sf.3 f.3	ashy floor	7	40
22. E2 3 sf.3 f.4	ashy floor	3	16
23. E2 3 sf.3 f. 5	ashy floor	4	20
24. E2 3 sf.3 f.6	ashy floor	3	11
25. E2 3 sf.3 f.7	ashy floor	1	7
26. E5 3 sf.3 f.1	dark soil		1
27. E2 3 sf.2 f.5	pit	3	15
28. E9 3 sf.2 f.1	large pit	3	10
29. E9 3 sf.2 f.2	large pit	1	2
30. E3 3 sf.1 f.1	pit	3	11
31. E3 3 sf.1 f.4	pit	6	18
32. D2/E2/F2 3 sf.1 f.6	loose soil	48	263
33. E6 2 sf.9 f.1	burnt clay/ pottery	4	16
34. E7 2 sf.4 f.1	clayey floor	1	3
35. E7 2 sf.3 f.1	dark soil	17	69
36. D8 2 sf.2 f.1	yellow/ashy floor	2	6
37. D9 2 sf.2 f.1	yellow/ashy floor		3
38. E9 2 sf.2 f.1	yellow/ashy floor	2	5
39. G5/G6/G7 2 sf.1 f.1	pit	20	81
Total		244	1234

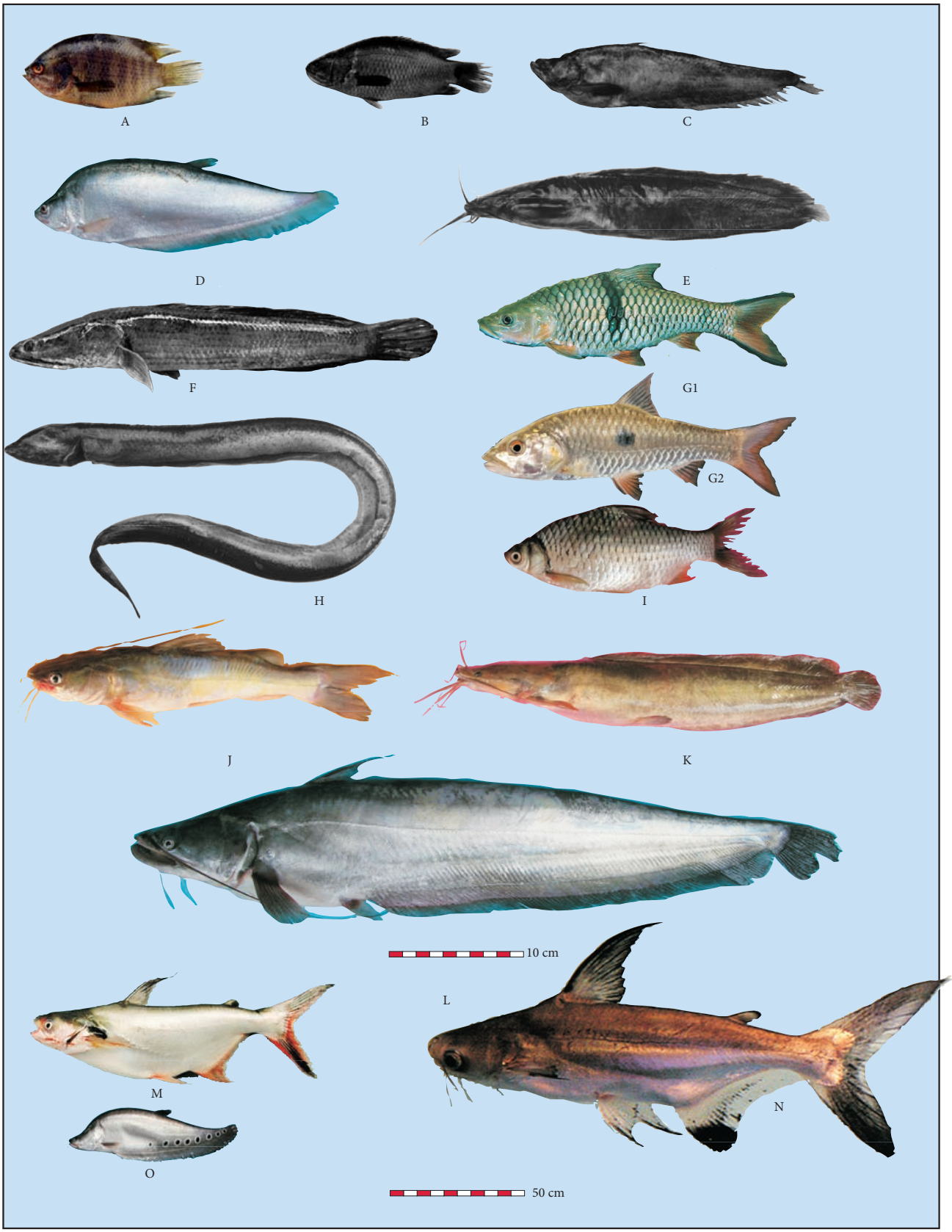


FIG. 4:1 The fish represented at Ban Non Wat. A. *Pristolepis fasciatus*, B. *Anabas testudineus*, C. *Ompok bimaculatus,* D. *Notopterus notopterus*, E. *Clarias macrocephalus*, F. *Channa striata*, G1. *Hampala macrolepidota,* G2. *Hampala dispar,* H. *Monopterus albus*, I. *Barbonymus gonionotus*, J. *Hemibagrus filamentus*, K. *Clarias batrachus*, L. *Wallago attu,* M. *Pangasius larnaudii, N. Pangasius sanitwongsei* O. *Chitala ornata*

THE ANIMAL BONES FROM D8-9 4:2 FEATURE 1

C.F.W. HIGHAM

This feature has been described on page *. It comprised a hard floor containing on its surface, a dense concentration of animal bones, together with over 60 artefacts. The presence of iron knives and whetstones among these suggests that it iwas a place where animals were butchered. Therefore, the species identified, and their status as domestic or wild stock, will reflect the preferences of the early Iron Age inhabitants of Ban Non Wat. The following species were identified.

Bubalus bubalis

The following bones were identified as *Bubalus bubalis,* the water buffalo. It is noted that only certain bones can be distinguished between the water buffalo and cattle.

Metacarpal. All metacarpals identified came from *Bubalus bubalis*. Five were adult or sub-adult, and two were young. They bore the cut marks from butchering (Fig.).

Metatarsal. There are at least six individuals represented. Four were adult or sub-adult, one was young and one was a large large bone but with an unfused epiphysis. Two distal ends had signs of heavy battering and cut marks.

Magnum. All four specimens recovered come from the water buffalo.

Phalanx 1, fore. There are at least five individuals. All are from adult animals.

Phalanx 1 rear. the single bone was split lengthwise down the middle.

Phalanx 2. There are nine complete specimens, all coming from the water buffalo.

Phalanx 3. There are four bones, all from the water buffalo.

The size distribution of the fore phalanges is seen in figure 4:2. The Iron Age specimens are far smaller than those from Neolithic Ban Non Wat attributed to wild animals, but while the same length as the modern water buffalo, they are much more robust. It is suggested that they come from a domestic herd. The phalanges from Iron Age Noen U-Loke are also considerably more robust than their modern counterparts (Fig. 4:2).

Bos

Metatarsal. One individual. The bone was smashed across the diaphysis.

Bubalus bubalis or *Bos*

Given the overwhelming dominance of the water buffalo over cattle in bones where the two can be distinguished, the following bones are almost certainly from the former. However, it is not possible to distinguish between the two on the basis of form.

Astragalus. There are at least six individuals. Two were cut across the centre, and one was smashed into two. One came from a young individual.

Calcaneum. There are at least three individuals, all four specimens come from subadults with no ephyphsis closed.

Tibia. There are the distal ends of at least four individuals. All were smashed across the middle of the bone.

Femur. There are two complete distal ends but both were smashed across the centre of the bone. There are at least three individuals. One is young.

Pelvis. There is one specimen, smashed across the acetabulum.

Humerus. There are at least six individuals. All are large and almost certainly from the water buffalo except one, which is of the size of the domestic cow. All were cut across the diaphysis.

Scapula. At least four individuals are represented, one of them has cut marks.

Radius. There are at least four individuals, all large, and probably water buffalo except for one small individual, which is probably *Bos.*

Mandible. At least five mandibles were recovered. Three adult and two young. One survived complete but others were broken and butchered in antiquity.

Cuboid navicular. There is one complete specimen.

Patella. One butchered patella was recovered.

Tarsals and teeth: Many fragments were recovered.

Sus scrofa

Scapula. There are at least six individuals represented, the bones being cut cut across the neck.

Humerus. The bones of eight individuals were identified, three young, and one subadult with a just fused distal epiphysis.

Tibia. There are at least eight individuals, mainly cut across the middle

Femur. At least four animals represented

Radius. At least five animals represented

Pelvis. Nine fragments have survived.

Calcaneum. Four individuals are represented, three with unfused epiphysis.

Phalanx 1. There are four bones.

Astragalus. there are two specimens.

Metapodials. Six specimens were recovered.

Skull and teeth. Three occipital bones were smashed across.

Mandibles. At least six individuals are represented.

There are also the remains, in addition to the above, of one very young pig comprising the femur, humerus and mandible with deciduous teeth in place and barely worn.

Canis familiaris

TABLE 4:2 *The dimensions of the animal bones from square D8-9 layer 4:2 feature 1*

Species	Bone	L	PW	DW	MW	NW	Br. Ac.
Bubalus bubalis	metacarpal	185	68	76.7	45.4		
	metacarpal		69.3, 64.5, 65.3, 67.8, 63.4	74.9, 73.0, 77.8			
	metatarsal		55.5, 56.5, 52.5, 54.5	74, 72.2			
	magnum	41.0			38.0		
	magnum	40.5			39.0		
	magnum	41.0			37.0		
	phalanx 1 fore	58.2	36.0				
		63.0	39.0				
		63.2	39.0				
		64.0	40.2				
		65.2	39.0				
	phalanx 1 rear	62.0	34.5				
		62.0	32.5				
		63.0	36.0				
		70.0	36.0				
	tibia		108.0	73.0, 71.5, 75.5, 72.0			
	radius			74.0 83.0, 77.0, 78.5, 81.0			
Bos	radius			63.0			
Muntiacus muntjak	tibia		21.8, 22.0, 23.0	23.0			
	magnum	21.0					
Medium deer	astragalus	44.9, 43.5, 40.6, 43.5, 39.5					
	radius		38.5				
	tibia			34.0, 34.5, 35.0			
	metacarpal		32.5	26.0, 29.5, 28.0			
	metatarsal		26.5, 28.0	29.2			
	phalanx 1	47.5, 47.0, 50.0					
	scapula					21.5, 27.0	
	pelvis						28.5
	phalanx 2	36.0	14.0				
Cervus unicolor	calcaneum	99.0					
	tibia		55.0				
	radius		62.0				
	magnum				30.0		
Canis familiaris	humerus			30.0, 30.6			
	pelvis						18.0, 19.8
	scapula					21.0	

L: length, PW: proximal width, DW: distal width, MW: minimum width, NW: neck width, Br Ac. width of acetabulum

Three individuals of the domestic dog are represented from the humerus and four from the maxilla. There are also four individuals represented by the mandible. All are adult. The other surviving bones are the proximal end of a radius, two pelvis fragments, a scapula, femur and tibia.

Muntiacus muntjak
Three individuals of this small deer are represented, by the tibia, radius, magnum, scapula, metatarsal and humerus.

Axis porcinus or *Cervus eldi*
Since it is impossible to distinguish readily between these two species on the basis of size, they are described as medium-sized deer. On the basis of the tibia and the astragalus, there are at least four individuals. The following anatomical bones were recovered.
Calcaneum: two specimens, one with an unfused epiphysis.
Radius: one proximal end.
Tibia: six bones, three left and three right.
Metacarpal: four bones.
Metatarsal: two bones.
Phalanx 1: three specimens.
Phalanx 2: one complete bone
Femur: two distal end fragments.
Humerus: one distal end fragment.
Scapula: Ttwo specimens.
Cuboid navicular: one bone.
Pelvis: one fragment of acebulum.
Femur: one distal end fragment.
Antler: there are two antlers, both still attached to the cranium.

Cervus unicolor
The large sambar deer is represented by two individual animals on the basis of the calcaneum. There is also one tibia, a radius, metatarsal, upper molar and magnum.

Other species identified comprise turtle, 7 carapace fragments, frog, 1 humerus, rat, a tibia and femur, the dentary of a swamp eel and some fish vertebrae.

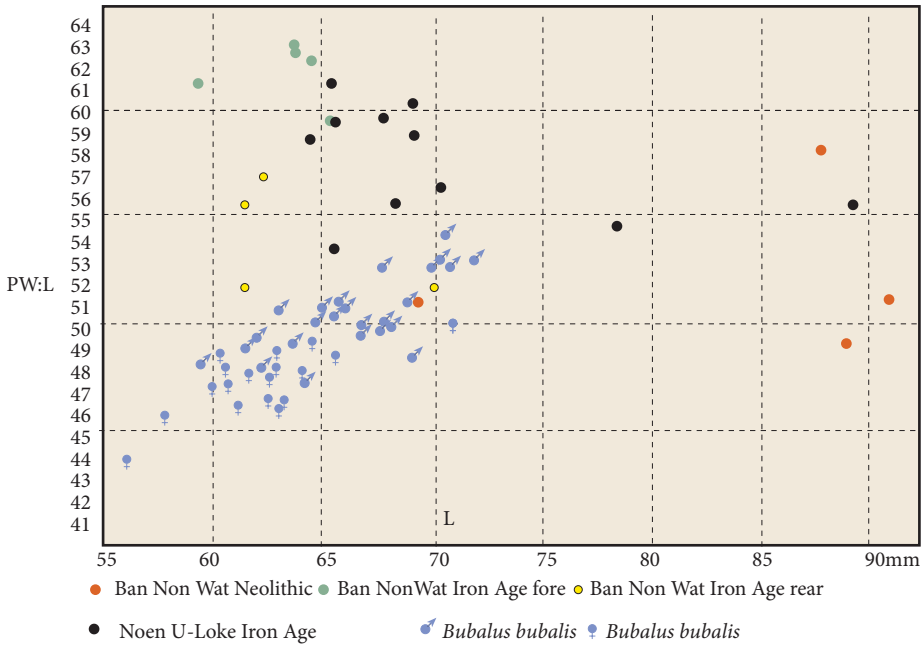


FIG. 4:2 The size distribution of *Bubalus bubalis* first phalanges from Ban Non Wat and modern animals

V THE PHIMAI BLACK CERAMIC

ROSE NICOL GEARY

Phimai black pottery is a rice chaff tempered earthenware that is specific to the late Iron Age of the upper Mun River valley of the Khorat Plateau in northeast Thailand. The pottery is distinctive in its colour, form and decoration; vessels are characteristically black or grey with burnished lines in several patterns on both the interior and the exterior of delicate, thin-walled bowls or jars. Phimai black is one of several regional prehistoric pottery traditions that are present across the Plateau. The pottery has played a major role in the archaeology of the Mun River valley due to its ubiquity throughout the area in late prehistoric contexts. It has been used to characterise the 'Phimai Phase', relating to the Southeast Asian Iron Age (500 BC-AD 500) in Welch and McNeill's (1991a) regional chronology.

This study will consider the hypothesis that Phimai black was potentially a product of specialised manufacture. Many authors have commented on the standardised appearance and restricted distribution of Phimai black pottery and suggested the possibility of specialised manufacture at a specific location (Higham 1996:224, 2002:201-202; O'Reilly 2000:10-11; Welch 1984:147; Welch and McNeill 1991a:332, 2004:540). However no efforts have been made towards measuring the degree of standardisation in Phimai black samples and relating the results to the possibility of craft specialisation in the upper Mun River valley. Standardisation is generally assumed to be correlated to specialisation in craft production, and craft specialisation is generally assumed to be a concomitant of social ranking and political centralisation (Rice 1981, 1987, 1991). Welch and McNeill have noted that 'the great similarity in the paste, form, and decoration of the Phimai black bowls found at numerous sites suggests centralised manufacture of Phimai black bowls and their subsequent distribution over much of the upper Mun River valley' (Welch and McNeill 1990:119). Therefore measuring standardisation in Phimai Black samples could contribute to existing interpretations of sociopolitical development in the upper Mun River valley.

This research proposes to measure the degree of standardisation in an assemblage of Phimai black pottery from Ban Non Wat. The form and fabric of the vessels from Ban Non Wat and samples from the nearby Iron Age sites of Noen U-Loke and Ban Suai will be assessed. The form of the vessels will be evaluated using the method proposed by Feinman *et. al.* (1984) and the fabric will be analysed using electron microscopy. The results of this assessment will be applied to Rice's (1981) model correlating pottery standardisation, craft specialisation and sociopolitical development. In assessing standardisation and applying this to Rice's model, it is hoped to construct a model concerned with Phimai black production and the organisation of the producing society.

THE MATERIAL FROM BAN NON WAT

The 2006/2007 field season held from December to March at the village of Ban Non Wat near Phimai in Northeast Thailand excavated a 144m² area from the surface down to sterile soil. In the third spit of layer 3, corresponding chronologically with the late Iron Age, a large feature (approximately 4.5m at its greatest length) was uncovered extending across the centre of the excavation area and covering aspects of four units. This feature consisted of a dense concentration of pottery, the majority of which was made up of the Phimai black complex (Fig. 5:1). Iron artefacts, faunal remains, burnt clay and iron slag were also included in this feature. Upon investigation it was demonstrated that the feature continued to a depth of about 50cm but reduced in area (Fig. 5:2). The feature was conspicuous in that the density of the concentration was in direct contrast to the remaining excavation area which was characterised by post holes, widely-scattered pots and midden deposits.

The feature was clearly occupational in context, being situated above the latest Iron Age burials and characterised by broken pottery in what appears to be a rubbish pit. This represents an important aspect of this study. Previous research on Thai ceramics has tended to concentrate on pottery from mortuary contexts and little effort has been directed towards pottery from occupational deposits. This is primarily due to the difficulty in procuring a comprehensive and well-preserved sample of occupational pottery, especially when compared with the relative abundance of mortuary material. Therefore the pottery from this feature represents a rare opportunity to conduct analysis on pottery from outside the mortuary context and thus contribute to a more holistic understanding of Thai ceramics in late prehistory.

The feature was excavated in three exposures as the pottery concentration deepened and reduced in area. In the first exposure ceramic fragments that had potential to be reconstructed into whole pots due to their location and appearance were identified and assigned catalogue numbers. These were excavated separately and bagged individually. The excess pot sherds were separated into loosely associated groups and then removed and bagged in these groups in order to aid later reconstruction. All pottery was then washed. This process was repeated when removing the second and third exposures. Artefacts as-



FIG. 5:1 The upper part of the feature under analysis, showing the broken Phimai black vessels. Scale 50 cm



FIG. 5:2 The lower part of the feature under analysis, showing the broken Phimai black vessels and thin shell midden. Scale 50 cm

sociated with the feature were excavated, cleaned and assigned catalogue numbers as they were removed. Faunal remains were separated into shell and bone material and bagged. A soil sample of five buckets from each unit and spit associated with the feature were wet sieved. The feature extended over four units so soil samples were taken from spits below and above the feature from each unit.

The pottery

Following the removal of all material contained in the feature, the pottery was washed and sorted by appearance and relative location within the feature. Fragments already catalogued as whole vessels were kept separate. Reconstruction was attempted on these vessels first with great success. Following this, reconstruction was attempted on the remaining sherds with less success; however this process still yielded a number of partial vessels of great use to this study. Significantly reconstructed vessels were then catalogued, measured and photographed. Following this process, diagnostic rims and bases were sorted from the excess ceramic material for the purpose of quantification. A standard rim-diameter quantification chart was used to identify the approximate number of vessels contained within the feature and the relative abundance of Phimai black vessels to non-Phimai black vessels. Rims from Phimai black vessels were distinguished by grey or black matte surface and burnishing streaks which characteristically occur on the rim (Solheim and Ayres 1979) while rims from non-Phimai black vessels tended to be red or tan in colour. This quantification indicated that Phimai black vessels made up approximately 70% of the ceramic assemblage from the excavated feature. The number of vessels totalled 245.

Variation in lip type and decoration on the Phimai black examples was noted and photographed. Due to the severely fragmented nature of the assemblage, lip type was selected for analysis as it represented the most reliable source of distinction for vessel forms. Decoration types were also selected as they provide another reliable source of distinction. Of the 52 partially reconstructed vessels that were catalogued, 41 were identified as Phimai black. These are used in this study as an indication of Phimai black form within the assemblage. Six Phimai black sherds were taken from the assemblage for electron microprobe analysis. They were collected on criteria similar to rim identification; grey or black matte surface and burnishing streaks, so as to be sure that Phimai black fabric only was to be analysed. In order to ensure the sherd samples covered the range of the excavated feature and were not taken from one location, two sherds were selected from each of the three of the four excavation units that the feature covered. Finally the excess ceramic material that was not catalogued was weighed to establish the approximate amount of ceramic material contained in the assemblage. The total weight of the excess ceramic material was 47.4kg.

The artefacts

A range of artefacts was recovered from the excavated feature. Several iron objects including a point, a sickle and two iron knives one of which was bone-hafted were found. A clay pellet, an inset for iron working and a crucible fragment made up the clay artefacts. The remaining items were a glass bead and a bronze finger ring.

The faunal remains

Faunal remains were divided into bone and shell and the total amount of each was weighed. Species represented within the collection were then identified. The total weight of animal bone represented in the feature was 0.7kg. All bone was in an extremely fragmented condition and some examples demonstrated obvious butchery marks. The animals represented by the sample are typical of prehistoric faunal remains in Southeast Asia; cow, pig, dog and deer. The total weight of the shell remains was 0.7kg. The molluscs represented in this material were *Pseudodon* sp., *Adamietta* sp., *Pila ampulacea* and *Filopaludina*, the first being a bivalve and the other three gastropods.

The clay

The lumps of clay recovered from the excavated feature were weighed and totalled 7.5kg. The material was assessed and identified. The material consisted of air dried alluvium that was mined as clay, natural silty bedrock, daub that had been tempered with rice and roasted (this material possibly represents the remains of wall plaster from a structure) and laterite, a clay heavy with iron nodules that is soft when mined and dries to a very hard rock. Finally a lump of clay was recovered which appeared to be similar to Phimai black fabric in its colour and texture. A sample of this clay was taken for electron microprobe analysis to determine whether it was similar in chemical composition to the clay used to make Phimai black pottery. Similarity in raw material could suggest that the pottery was manufactured at the site and have an impact on the issue of centralised production.

The iron slag

Thirty-four cakes of iron smithing slag were recovered, with a total weight of 2.3kg. Each represents the debris of individual smithing operations.

The feature:summary

The feature was located in a late Iron Age occupation level. The material content of the feature was dominated by broken pottery vessels, primarily of Phimai black type, and also contained butchered animal bone, shell remains, a small number of artifacts and dried clay and slag. The nature and density of this material and its fragmentary state suggests that it was discarded as rubbish by the inhabitants of the site. This is supported by the shape of the feature, which upon excavation was found to contract as it got deeper indicating the existence of a shallow pit used

for refuse. When the feature was removed, what appeared to be an animal butchery floor was recovered beneath it. It is possible that this floor was filled in when it was no longer functional leaving a shallow depression into which refuse was later discarded.

The Material from Ban Suai and Noen U-Loke

The Phimai black pottery excavated at Ban Non Wat forms the primary assemblage from which information in this study is taken. Ceramic material from Ban Suai and Noen U-Loke will provide the basis to compare aspects of Phimai black vessels from Ban Non Wat and assess the level of standardisation apparent from this comparison. Aspects of style and form from the Ban Non Wat Phimai black vessels were assessed against available information concerning Phimai black vessels from Ban Suai and Noen U-Loke. In the case of Ban Suai this means the typology constructed by Solheim and Ayres (1979) and refined by Welch and McNeill (2004). This typology was constructed from Phimai black vessels found in occupational contexts and thus of utilitarian function. The published report of the Noen U-Loke excavation (Higham *et. al.* 2007) provides photographic evidence of Phimai black vessels found in both mortuary and occupational contexts at this site and was used for comparison of style and form. Given that Phimai black is such a particular and apparently standardised ceramic complex, and that it has a wide and even distribution throughout industrial, mortuary and occupational contexts in the upper Mun River valley, it is considered reasonable that occupational and mortuary vessels be compared. The material from Ban Suai and Noen U-Loke are used principally to contextualise the Phimai black assemblage excavated at Ban Non Wat. This material provides comparative data by which aspects of style and form may be assessed in a broader range of material and levels of standardisation may be further understood.

Similarly, samples from Phimai black ceramics from both Ban Suai and Noen U-Loke were used for fabric comparison with the samples taken from Ban Non Wat. Again, six sherds were taken for analysis from the assemblage of each site. The samples from Ban Suai were held at the Phimai office of the Fine Arts Department and the Noen U-Loke samples were taken from a collection of Noen U-Loke ceramics held in storage at Ban Non Wat. The criteria used to select sherds at Ban Non Wat were followed and from each assemblage two sherds were selected from three provenances to maintain a broad range of material. Therefore a total of eighteen sherd samples were taken from three provenances from each of the three sites. All samples were selected from occupational contexts.

STYLE AND FORM ASSESSMENT

This assessment of stylistic and formal features of Phimai black pottery follows the example of Feinmann *et. al.* (1984) in employing simple but relevant processes of ceramic evaluation. Feinmann studied ceramic traditions of the Monte Alban culture in Oaxaca Valley, Mexico, involving several ceramic traditions over time utilising assemblages collected over the entire valley, and included consideration of pottery production locations. However a number of methods were used to assess different aspects of variability in the assemblage and, while including statistical processes, the study also utilised a more simplistic approach in the initial evaluation of the ceramic traditions. The nature and number of traditionally defined types dated to each phase were important considerations in the preliminary assessment. Quantification of relative abundance of the most common pottery vessels in each phase was also undertaken.

These processes are also utilised in this study to assess features of the ceramic sample. However they are applied to an assemblage that was recovered from one time and place rather than to several assemblages covering a large chronological period and geographic area. Formal and stylistic features of the Phimai black vessels in the Ban Non Wat assemblage are assessed and quantified in order to illustrate major types. These features are rim form, vessel form and decoration. Due to the fragmentary nature of the assemblage, the rim is the most abundant diagnostic part and is therefore the most reliable source of distinction between vessel types. Assessment of lip form is supplemented when possible by vessel form from the available vessel profiles of the reconstructed and catalogued vessels. Decoration types are also noted. It has already been established by previous research that Phimai black vessels appear to possess a standardised set of formal and stylistic features (Higham 1996:224, 2002:201-202; O'Reilly 2000:10-11; Welch 1984:147; Welch and McNeill 1991b:332, 1990:159, 2004:540). It is therefore expected that categorization of features in the Ban Non Wat Phimai black ceramics be reasonably simple and able to be quantified. Quantifications are compared in order to assess the relative abundance of types, and therefore the most common types may be identified.

Common formal and stylistic features are then compared with the Ban Suai typology and the photographic material from Noen U-Loke in order to illustrate whether these features are common to other spatially distinct samples of Phimai black. This contextualises the Ban Non Wat sample and supports conclusions drawn from that sample concerning standardisation. Therefore inferences can be made from the assessment of formal and stylistic features despite the absence of complex statistical processes. This is expected to confirm those categories already noted in the Phimai black typology (Solheim and Ayres 1979; Welch and McNeill 2004), establish any unrecognised types and introduce fabric analysis to the body of work on Phimai black ceramics. It must also be mentioned that the small sample size and selection may skew the results. However a complete survey of all available Phimai black material from the upper Mun River valley is far beyond the scope

of this study. Instead it is hoped to offer some small insight into Phimai black production and provide hypotheses for further testing.

FABRIC ANALYSIS

Traditional ceramic assessment will be integrated with the analysis of ceramic composition. Chemical composition analysis of Phimai black samples from all three sites forms a major contribution towards assessing standardisation in Phimai black pottery and thus the possibility of craft specialisation in the upper Mun River valley. The assessment of formal and stylistic aspects of the available assemblage does not undergo any objective measures or indices but rather consists of characterisation and comparison between materials. The analysis of ceramic fabric will provide a form of assessment that will undergo rigorous scientific and statistical measures, thus providing a more objective methodological component to offset any subjectivity in the assessment of formal and stylistic features.

The present research utilises electron microprobe technology to analyse the chemical composition of Phimai black fabric from the eighteen samples collected from Ban Non Wat, Ban Suai and Noen U-Loke and the one clay sample from Ban Non Wat. It is believed that use of the electron microprobe provides a superior means of investigating patterns in the fabric of Phimai black ceramics and thus providing information concerning standardisation of the ceramic complex. The electron microprobe measures energy emitted by individual elements and pinpoints areas within the sample, thus permitting discrimination between the clay matrix and non-plastic inclusions. Therefore the electron microprobe provides a specific means of ascertaining the compositional nature of the ceramic fabric.

The electron microprobe is a form of electron microscopy that utilises aspects of scanning electron microscopy (SEM), a process in which electrons directed at the sample scatter in different ways sending signals that, after magnification, reach a fluorescent screen thus providing a magnified image. The electron beam is sharply focused and able to move across the sample to analyse different areas. Essentially the electron microprobe first uses SEM apparatus to bombard the specimen with a focused beam of high energy electrons to scan the specimen surface and produce the image. When the beam is focused on a particular point in the specimen, energy is emitted at wavelengths characteristic of the elements contained in the point that the beam excites. This energy is analysed in terms of these characteristic wavelengths by an energy dispersive spectrometer and elements with atomic numbers larger than 12 (magnesium) are detected and listed as oxide percentages. Therefore the electron microprobe combines the image produced by scanning electron microscopy with the element wavelength identification. This provides a means of selecting specific areas of the sample and measuring its elemental composition. The primary advantage of this technique is its 'extraordinary versatility; it can be used for both point analyses and composite or bulk analyses and to analyse particular tiny points of a specimen, such as inclusions, glazes or pigments (Rice 1987:402).

Preparation of samples for electron microprobe analysis involved sectioning of the original sherd to obtain pieces small enough to be analysed. The electron microprobe analyses samples after they are placed in a vacuum chamber in the form of circular briquettes, 2.5cm in diameter, which hold a maximum of three ceramic samples. Initially sherds were washed and small pieces approximately 1.5cm in length were cut using a 8" diamond edge saw. These small samples were left to dry overnight in an oven at 60°C to ensure no water remained in the sample. Samples were then impregnated with epoxy resin and hardener glue by placing two or three samples in a brass mould which was then filled with five parts resin to one part glue. The moulds were left for a minimum of twelve hours at room temperature for the resin to polymerise and form briquettes. The surface of the briquette was ground down using 60 mesh and 120 mesh diamond dust grinders, 120 mesh dry sandpaper and wet silicon carbide dust in succession until the cut surface of the sample was exposed. Briquettes were then polished using 1μ aluminium particles in an automatic lapping and polishing unit and examined under microscope at x40 magnification. All sample surfaces must be highly polished as 'surface irregularities affect the matrix corrections…the take of angles of X-rays from rough surfaces will affect their detection and absorption rates' (Summerhayes 2000:38). All briquette surfaces were cleaned using ethanol and acetone and finally coated with carbon under vacuum to supply a conductive layer needed to 'provide a path for the probe current to flow to earth' (Reed 1997:178 cited in Summerhayes 2000:38).

Samples were analysed on the electron microprobe (JEOL JxA 8600 Superprobe) housed in the Department of Geology at the University of Otago. Three briquettes were able to be simultaneously clamped in a specimen holder and entered into the microprobe vacuum chamber to be analysed. The sample was viewed through both the optical microscope used for viewing the samples in the vacuum chamber and the video camera attached to the microprobe. Points were selected for analysis by moving the specimen holder using an X and Y axis precision control mechanism until the point for analysis was situated under the electron beam. On the microprobe the beam current was set at 1nA and 15KV accelerating voltage was applied. Analysis consisted of viewing the sample on screen through a wavelength dispersive spectrometer (WDS) to ascertain spots for wavelength measurement. Once this was done an energy dispersive spectrometer (EDS) measured energy intensity emitted by the point under analysis. Moran Scientific Software was then used to present and organise the results. Standards were employed to ensure compatibility of analyses and allow cor-

rections to be made. The count rate from a standard of a material where the composition is known is taken to compare the rate of counts in the sample (Summerhayes 2000:38). Standards were standardised at the beginning of each session and re-analysed at the end. A maximum of eight inclusion points and five clay matrix points were subjected to analysis for each sample. Inclusions were selected due to their obviously contrasting appearance to the body of the sample. Finally, the following elements (as oxides) were measured in the analysis:Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe and Ni.

Once the electron microprobe analysis was completed the next step was to transform the results of the EDS measurements taken of the clay matrix into meaningful information that could be applied to the research question. This required the definition of groups within the available chemical data to ascertain the degree of similarity between the clay used in each sample. Therefore the definition of these groups must make both chemical and archaeological sense, that is, behavioural influences must be considered alongside elemental characteristics (Summerhayes 2000:39). The concept of Chemical Paste Compositional Reference Units (CPCRUs) (Bishop *et al.* 1982) is useful in the grouping of pottery by elemental composition. This concept equates with the resulting groups of elemental data received from microprobe analysis. Analysis of these data is performed using multivariate techniques to organise the large number of elemental variables produced by the chemical composition analysis.

In this study Principal Components Analysis (PCA) and hierarchical clustering analysis using the Group Average method were used. PCA 'permits the compression of multivariate compositional data into a few dimensions' (Tite 1994:199) by identifying major clusters and group structure. The first component should account for the maximum variance in the data with each successive component accounting for the maximum of remaining variation. The 'major aim of PCA is to reduce the number of attributes to a few dimensions so that firstly, the data can be plotted and clusters can be identified visually, and secondly, an element's contribution to the hierarchical clustering method…can be assessed' (Summerhayes 2000:39). The scores from the PCA were then used for hierarchical clustering analysis using the Group Average method. In this technique the compositional resemblance between samples is assessed using Euclidean distance as a similarity measure and a dendrogram is produced which links together samples with the greatest similarities. CPRCUs displayed by PCA were compared with dendrograms to assess the universality of these groupings.

Finally the EDS measurements taken from the non-plastic inclusions that were analysed in each sample were identified. This was done to elucidate the nature of the temper used in the ceramic production process. Oxide measurements and the physical appearance of the inclusion under magnification were used to determine whether the inclusion was organic or mineral. Organic inclusions were identified by comparison to literature concerning microscopic research performed on organic remains in archaeological contexts, primarily Harvey and Fuller (2005) and Vincent (2004). Minerals were identified by comparison of oxide measurements to previous analyses of minerals published in Deer *et. al.* (1992).

The assessment of formal, stylistic and fabric features of the Phimai black material in this study is undertaken to generate information that can be used to evaluate standardisation and craft specialisation in the upper Mun River valley in the Iron Age. Assessment of stylistic and formal features of the vessels from Ban Non Wat, when compared against similar information from Ban Suai and Noen U-Loke, provide a basic indication of the level of standardisation inherent in Phimai black production. This information is supplemented by scientific analysis of the chemical composition of the raw material and non-plastic inclusions of the fabric of Phimai black samples using the electron microprobe and multivariate statistical methods. These results are applied to Rice's 1991 model correlating standardisation in archaeological ceramic material to craft specialisation and sociopolitical development. Implications gained from this process are set against existing interpretations of social complexity that existed in the upper Mun River valley in late prehistory in order to construct hypotheses concerning ceramic production and social organisation.

FORMAL AND STYLISTIC REVIEW

Ban Non Wat

Before comparison between site assemblages was undertaken, the Phimai black material from Ban Non Wat was itself assessed in order to ascertain the degree of intra-site similarity. First the material was quantified using a rim chart, then all sherds possessing diagnostic rim parts were sorted into types based on lip variation. The quantification indicated that approximately 245 pots were contained in this assemblage. This total included both Phimai black and non-Phimai black material. The assemblage was sorted on the basis of colour and decoration, Phimai black material being distinctively grey or black matte with burnishing streaks. This process demonstrated that 172 of the pots included in the assemblage belonged to the Phimai black type. The rim sherds of the Phimai black material were assessed and sorted into fifteen groups based on lip variation. These rim types and the distribution of the ceramic material amongst them are outlined in table 5:1.

The categorisation of rim types into only fifteen different forms indicates that stylistic variation within this assemblage is limited. Assessment of the relative abundance of rim types included in this assemblage provides further indication of a high degree of similarity within the Ban Non Wat Phimai black material. Higher abundance of a certain rim type would logically correspond with greater

production of that type. Of course, sampling error must be considered when making these assumptions; it is possible that the quantities in this study are biased against particular types given that the entire ceramic assemblage of this site was not sampled. However the scope of the present research is not wide enough to include such an extensive range of material and is particularly focused on the assemblage recovered from the feature being considered. Therefore conclusions concerning the relative abundance of Phimai black rim types will be drawn from the available information.

The relative quantities of Phimai black rim types from the assemblage are displayed in figure 5:7. The most common types (those that fall between the 20-30 abundance range) are Exterior Ledge and Straight Everted in reducing order. Those that fall in the 10-20 abundance range are Rounded, Hollow, Large Square Ledge, Interior Ledge and Circular. Eight rim types fall within the 0-10 abundance range; Quadrupartite, Double Ledge, Large Overhanging Ledge, Tripartite, Small Straight Everted, Large Triangular Ledge, Interior Step, and Ridged Everted. It can therefore be suggested that vessels featuring Exterior Ledge and Straight Everted rim types were either the most commonly produced or alternatively the most commonly consumed, while other vessels featuring the remaining rim types were either produced or consumed in differential quantities.

It is possible on a theoretical basis to connect particular rim types with particular vessel types; if production of Phimai black vessels was in any way standardised it is logical to associate particular stylistic features with particular forms. In order to assess this possibility within the Ban Non Wat assemblage, rim diameters were measured within respective rim types (Fig. 5:4). It is clear from these data that variation of rim diameter exists within rim types. However the data also demonstrate that despite this range of variation, the majority of examples cluster around particular diameter sizes. This suggests that the majority of vessels produced which feature a particular rim type, were also produced within a particular range of rim diameters.

TABLE 5:1 *Phimai black rim types from the Ban Non Wat assemblage*

Phimai Black	n	Phimai Black	n
Straight Everted	26	Exterior Ledge	29
Double Ledge	7	Quadrupartite	10
Tripartite	4	Rounded	19
Large Triangular Ledge	2	Large Overhanging Lip	7
Hollow	17	Large Square Ledge	16
Interior Ledge	16	Interior Step	2
Circular	13	Ridged Everted	1
Small Straight Everted	3		
Total	172		

For example, while the range of rim diameters within the Straight Everted rim type extended from 130 to 310mm, the vast majority of examples that were measured clustered around the 200 to 230mm range. These results suggest that rim type corresponds to a particular range of rim diameter. This in turn indicates that rim type can be linked to a particular vessel size and therefore potentially a particular vessel form. It may be inferred that Phimai black vessels featuring particular rim types were being produced to a standardised size and form. Given that the production process featured hand manufacture rather than use of pottery wheels, it is understandable that a small range of rim diameters is evident within rim types. However, generally these data supports the hypothesis that Phimai black vessels, at least those at Ban Non Wat, were being manufactured according to a standard production process.

The analysis of rim types and diameters of the Phimai black vessels from Ban Non Wat has suggested the manufacture of standardised vessels in terms of vessel form and style. The relative abundance of rim types indicates greater consumption of certain vessels. The theoretical correspondence of particular rim types to particular

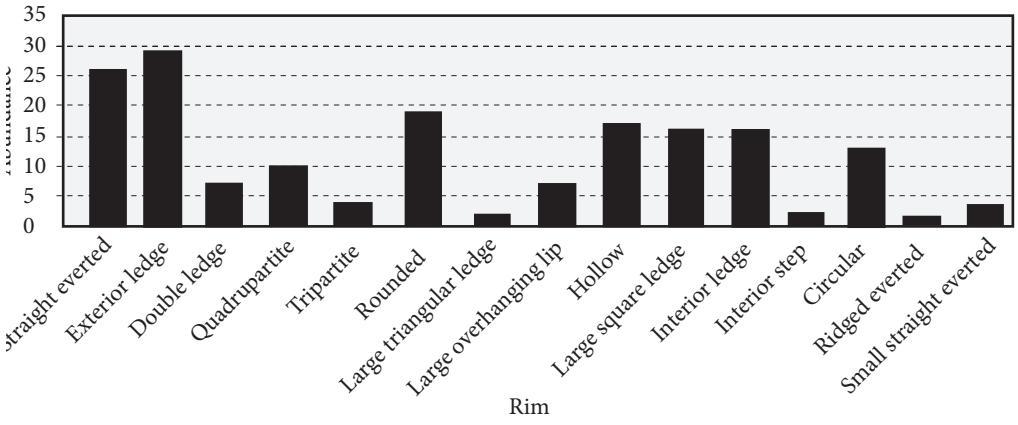


FIG. 5:3 Relative abundance of Phimai black rim types from Ban Non Wat.

vessel forms is supported by the relation of rim types to rim diameters, indicating a standardised manufacturing procedure which associated rim type and diameter and thus potentially rim type and vessel form. The following discussion will consider the results of the inter-site assessment undertaken on formal and stylistic features of Phimai black ceramics. Reconstructed vessels from Ban Non Wat and Noen U-Loke will be compared to the Phimai black typology constructed from the Ban Suai assemblage. This assessment will provide an indication of the similarity of Phimai black form and style between the different communities.

Ban Suai

Phimai black vessel forms and decoration from the Ban Suai assemblage were defined by Solheim (1965) and Solheim and Ayres (1979). This typology was later refined by Welch and McNeill (2004) but the vessel and decoration types originally proposed remain essentially the same. The typology will be outlined in order to describe the physical appearance of the Ban Suai Phimai black ceramics and to provide the necessary descriptive background against which the results of the inter-site comparison may be judged. Five forms of bowl and two forms of jar were identified in the Ban Suai material as were eight major decoration types as follows:

Bowls

a) small, shallow bowls with straight sides

These bowls have an average height of 4.5-5.5cm and an average rim diameter of 11-15cm. The lip is rounded or flat and sometimes curved inward. The walls taper to a concave base 5-6cm in diameter. The walls vary in the degree of flare but all are straight. Sometimes these bowls possess low ring feet.

b) small, shallow bowls with curved sides

These bowls have an average height of 3.5cm and an average rim diameter of 9cm. The lip is most often rounded. The walls are curved from the rim around to the base, forming a gently rounded base despite which the vessel is able to stand freely.

c) angled bowls

These bowls have an average height of 5-7.5cm and an average rim diameter of 14-18cm. Three varieties of this bowl have been identified in the Ban Suai assemblage but all possess a distinctive angle between the upper rim and the bowl proper and concave or ring foot bases. The first variety is distinguished by a straight, vertical rim, a rounded or flat lip and a body that begins with an abrupt change in orientation from the rim and follows this angle. The second variety differs from the first variety in its straight, inverted rim and rounded lip. No whole example of the third variety of angled bowl was recovered from Ban Suai but assessment of certain sherds has suggested a short, straight everted rim and large channels on both sides immediately below the rim and extending down the body.

d) wide shallow bowl

Only one example of this type was recovered from Ban Suai and is described by Solheim (1965:252-254; Solheim and Ayres 1974:71) as having a rim diameter of 38-40cm and a wide, flat base.

e) large deep bowls

These bowls feature a gently rounded rim that tapers gently down to a flat, concave or ring-foot base. These vessels are essentially the same as the small, shallow bowls with straight sides but significantly larger in height and rim diameter.

Jars

a) small, globular jars

These jars are distinguished by a completely globular body combined with a short, everted rim. Small, globular jars have an average rim diameter of 10-12cm.

b) large, globular jars

These jars have an average rim diameter of 20cm. Rims are either straight vertical, straight everted or curved everted with rounded, flat or concave lips. Shoulders are generally not defined but some examples show rounded shoulders or shoulders angling towards the rim like a fat neck. The body shape ranges from globular to heart-shaped, the shoulders sloping down towards the body then curving inwards towards the rounded base.

Decoration

a) horizontal burnishing

Burnishing streaks that run horizontally

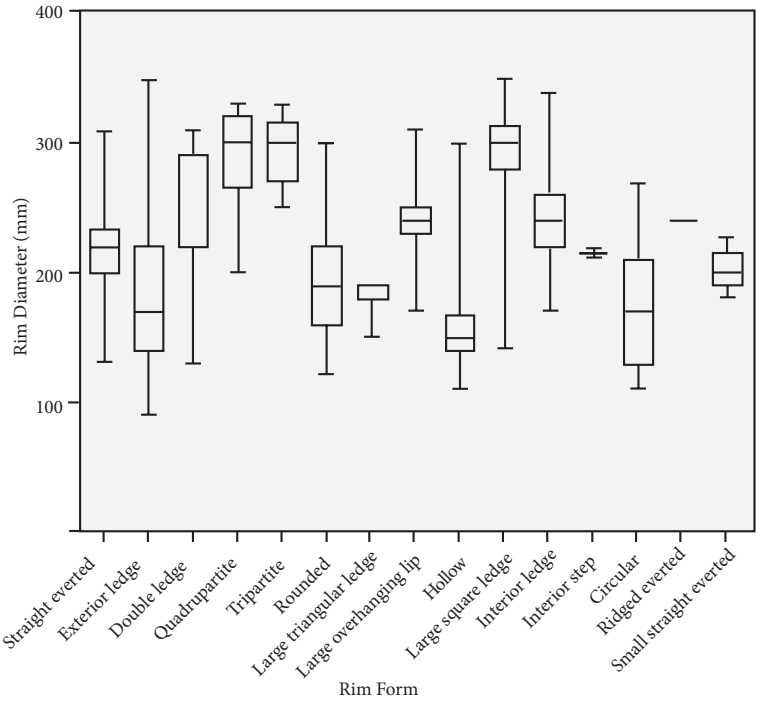


FIG. 5:4 Rim diameter ranges of Phimai black rim forms from Ban Non Wat

around the vessel. It is the most common form of decoration and generally occurs on the interior and exterior rims and bodies of both bowls and jars.

b) radial burnishing

Diagonal or vertical burnishing streaks that run from below the lip converging towards the centre. This generally occurs on the interior rims and bodies of bowls.

c) cross-hatch burnishing

Burnishing streaks running diagonal or perpendicular to the rim crossed with burnishing streaks running parallel to the rim. This generally occurs on the interior rims and bodies of bowls.

d) spiral burnishing

One continuous burnishing streak spiralling out from the centre of the base. This decoration type is found on interior bowl bases.

e) lenticular burnishing

Repeating biconvex, lens-shaped burnishing streaks contained one within the other. Like spiral burnishing this is most often found on interior bowl bases.

f) polishing

Horizontal burnish streaks performed so closely together they form a uniform glossy, black surface. This decoration type generally occurs on the on the interior and exterior rims, exterior shoulders and bodies of both bowls and jars.

g) punctuates

Rows of small, hollow circles impressed into the vessel using a hollow instrument such as bamboo or bird-bone. Punctuates can occur in single, double or triple rows and are found on the exterior shoulders and necks of jars.

h) raised bands

Narrow bands of raised clay that occur in tandem with punctuates to accentuate rows of the latter design. They occur on the exterior shoulders and necks of jars.

It is demonstrated in this typology that formal and stylistic variation within the Ban Suai assemblage is minimal. Therefore intra-site variation at Ban Suai is similar to the circumstances at the Ban Non Wat assemblage discussed above. The respective assemblages from both sites, although assessed by different methods, display significant similarity. The following discussion will review the assessment of the inter-site comparison of ceramic material to ascertain whether this suggestion of standardised production was shared between communities or whether they were discrete occurrences. Regional ceramic standardisation has already been considered a likely circumstance. Phimai black pottery has been interpreted as a regional ceramic tradition, implying a certain level of similarity in the material. The purpose of the following discussion is to confirm and refine the degree of similarity in the formal and stylistic features of the Phimai black material from Ban Non Wat, Noen U-Loke and Ban Suai.

INTER-SITE COMPARISON OF PHIMAI BLACK MATERIAL

The reconstructed Phimai black vessels from the Ban Non Wat and Noen U-Loke assemblages were compared against typology derived from the Ban Suai material. Vessels were assessed as to whether they demonstrated the formal and stylistic features described by Solheim and Ayres (1979) and Welch and McNeill (2004) as diagnostic of the Phimai black ceramic tradition. The material from both Ban Non Wat and Noen U-Loke fell easily into the formal categories proposed by the typology (Table 5:2).

While the majority of reconstructed vessels included in the Ban Non Wat and Noen U-Loke assemblages were easily categorised into the forms described from Ban Suai, some discrepancies were identified during comparison. The one vessel form specific to Ban Suai, the wide, shallow bowl, was acknowledged by Solheim and Ayres (1974:71) as unusual and probably not a common Phimai black form. The assemblage from Ban Non Wat did not possess any angled bowls of the second or third variety. However several examples of the first variety were identified, indicating that the angled bowl form was familiar to the community. No large, deep bowls were found in the Ban Non Wat material while only two examples of this form were identified in the much larger sample from Noen U-Loke. This indicates that large, deep bowls may not have been produced in much abundance. The Noen U-Loke assemblage did not possess any examples of the third variety of angled bowl either. It is worth reiterating that no complete vessel of this form was actually identified at Ban Suai and Solheim and Ayre's categorisation was therefore tentative (Solheim and Ayres 1974:70). It is possible that the third variety of angled bowl was not actually a discrete form within itself, and ceramic evidence used for its proposition was rather a stylistic variation of the first and second varieties.

Three vessel forms were identified in the Ban Non Wat and Noen U-Loke assemblages that were not mentioned in the Ban Suai typology. The first is ambiguous, falling between two categories. Vessels of this form have the general appearance of the small, shallow bowl with curved sides. However the sides fall straight from the rim for a few centimetres before angling in to a rounded base. These vessels therefore possess the fundamental feature of angled bowls, but Solheim and Ayres state that angled bowls possess concave or ring-foot bases (Solheim and Ayres 1974:70). This form of bowl is therefore either a slight variation on the small, shallow bowl with curved sides, or a form of angled bowl not identified within the Ban Suai assemblage. Two forms of jar were also identified in these assemblages that were not present in the Ban Suai material. The first, labelled 'large, tapered jar' in table 5:2, is a large jar featuring a square lip, a curved, everted rim, small rounded shoulders and a body that tapers dramatically to a convex foot. They are identified as Phimai

black vessels by their dark matte surface and consistent polishing on the exterior rim and shoulder. All examples of this jar form found in the Noen U-Loke assemblage functioned as infant burial vessels. One of these vessels was identified in the Ban Non Wat assemblage.

The second jar form, labelled 'large, tapered jar with inverted rim', was also identified from both Noen U-Loke and Ban Non Wat. The one fully reconstructed example from Noen U-Loke features a wide rim diameter tapering to a small foot with a high, tightly rounded shoulder and a short, slightly inverted rim. This jar has been associated with reconstructed portions of jars in the Ban Non Wat assemblage that demonstrate the same large tapering body, tightly rolled shoulder and inverted rim. These examples are distinguished by complex lips which are divided into tripartite or quadrupartite ridges. Examples from both sites feature burnishing and polishing around the exterior rim and shoulder.

There is therefore some variation in form between the ceramic material from each of the three sites. However it is important to emphasise their general similarity. Despite some discrepancies, the vast majority of material from both Ban Non Wat and Noen U-Loke were easily categorised into the Ban Suai typology. It is interesting that one of the major variances in form, the large tapering jars, functioned as infant burial vessels at Noen U-Loke. It is possible that this form was created specifically for burial use and therefore differed from the generally utilitarian function of most Phimai black vessels.

All decoration types described in the Ban Suai typology were identified in the Ban Non Wat assemblage. Lenticular and cross-hatch burnishing were not identified in the Noen U-Loke assemblage. However the photographic material used to assess the Noen U-Loke assemblage tended to show the vessels' exteriors. As both designs are generally found on the interior of vessels (Solheim and Ayres 1974:71) it was not possible to confirm their presence or absence. Given the general similarity in style apparent throughout the three assemblages, it is expected that upon inspection of the interior of the Noen U-Loke vessels lenticular and cross-hatch burnishing would be identified. No further decoration types were identified in the Ban Non Wat and Noen U-Loke material. Therefore the Phimai black material in the ceramic assemblages from Ban Non Wat, Noen U-Loke and Ban Suai display a marked degree of similarity.

The Ban Non Wat data discussed above indicate a high degree of standardisation in terms of rim types correlating to sizes and probably particular forms. Therefore ceramic standardisation within communities appears likely. Inter-site comparison also suggests a remarkable degree of similarity in form and style of vessels between the three sites studied, rendering the possibility of regional standardisation in the form and style of Phimai black ware likely. It must be acknowledged that the samples, particularly that from Ban Non Wat, are small and do not cover the entirety of ceramic material of each site. There is therefore potential for further vessels to either correspond with the typology or present diversions from it. However this research does not propose to undertake a full analysis of every available example of Phimai black pottery. Assessment of material from three sites has provided adequate indication of the great degree of similarity in Phimai black ceramics.

TABLE 5:2 *Phimai black vessel forms and decoration types identified at Ban Non Wat, Noen U-Loke and Ban Suai*

Phimai Black Vessel Form	Ban Non Wat	Noen U-Loke	Ban Suai
Small, shallow bowl with straight sides	X	X	X
Small, shallow bowl with curved sides	X	X	X
Angled bowl - first variety	X	X	X
Angled bowl - second variety		X	X
Angled bowl - third variety			X
Angled bowl with rounded base	X	X	
Wide, shallow bowl			X
Large, deep bowl		X	X
Small, globular jar	X	X	X
Large jar	X	X	X
Large, tapered jar	X	X	
Large, tapered jar with inverted rim	X	X	
Phimai Black Decoration Type			
Horizontal burnishing	X	X	X
Radial burnishing	X	X	X
Cross-hatch burnishing	X	?	X
Spiral burnishing	X	X	X
Lenticular burnishing	X	?	X
Polishing	X	X	X
Punctuates	X	X	X
Raised bands	X	X	X

ELECTRON MICROPROBE ANALYSIS OF PHIMAI BLACK FABRIC

The chemical composition of the clay matrix

The clay matrix is the plastic clay material used for pottery manufacture to which non-plastic inclusions are added in order to increase the clay's plasticity. The clay matrix of all samples underwent electron microprobe analysis to ascertain the chemical composition of the clay used to make Phimai black pottery. The results then underwent Principal Components Analysis in order to ascertain the degree of similarity in the samples (Figs. 5:9 and 10). The distribution of samples in figure 5:9 is non-random, cre-

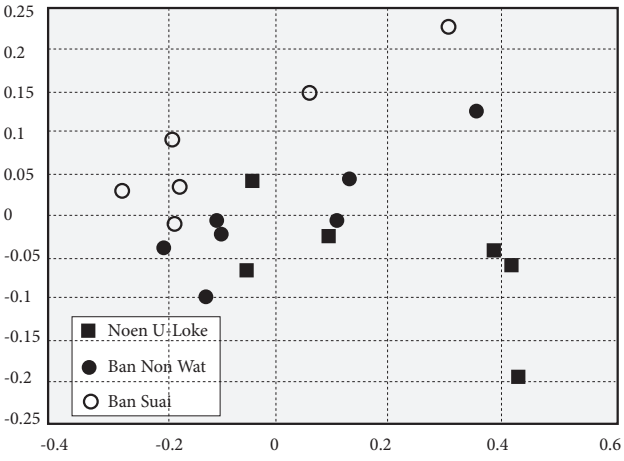


FIG. 5:5 Scatter diagram demonstrating the results of the PCA 1 and 2 in terms of the chemical composition of samples

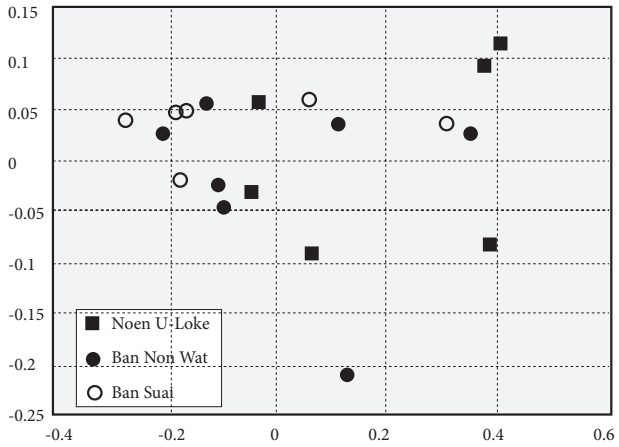


FIG. 5:6 Scatter diagram demonstrating the results of the PCA 1 and 3 in terms of the chemical composition of samples

ating three distinct CPCRUs clustering along the Y-axis. Variation along the Y-axis is based on varying amounts Na and Ca within the clay of samples. This variation creates the vertical distribution of samples and forms the chemical basis for the clustering of the CPCRUs. Each of these CPCRUs correspond to an archaeological site. Therefore the clay used in the Phimai black pottery from each site, based on the samples analysed, is chemically distinct from the clay used in the Phimai black pottery from the other two sites. Samples therefore have similar levels of Na and Ca within site groups but different levels between site groups.

The Noen U-Loke samples cluster lowest on the Y-axis suggesting a relatively low amount of Na and Ca in their chemical composition. One of the Noen U-Loke samples appears to be placed among the samples from Ban Non Wat. Although it appears distinct from the other Noen U-Loke samples, it is clearly related to them when the data are rotated and displayed as in figure 5:10. While the CPCRUs are not obvious, the specimen obviously clusters with other Noen U-Loke samples along the Y-axis, indicating that it is in fact closely related in chemical composition to other samples from Noen U-Loke. Figure 5:9 displays 83.35% of chemical variation in the samples. Figure 5:10 displays a different 7.08% of variation, thus accounting for the chemical similarity between the Noen U-Loke samples not visible in figure 5:9. That the variation accounted for in these two figures includes almost the entire spectrum indicates that the results of the chemical composition analysis of Phimai black clay matrix are extremely reliable.

The samples from Ban Non Wat cluster higher on the Y-axis between Noen U-Loke and Ban Suai. This suggests a higher amount of Na and Ca in their chemical composition than the Noen U-Loke samples but a lesser amount than the Ban Suai specimens that cluster above those from Ban Non Wat on the Y-axis.

It is important to note that the analysis performed on the clay sample from the excavated feature at Ban Non Wat produced a similar chemical signature to the Ban Non Wat pottery samples, thus including it in the Ban Non Wat CPCRU. This will have a significant influence on the interpretation of these results. The statistical analysis of data collected from the electron microprobe analysis of the clay matrix in Phimai black pottery samples has produced three obvious CPCRU's that are chemically distinct from one another. These correspond to the three archaeological sites under review. The pottery derived from each site is distinct in chemical composition from the others.

THE CHEMICAL COMPOSITION OF NON-PLASTIC INCLUSIONS

A maximum of eight non-plastic inclusions were selected from each sample for electron microprobe analysis. A chemical signature was provided for each inclusion, and these were compared to the composition of minerals outlined in Deer *et. al.* (1992). In this way the mineral inclusions were identified. However, upon analysis it became clear that the majority of non-plastic inclusions were not minerals but rather organic matter. This was to be expected, as previous research has identified Phimai black pottery as being rice-tempered earthenware (Welch and McNeill 2004:538). Under magnification, the organic inclusions were easily differentiated from mineral grains. The former are large, dark and often feature scalloped edges. Upon comparison with microscopic research performed on organic substances in archaeological contexts (Harvey and Fuller 2005; Vincent 2004), these inclusions were identified as rice husks. When measured for chemical components the organic inclusions consistently produced high Ca, K and P counts. These organic inclusions dominate the fabric of all samples and there can be little doubt that they functioned as the major non-plastic inclusion in Phimai black ceramics. It should be noted, however, that the clay sample from Ban Non Wat did not contain

any organic inclusions. Therefore the clay was likely refuse that was fired without temper being added.

The analysis of other inclusions beyond the organic material proved difficult. Quartz grains were large and found in abundance throughout all samples. Whether this is indicative of quartz sand being used as temper or that these grains are a component of the clay is ambiguous, however the high silica count in the composition of the clay matrix would suggest the latter. Other mineral inclusions were extremely small and difficult to identify visually despite magnification. The size of these grains meant that when analysed, the electron beam picked up chemical information from the clay matrix surrounding the grain. Those grains that proved indiscernible from the surrounding matrix have been labelled 'clay', while grains labelled 'haematite and clay' represent analyses on high iron grains that include matrix information. These are represented in all samples analysed. A few further minerals were identified in some samples. Rutile was present once in a sample from Noen U-Loke and once in a sample from Ban Suai. Zircon was present twice in a sample from Noen U-Loke and once in sample from Ban Suai and albite was present once in a Ban Suai sample. The small amount and diminutive size of these minerals relative to the dominance of organic inclusions suggests that they should not be considered as indicative of temper preference. Furthermore, given that they were found in samples from two of the three sites studied and considering the small sample size, it would not be surprising that if further analysis was undertaken these minerals would be found in Phimai black samples from Ban Non Wat.

These results provide the means towards assessing standardisation in the Phimai black ceramic material from the three sites in the upper Mun River valley that are included in this study. The degree of standardisation evident from these results will be used in examining the level of craft specialisation and their implications concerning sociopolitical complexity in this area. In order to explore these concepts, the archaeological evidence outlined above will be applied to Rice's 1981 model correlating recovered material with degrees of craft standardisation, economic specialisation and sociopolitical development.

SUMMARY OF RESULTS

Evaluation of the similarity of material within the Ban Non Wat assemblage identified few rim type categories which were then correlated to particular diameters. This reflects a high degree of standardisation within this assemblage alone. From this information we can infer that the form and style of the Ban Non Wat Phimai black pottery was produced according to a standardised process. This is particularly comprehensive if the pottery was being produced within the community, given the reduced chance of variation in this situation. It is also possible that the pottery was externally produced and traded into the community; however in this situation one must consider the effects of consumer selection on the archaeological record. Like the Ban Non Wat assessment, inter-site comparison of the Phimai Black material from Ban Non Wat, Noen U-Loke and Ban Suai demonstrated a high degree of similarity in formal and stylistic features between the assemblages. Again, this indicates production according to a standardised process. Therefore the physical appearance of Phimai black pottery demonstrates a particularly high degree of ceramic standardisation both within the Ban Non Wat assemblage and between the three site assemblages.

The chemical analysis of the clay matrix undertaken on Phimai black samples by electron microscopy demonstrates that the evident homogeneity of form is contradictory to this major component of the ceramic fabric. The pottery samples fell into three distinct groupings of clay composition, each sample grouping with the other samples from the site from which they were taken. These results suggest that the pottery from each site was manufactured from clay derived from an independent source. Analysis of the non-plastic inclusions in the ceramic fabric by the same means demonstrated that temper additives in all samples were largely homogenous. Organic material, primarily rice husk, was the dominant inclusion from all sites. Therefore the Phimai black pottery assessed in this research possesses a very high degree of standardisation in physical appearance and non-plastic inclusion components of the pottery. However distinct chemical variation in the clays used to manufacture Phimai black was observed, indicating that the pottery from each site was produced using a different clay resource.

ALTERNATIVE EVIDENCE FOR CERAMIC PRODUCTION

The contradiction of heterogeneous clays and homogenous appearance and temper that, based on the results from samples used in this study, is characteristic of the Phimai black ceramic tradition raises questions concerning its production. The similarity of major aspects conforms to the general hypothesis of centralised production proposed for this tradition (Higham 1996:224, 2002:201-2; O'Reilly 2000:10-11; Welch 1984:147; Welch and McNeill 1991a:332, 1990:159, 2004:540). However the chemical composition of the clay is distinct between the samples from each site which suggests independent clay procurement and the possibility of local ceramic production. Ceramic production has archaeological correlates beyond the pottery that is produced (Rice 1987:172). These may be production tools, unused clay material, wasters, firing sites and pigments that can be excavated alongside the ceramic material. In order to investigate the possibility of Phimai black pottery production within the respective communities, the record from each site was examined for further evidence of production.

The dominant forms of evidence for production found

in the archaeological record of the upper Mun River valley sites are anvils made of clay or stone, unused clay and stones used to produce the distinct burnishing decoration on Phimai black and other ceramic traditions. A total of 336 anvils, both complete and fragmentary, were identified during seven seasons of excavation at Ban Non Wat. Moreover these anvils were distributed throughout all nine stratigraphic layers indicating that pottery production was an important component of the community's activity from a very early stage. Furthermore, 108 burnishing stones were identified as distributed throughout all stratigraphic layers with the exception of Layer 8. The unused lumps of clay found in direct association with the Phimai black assemblage from Ban Non Wat used in this study provide further support for the importance of ceramic production at this site, particularly of Phimai black. The burnt clay sample that underwent chemical analysis demonstrated a similarity to the clay used in the Ban Non Wat Phimai black samples. That fact that unused clay matching the chemical composition of finished samples was found in association with vessels provides support for local Phimai black production.

Like those at Ban Non Wat, the more recent excavations at Ban Suai conducted by the Thai Fine Arts Department recovered evidence connected with ceramic production, most notably burnishing stones and unused burnt clay in association with Phimai black sherds (Talbot 2002:15; Voelker 2002:13). However Noen U-Loke contrasts with these two situations; the excavations undertaken at this site from 1996-1998 recovered only four anvils and anvil fragments, all from the lower layers, and no other evidence for production. Voelker states that if the inhabitants of Noen U-Loke were producing pottery in the late Iron Age they were doing so in part of the site outside the excavated area. (Voelker 2002:98).

APPLICATION OF RESULTS TO RICE'S MODEL

In her 1981 paper Rice distinguished between 'utilitarian' ceramic ware - 'low-status ceramic goods of widespread occurrence, low value and high consumption' (Rice 1981:222) – and 'elite' ware. She uses these distinctions to organise her model correlating ceramic material to standardisation and specialisation. It is therefore important to note that Welch and McNeill concluded that Phimai black was a utilitarian ceramic ware in the sense that it had a wide distribution and was found in all types of sites rather than sites of particular significance:'Phimai Black cannot be seen as a distinctive marker of elite status, as a ceramic chiefly used in ritual contexts, or as a ceramic associated with more centralised as opposed to rural communities. The contexts in which it is found, from rich burials to the eroding edges of small salt processing mounds, suggest use by all segments of society for both everyday and ritual purposes' (Welch and McNeill 1991a:332).

Rice's model outlined the level of standardisation that ceramic material is expected to possess in each of her four phases. Step 1 applies to material that displays little uniformity in both clays and tempers, and variation in decoration resultant of idiosyncrasies in production time and producer skill. In this phase material is expected to be distributed in household concentrations of similar ceramic paste, form and design. Step 2 applies to material similar to that of Step 1 in terms of distribution but which displays an increase of standardisation in some pottery types and the skill and consistency of the potter, and a decrease in the variety of decoration. The results indicate clearly that neither of these phases applies to the Phimai black ceramic tradition. The obvious uniformity of form and decoration opposes the required variety while the paste is the one component that is not standardised. Furthermore the distribution of Phimai black pottery goes far beyond the household and community area that is suggested by these phases.

Therefore if the ceramic material examined in this study is applicable to Rice's model it must fall into the second two phases. Indeed, when the evidence is examined it is apparent that the Phimai black ceramic tradition possesses components of both Step 3 and Step 4. Step 3 signifies a major change in ceramic evolution by proposing the unequal distribution of different classes of pottery. This introduces utilitarian and elite ceramics, with a relative homogeneity of pastes within these classes. However 'new pastes in standard elite formal or decorative styles may appear, suggesting imitation wares and/or competition among producers' (Rice 1981:223). Elite wares with standardised pastes would have a restricted distribution when compared with more variable pottery, and would be found in particular contexts such as ceremonial or mortuary. The imitation pottery may also overlap the distribution of the elite high-value wares. Moreover an increase in variety over the total ceramic complex should be apparent, corresponding to the increasing complexity of the social system. Step 4 is the culmination of this development, proposing fully standardised production locations and ceramic forms, dimensions and details especially in utilitarian ware. Utilitarian pottery should have standardised pastes while increased elaboration should be apparent in the decoration ware. Indicators of mass-production such as tools for rapid manufacture and storage areas may also be evident. Moreover a wide distribution would be expected for standardised ceramic types.

Upon assessment the Phimai black ceramic tradition seems to stand somewhere between these two development phases, recognising features from each. Phimai black corresponds with the widely distributed utilitarian ware featuring a standard appearance of Step 4. Moreover manufacturing tools have been found at two sites as discussed above. However the samples analysed in this research do not demonstrate a standardised ceramic fabric. Step 3 mentions the production of pottery in imitation of elite wares and it is possible that this activity explains

the dichotomy between the heterogeneity of the clay and the homogeneity of other components. Elite wares are expected to have a standard paste and be distributed in particular contexts. Imitation wares on the other hand, would be produced in the same form and style, illustrating the intention of emulating the higher valued material, but be manufactured from a variety of resources reflecting the diversity of centres producing this type of ceramic. Moreover Rice stipulates that imitation ware may overlap the distribution of elite wares. It is therefore possible that Phimai black originated as an elite, high-valued pottery type that was distributed in particularly significant contexts. However as demand instigated imitation of this ware in various centres, proliferation of the type may have resulted in its devaluation as saturation of the market led to expansion of Phimai black function, thus creating the ubiquitous distribution of Phimai black pottery that is evident archaeologically.

IMPLICATIONS FOR CERAMIC PRODUCTION

When the material evidence is applied to Rice's organisation of production, it tends to correspond with the later phases of development. Phimai black cannot be firmly placed in either phase but instead possesses features of both the third and the fourth. This application presents the possibility of a transitional phase in which Phimai black transformed from a distinctive elite ware to a widely distributed utilitarian ware by means of the production of imitation Phimai black ceramics. On the grounds of the implications established in Rice's model, Phimai black may have originally been produced at one centre as an elite ware and traded to other communities for use in particular contexts such as burial. It is possible that potters in these other communities may have begun producing vessels in emulation of this elite ware, conforming to a standardised production process while utilising local resources.

The archaeological evidence in many ways supports this hypothesis. The ceramic fabric is of principal interest given that the variation in clay is the sole component preventing Phimai black from being a homogenous pottery type. Vessel form, style and temper all point towards production at a single centre but the variation in clay contradicts this, suggesting three different production locations. Given that each variation corresponded only to samples taken from one of the three sites, it appears possible that the communities used in this research were producing their own Phimai black pottery. These local potters would have exploited their traditional clay resource for manufacturing Phimai black, but would have conformed to the more easily emulated features of Phimai black production such as forming, firing and decoration. The uniform use of rice husk temper throughout the Phimai black samples indicates that the temper component of Phimai black production was also easily emulated. This in turn hints at easy accessibility to surplus rice in all three communities.

The recovery of alternative evidence of production such as anvils, burnishing stones and unused clay at both Ban Non Wat and Ban Suai further supports the concept of local production of pottery in the Iron Age. However only four anvils were recovered in the excavation of Noen U-Loke, all found in the lower levels. This does not immediately refute the possibility of Phimai black production at the site as it is possible that production took place outside the excavated area. However, despite the strength of the evidence, the correspondence of clay variations to samples from a particular site does not dictate the production of the sample vessels on the site in which they were found. It is also possible that local Phimai black production was an activity in which not all communities participated. Non-producing communities may have continued to trade for Phimai black vessels from the original, and presumably strongest, production centre or other producing communities. Finally, Welch and McNeill have noted that Phimai black is found in all site types and contexts including traditionally special contexts such as mortuary and ceremonial and traditionally basic contexts such as industrial and utilitarian. It is possible that Phimai black was therefore initially used in particularly significant contexts but rapidly became functional in other activities as production of the pottery proliferated.

While the above hypothesis presents one possible explanation for the dichotomy demonstrated in the Phimai black material analysed, it is the product of the application of material to a particular model with the aim to correlate standardisation and sociopolitical organisation. There are alternative explanations for Phimai black production that have not been theoretically connected to broader issues of social complexity through standardisation theory. Considering that a particular aim of this research is the application of standardisation theory to Phimai black material through use of Rice's model, these alternative possibilities will not be explored in depth but it is considered important to identify them. The first possibility concerns a single social group inhabiting numerous communities in a socially isolated region. These communities possess similar cultural ideas which are observed in the local production of a homogenous ceramic tradition over the entire region. The second possibility concerns the employment of itinerant specialist potters. Professional craftsmen potentially travelled throughout the region producing a uniform ceramic type using the local clay resources. While these possibilities merit further evaluation, the scope of this research prevents detailed discussion. The following will return to the original implications produced by application of the material to Rice's model and their association with social organisation.

IMPLICATIONS FOR CRAFT SPECIALISATION AND SOCIOPOLITICAL COMPLEXITY

In order to give the material evidence meaning in prehistoric social evolution, Rice relates the expected archaeological evidence in each phase of her model with generalised correlates concerning levels of craft specialisation and economic, social and political circumstances. Thus Step 1 proposes unstandardised household pottery production in a relatively egalitarian society with primitive economic structure. Following, Step 2 expects informal specialisation of pottery production among households within a community in which exchange or gift-giving relationships between households provides the community with ceramics. In this phase, pottery production may be associated with kin-groups or lineages but society does not feature exclusively specialised or ranked groupings. Given that the evidence from the ceramic material used in this research corresponds to components of the following third and fourth phases, the economic and social implications of the first two phases may be safely excluded from any hypothesis concerning late prehistoric social development in the upper Mun River valley based on ceramic evidence.

With Step 3 the expected economic and social circumstances undertake major changes and it is this new situation that is applicable to the material evidence in this study. Over the course of this phase socioeconomic ranking is expected to increase with the formation of 'more highly competitive, productive and upwardly mobile sectors of society' (Rice 1981:223). Resources are initially controlled by 'localized self-sufficient kin-oriented social units' (Dumond 1972 cited in Rice 1981:223) and this control is gradually appropriated by the emerging elite. These changes make an impression on ceramic material with increased competition and social differentiation instigating new innovation and elaboration in pottery. Commodities of scarce resources are increasingly channelled towards the new elite; therefore it is in the production of elite objects that intense economic specialisation first takes place. Moreover the exchange of these items is potentially separated from any existing subsistence exchange in order to reinforce social ranking.

Step 4 represents the culmination of the ongoing stratification of the former phase, proposing a stratified society in which social and economic variety is highly evolved towards the standardisation of both behaviour and produce. The level of economic interaction is defined by extensive tribute of surplus produce to a central power. Sahlins (1972) has emphasised the relationship between the evolution of centralised leadership and surplus production, proposing that when the elite begins to extract pottery from the populace as tribute or trade items, intensified rural production begins. Rice uses ethnographic evidence to support this, stating that 'some contemporary peasants…will intensify production and specialise toward the creation of "surplus" only if compelled to by the forcible removal of such surpluses by a coercive higher power as a political elite or ritual structure' (Rice 1981:223).

Considering that the ceramic material used in this study correlates with these two later phases, it may be hypothesised that the level of standardisation demonstrated by Phimai black material reflects a society in which ranking has evolved to the extent that a central power is capable of extracting tribute from the populace. Economic specialisation may have intensified to the point of producing an elite ceramic ware that was traded among the elites of the region's communities. The elite group responsible for the production of this pottery was potentially powerful and influential enough to bestow a high emic value to the ceramics. Thus demand for this pottery would have instigated production of pottery in local communities in imitation of the highly valued ware. The market would have been rapidly saturated with this ceramic type thus decreasing its value as its function expands beyond use in specific significant contexts. In this way Phimai black pottery could have developed the ubiquitous distribution evident in the archaeological record.

Schortman and Urban (2004) note that elites may also initially control the distribution of ceramic products. While a small, centrally located and highly specialised group is producing a constant supply that is yet small enough not to swamp the market, product consumption is easily monitored. However if the items are fragile and easily broken or frequently removed from circulation by other means such as burial, consumption levels are enhanced and production output may be increased. The growing number of items would prove more difficult for the elite to control, thus allowing for the initial production of imitation items outside the central location. This situation corresponds in some ways with the circumstances of Phimai black pottery in the archaeological record. Recovered vessels are characteristically delicate and fragile and have often been found in mortuary contexts suggesting regular removal from circulation. Moreover, as discussed above, the variation in ceramic paste indicates production in more than one location, supporting relaxation of control. This strengthens the hypothesis of a centralised power that initially controlled Phimai black production in late prehistory that is suggested by Rice's model.

Schortman and Urban (2004) also discuss the possibilities of commoner participation in specialised manufacture in which production, consumption and distribution are not under elite control. It is postulated that attempts made by commoners to replicate prestige goods are the markers of the recently disempowered seeking to participate in the dominate ideology. However while resisting exclusion they confirm the importance of the discourses that have been created. These attempts may spur technological innovation on the part of the elite and the creation of new prestige goods more difficult to imitate thus allowing the older items to become commonly available. However craft production is postulated as a 'last resort' profession for commoners that occurs only when increased population investment in subsistence activities creates a need for

specialists in production roles estranged from the land. Furthermore as land becomes less available due to intensification, craft production becomes a means of meeting basic material needs through exchange. These circumstances can be compared to the situation proposed by Rice in Step 4 of her model in which she cites Sahlins's (1972) correlation of specialist production, surplus extraction and the intensification of agriculture. It would therefore appear that specialised pottery production by commoners is initiated in response to the effects of emerging elites on subsistence activities.

While potentially initiated by a resistance to elite exclusivity, the producers still participate in developing social differentiation. This cultural environment initiates a need for physically obvious markers that signal identities in social discourses, and any ambiguity in these identities is reduced when these markers are standardised. This condition, as is demonstrated by Rice's model, is generally encouraged by specialisation. The specialised production of commoner craft is encouraged by a demand for 'easily decoded, physically distinctive items useful as explicit markers of social affiliation. Objects fashioned from widely available raw materials that have high visibility (such as elaborately embellished pottery vessels made from local clays) are particularly susceptible to production by a large number of artisans labouring to meet the needs of a sizeable market' (Schortman and Urban 2002:198). Therefore the initiation of specialised pottery production outside elite control occurs in response to both economic and political pressures. As stated by Schortman and Urban, the specialised production of standardised items often serves to affiliate the consumer with a particular social identity, and thus production may be rapidly increased due to demand for such identification markers.

Therefore the hypotheses constructed from the application of material results to Rice's theoretical model and discussion of alternative production evidence and theory concerning economic specialisation and social organisation are as follows. Phimai black appears to be a highly standardised ceramic type in all aspects besides manufacturing clay. This description correlates with the archaeological expectations in the latter two stages of Rice's model, implying that Phimai black pottery is representative of a production system in which specialised ware is manufactured at a central location and distributed throughout the region. This ware is possibly associated with an emerging elite class and their attempts to control resources and produce material symbols of their exclusivity. However imitation of this pottery may eventually have occurred in other communities as commoners attempted to participate in the dominant ideology. Production of these replicas was potentially carried out according to a standardised process in terms of temper additives and physical appearance, but utilising local clay resources. Therefore the potential commoner production of Phimai black was similarly standardised and likely undertaken by specialised community potters.

The emergence of an elite class is often associated with intensification of agricultural production and the alienation of inhabitants from either subsistence production or material production. This creates a need for full-time commodity producers which is fulfilled by those who are estranged from the land and turn to craft production in order to gain material needs. Agricultural intensification in the upper Mun River valley is suggested by the dominance of rice husk as a temper additive in Phimai black fabric. The use of rice as a ceramic temper indicates a surplus in agricultural production. This is also suggested by the Iron Age rice burials seen in many sites in the upper Mun River valley. Agricultural intensification and the extraction of surplus are theoretically linked to the development of stratified society and the control of one central power over labour and production. If replication of the Phimai black tradition of the elite occurred, the populace would have participated in and confirmed the validity of the material symbol. However any increase in production of Phimai black in the Iron Age would have potentially swamped the regional market and degraded the emic value of the pottery. Therefore Phimai black may have rapidly become a ware associated with a large range of classes and activities causing the central power to look elsewhere for material symbols of status.

PHIMAI BLACK PRODUCTION AND IRON AGE SOCIAL ORGANISATION

Higham (1989, 2002, 2004; Higham and Thosarat 1998) has proposed that Iron Age social organisation was characterised by the establishment of highly ranked groups in regional centres that were supported by the intensification of production and exchange. In the Mun River valley in particular, petty chieftains evolved on the basis of ironworking, the salt industry and intensified agricultural production. This interpretation has been generally accepted and elaborated upon by further researchers.

Welch argued that a complex system of political organisation developed between 500 BC-AD 500 in the upper Mun River valley, a system with 'at last two levels of community decision-making authority, the highest level of which integrates lower level communities into a single political unit' (Welch 1984:130). He proposes that social organisation had reached the level of chiefdom in the Phimai Region during the Iron Age. The settlement pattern throughout regions in the Khorat plateau is expressed by smaller settlements dominated by a few larger centres. Welch argues that the ranges in settlement size and a tendency towards clustering throughout the Phimai region sites display functional differences that suggest the sites participated in a political and economic hierarchy. He proposes that the size of the settlement at Ban Suai in particular was approximately 30-40 ha around 200 BC and therefore Ban Suai may represent the remains of the

principal political site that grew into the regional capital of Phimai during the Angkorian period. Furthermore, Welch proposes that all sites in the region were potentially self-sufficient given their assumed catchment area in relation to their assumed population size. Phimai is the exception, possibly requiring the importation or forcible extraction of surplus produced by the surrounding communities in order to feed it inhabitants. This would require control over the production of specialised goods to exchange for subsistence material. Similarly, O'Reilly (1999) argues that full-time specialisation is only possible when surplus is produced and requires the existence of a controlling body with the power to subvert products for the support of the specialists. This supports the hypothesised relationship between craft specialisation and agricultural intensification controlled by an elite at Phimai.

Following their initial settlement pattern survey, Welch and McNeill (1991a) extended this research, culminating in the confirmation and elaboration of Welch's original conclusions concerning settlement distribution and function. They also constructed the first regional chronology. The Classic Phimai phase, correlating to the Iron Age, was defined by population increase and settlement expansion throughout the three environmental valley zones in the Mun River valley. They relate this growth to the demands of a new intensive agricultural system; the concentration of a large population in one settlement encouraged intensification in order to produce sufficient yields. Population growth and the intensification of agricultural production is therefore a major motivation for developing complexity.

Welch and McNeill's assessment of regional exchange also supports the emergence of social stratification in late prehistory (Welch and McNeill 1991a). Exotic materials and finely made artefacts recovered from Iron Age burials attest to a prestige exchange network that was likely controlled by high status members of society. The elite was able to maintain a separate identity through the use of these material symbols and maintained control of these items and the networks by which they could be shared among regional elites. This symbolic display was therefore a manifestation of underlying changes in the structure of social foundations. Welch and McNeill suggest competition for access to upland forest resources and for control over lowland agricultural and industrial resources may have stimulated these changes. Response to this competition can potentially be seen in the clustering of settlements and differential settlement size and function in the valley, for centralisation would have been an advantage to inhabitants distant from resources. Competition may also have engendered considerable social stress and conflict, a certain amount of which is evidenced by finds of weaponry in Iron Age burials and the possibility of moats and banks being fortifications.

The picture of Iron Age society in the upper Mun River Valley in the Iron Age produced by this research is one of a stratified society manipulated by aggrandizers attempting to solidify their status. It is possible that Phimai formed the main centre in which this elite originated, as population growth may have proved the settlement unsustainable and provoked alternative methods by which to gain agricultural produce. This possibly instigated the specialised production of Phimai black which was originally traded to outer communities for food. However as the elite emerged and gained control of production it is possible that agricultural production in other locations was intensified to produce further surpluses as tribute and Phimai black was solely produced as a material symbol of elite power that was traded to other emerging elites. If Phimai black was eventually devalued by imitation, it is possible that the exotic artefacts found in wealthy Iron Age graves represent alternative symbols of status that the elite individuals turned to after this occurred. The hypotheses constructed from the assessment of Phimai black material therefore correspond well with the current interpretation of Iron Age society in the upper Mun River valley which proposes social stratification and the importance of agricultural intensification and exchange.

CONCLUSIONS

The purpose of this study is to assess the degree of standardisation evident in Phimai black pottery, a regional ceramic tradition from Northeast Thailand, and to establish whether this assessment can contribute towards present understanding of social organisation of the Thai Iron Age. Phimai black material from three sites in the upper Mun River valley were analysed to ascertain similarity or variation within and between the assemblages. Results from these analyses produced hypotheses concerning the production location of Phimai black vessels, the possibility of specialisation in this production process and the level of sociopolitical complexity that is generally associated with the evidence provided from the analyses. In order to relate information gained from the archaeological material to more abstract concepts of specialisation and complexity and provide a means to assess these hypotheses against the existing interpretations of Thai prehistory, Rice's (1981) model combining archaeological material with economic and social theory was used. The following will outline the model constructed in this study concerning the production of Phimai black in the Iron Age Mun River valley and the society within which it was produced.

The three assemblages of Phimai black material used in this study demonstrated a very high degree of standardisation. Variation in form and dimension within the Ban Non Wat assemblage was minimal, suggesting that the production of the vessels used within this community followed a standardised manufacturing process and that consumption of ceramic vessels at Ban Non Wat endorsed this standardisation. While some discrepancies in form were identified during inter-site comparison of Phimai

black assemblages, the vast majority of vessels from Ban Non Wat and Noen U-Loke fell into the typology constructed from the Ban Suai material by Solheim and Ayres (1979). Furthermore the electron microprobe analysis of the ceramic paste in Phimai black samples taken from all three sites demonstrated that the non-plastic inclusions used as temper in the manufacturing process were predominately rice-husks, thus supporting a standardised production system. The chemical composition analysis of the clay matrix proved contradictory to the general similarity in the assemblages; each clay differed according to the site from which the sample was taken. The cumulative evidence therefore suggests production of Phimai black vessels according to a standardised process but utilising three different clay sources.

When the results from the material analyses were applied to Rice's model, the evidence corresponded to the expectations of the model's latter two phases. These two phases suggested that the level of standardisation that the assemblages possessed indicated a high degree of economic specialisation within the prehistoric society. However the variation apparent in the clay used prevented Phimai black from being indicative of a ware manufactured by specialised producers at one central location. Rice's model provided for emulation of elite ware by various communities within the society in the two latter phases. It is therefore hypothesised that Phimai black was initially produced in a central location as an elite ware for use in particular contexts throughout the region. However emulation of this ware may have rapidly occurred in communities throughout the region thus devaluing the tradition as an elite status symbol. If emulation of Phimai black became conventional then the consumer market would have been swamped and Phimai black vessels would have expanded in function, producing the wide and standard distribution of the tradition found throughout the upper Mun River valley in Iron Age contexts. This situation is supported by further evidence of ceramic production in Iron Age deposits at Ban Non Wat and Ban Suai. While this evidence has not been recovered at Noen U-Loke it is possible that pottery manufacture took place in an unexcavated location or that the inhabitants imported it from another site.

Rice's model associates this level of specialisation and production with particular aspects of sociopolitical organisation, namely the emergence of a powerful elite or centre within the society that initially controlled the production of prestige goods and their exchange. If the emulation hypothesis described above is valid, some form of social ranking and centralisation may have existed in the Phimai region in the Iron Age. The emerging elite may have originally controlled the production of Phimai black at a central location, but as the tradition became more conspicuous through use in significant contexts throughout the region, replication could have occurred in other communities by commoner producers attempting to participate in the elite ideology. In doing this the imitators would have confirmed the significance of the pottery as a symbol of status and the elite's right to that status, but would have rapidly devalued the pottery by increased production and consumption as the elite shifted to other material symbols of their identity.

The model of social stratification and a powerful elite constructed from assessment of standardisation in Phimai black material corresponds well with current interpretations of Iron Age society in the upper Mun River valley. The extensive research into settlement patterns in this area by Welch and McNeill suggests the emergence of larger, functionally different centres dominated by Phimai. This in itself indicates development of social stratification and the proposed insufficiency of Phimai's agricultural catchment suggests that Phimai's community may have been exchanging for subsistence produce or forcibly extracting it as tribute. In the first instance, it is possible that Phimai black ceramics played a major role in this economic interaction as it may have been exchanged to regional elites for surplus. It is also possible that specialised Phimai black production originated at Phimai to provide exchange items for rice, and only after Phimai's influence grew did Phimai black become symbolic for elite status as the elite began to control labour and agriculture and therefore extract tribute. All instances rely on the availability of surplus through agricultural intensification and elite control of labour as originally emphasised by Childe.

Intensification of subsistence production would have strongly contributed to craft specialisation in both elite and commoner production through providing surplus as tribute for the elite to support specialists and by forcing those alienated from the land to specialise in craft as a means of survival. Control of exchange networks and access to exchange commodities was also important in the developing stratification. Rice (1981) mentions that elites may control the distribution of prestige goods and exchange them with elites in other regions to foster a shared identity. It has been noted that Phimai black is restricted to the upper Mun Valley area, however it has been reported once in central Thailand by Bronson (1976). Under the present hypothesis, it is possible that some material was originally exchanged to another regional elite while Phimai black still possessed significance as a status symbol before becoming a utilitarian tradition that no longer had exchange worth.

The electron microprobe analysis of Phimai black ceramic fabric undertaken in this research is the most specific analysis of Phimai black chemical composition yet performed. The results of this analysis tend to refute the generally held hypothesis that the standardised appearance of Phimai black pottery indicates specialised production of the ceramic type at a central location. However the assessment of standardisation in the Phimai black assemblages from Ban Non Wat, Noen U-Loke and Ban Suai confirm the observed similarity in form, decoration and

temper. In relating these results to larger issues of production, specialisation and social organisation, Rice's model proved a very useful tool. Although it has been criticised for its linear progression of social development and for generalising the complexities of ceramic production and consumption (Adams *et al*., reply to Rice 1981), it remains the only model which relates the archaeological material to abstract ideas of specialisation and development and has been proven useful in many other studies. By comparing the hypotheses constructed by the application of results to this model and to current interpretations of social organisation in the upper Mun River valley, the potential circumstances of Phimai black's role in the Iron Age economy were illuminated and fit into the larger picture of late prehistoric society. Overall assessment of standardisation in Phimai black ceramics has provided an alternative and useful means by which to assess Iron Age society in the upper Mun River valley.

The analysis of Phimai black form, style and fabric and the application of the results to Rice's model have provided interesting suggestions concerning ceramic production and social organisation in late prehistory. However it must be emphasised that the situation hypothesised in this research was constructed from an application of the data to a specific explanatory model. Alternative explanations for the dichotomy represented in the ceramic material are available. The model outlined here would benefit from further testing. Investigation into the Phimai black ceramic tradition, particularly further analysis of Phimai black composition of more samples from a wider distribution. Attention should also be paid to possible discrepancies between mortuary and occupational Phimai black vessels. While formal and stylistic analysis undertaken in this research has provided some suggestion of specific mortuary vessels, the scope of this research prevents further consideration of this potentially important aspect of Phimai black production. Finally it is necessary to emphasise the importance of combining technological assessment of ceramics with traditional analysis. The analysis of ceramic fabric in this research provided information that proved imperative to understanding Phimai black production. Further analysis of ceramics found throughout the archaeological record in the upper Mun River valley will probably prove extremely useful in understanding the economic and social circumstances of prehistory in this region.

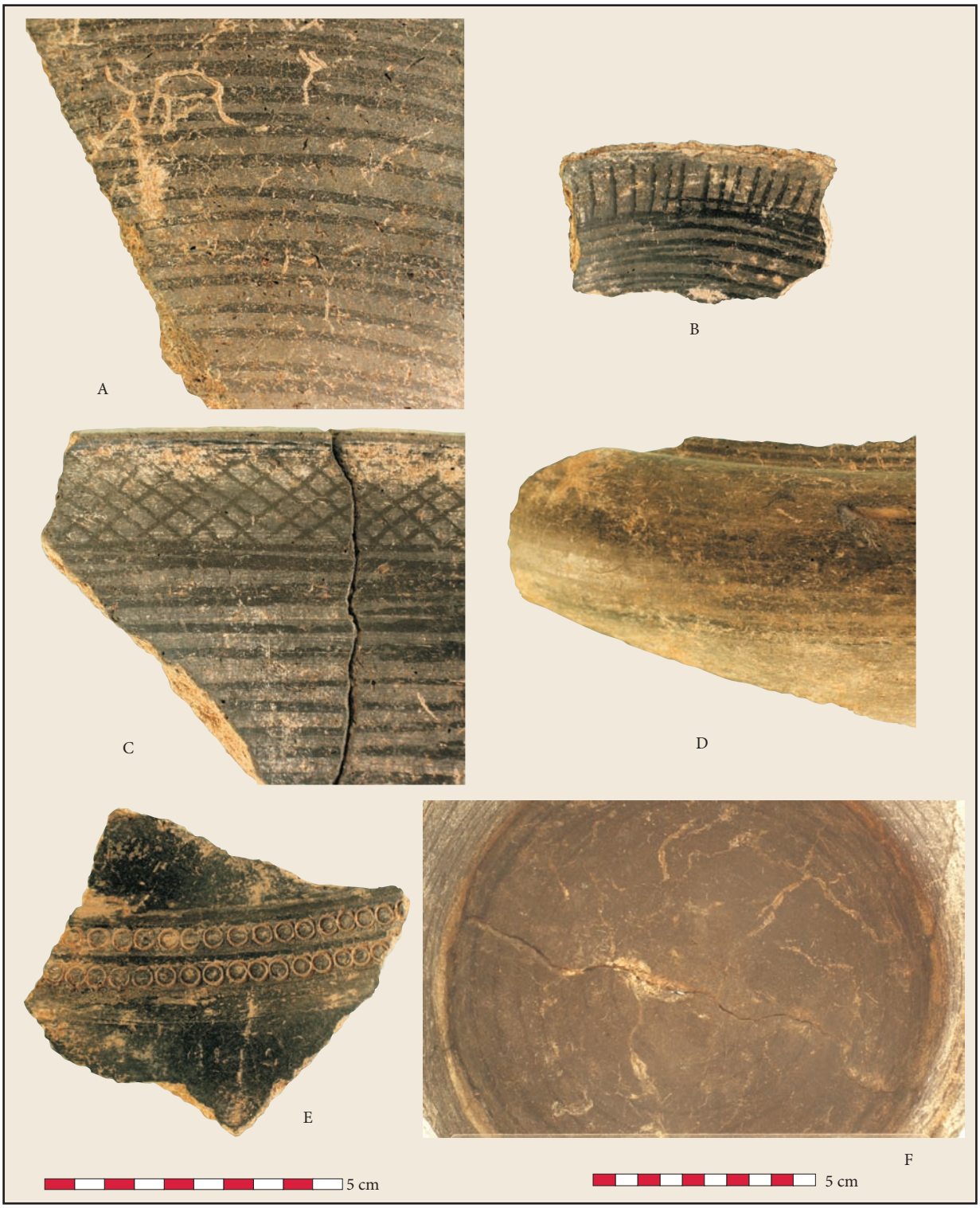


FIG. 5:7 Examples of Phimai black decoration from Ban Non Wat. A. horizontal streak burnishing B. radial burnishing C. cross-hatched burnishing D. polishing E. puntates F. spiral burnishing



FIG. 5:8 Reconstructed Phimai black vessels from Ban Non Wat. Cat. 24536 small shallow bowl, cat 25435 small shallow bowl with curved sides, cat. 24815 small globular jar, cat. 24147 angled bowl with rounded base, cat. 24026 possible base of a large, tapered jar with inverted rim, cat. 24154 large globular jar, cat 24023 part of a large tapered jar, cat. 24022 large tapered jar with an inverted rim



FIG. 5:9 Phimai black vessels from Noen U-Loke. Cat. 1526 small shallow bowl with straight sides, cat. 1623 small shallow bowl with curved sides, cat. 989 angled bowl, cat. 122 large globular pot, cat. 950 large mortuary jar, cat. 550 small globular pot, cat. 1415 large deep bowl, cat. 1679 large tapered jar with inverted rim

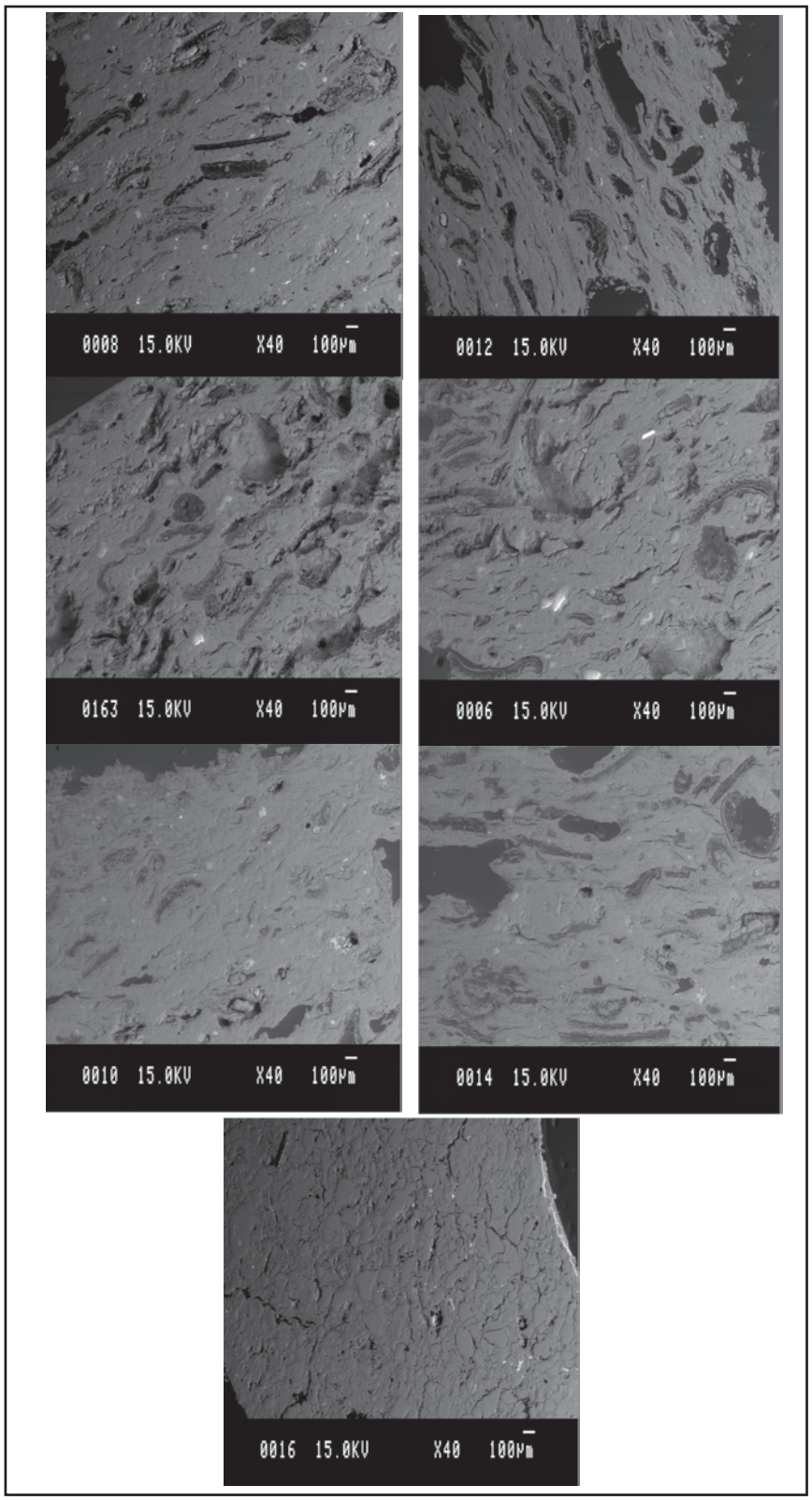


FIG. 5:10 Images of the ceramic fabric from Phimai black samples 1-6 and the clay sample from Ban Non Wat

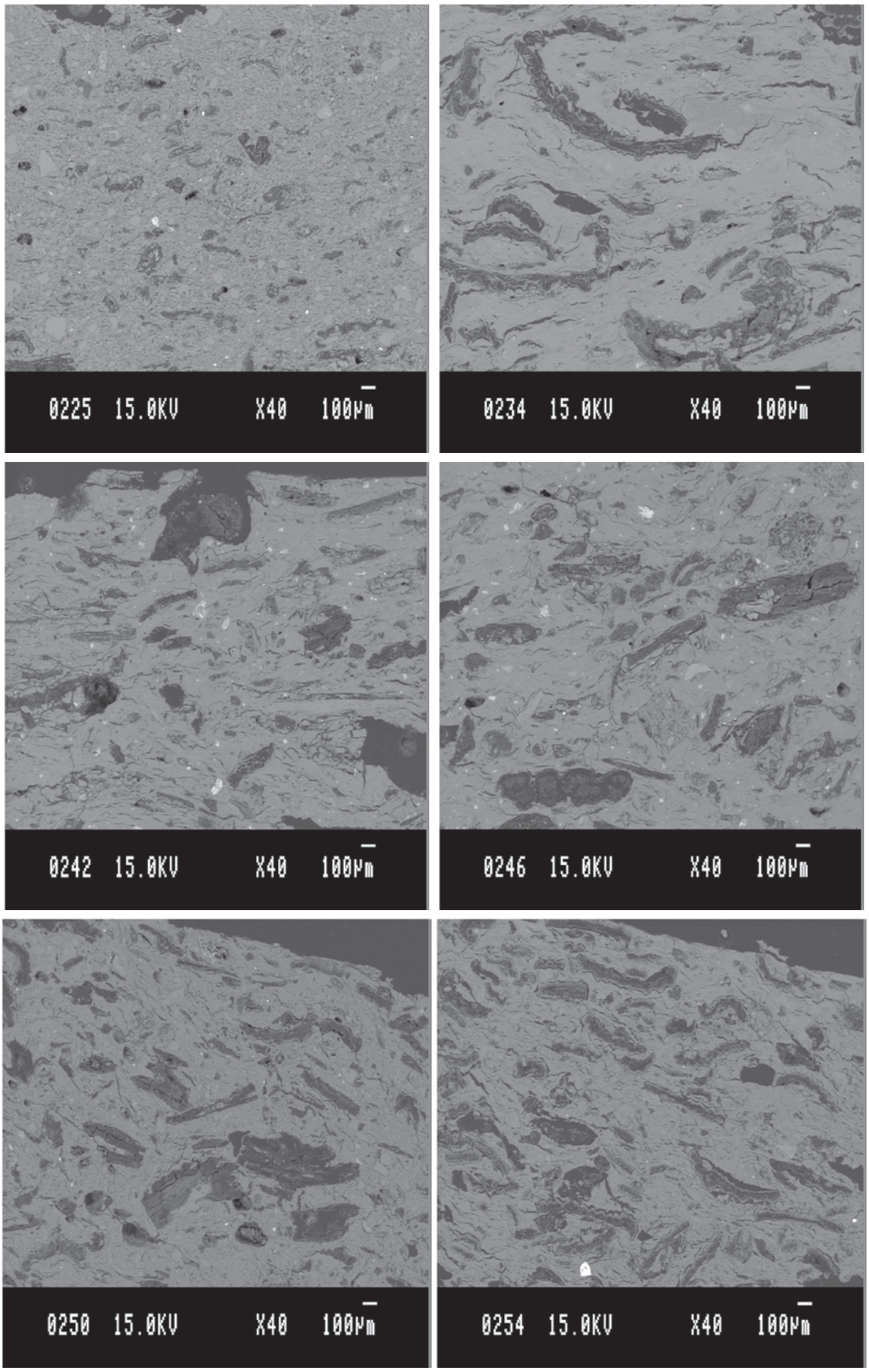


FIG. 5:11 Images of the ceramic fabric from Phimai black samples 1-6 from Noen U-Loke

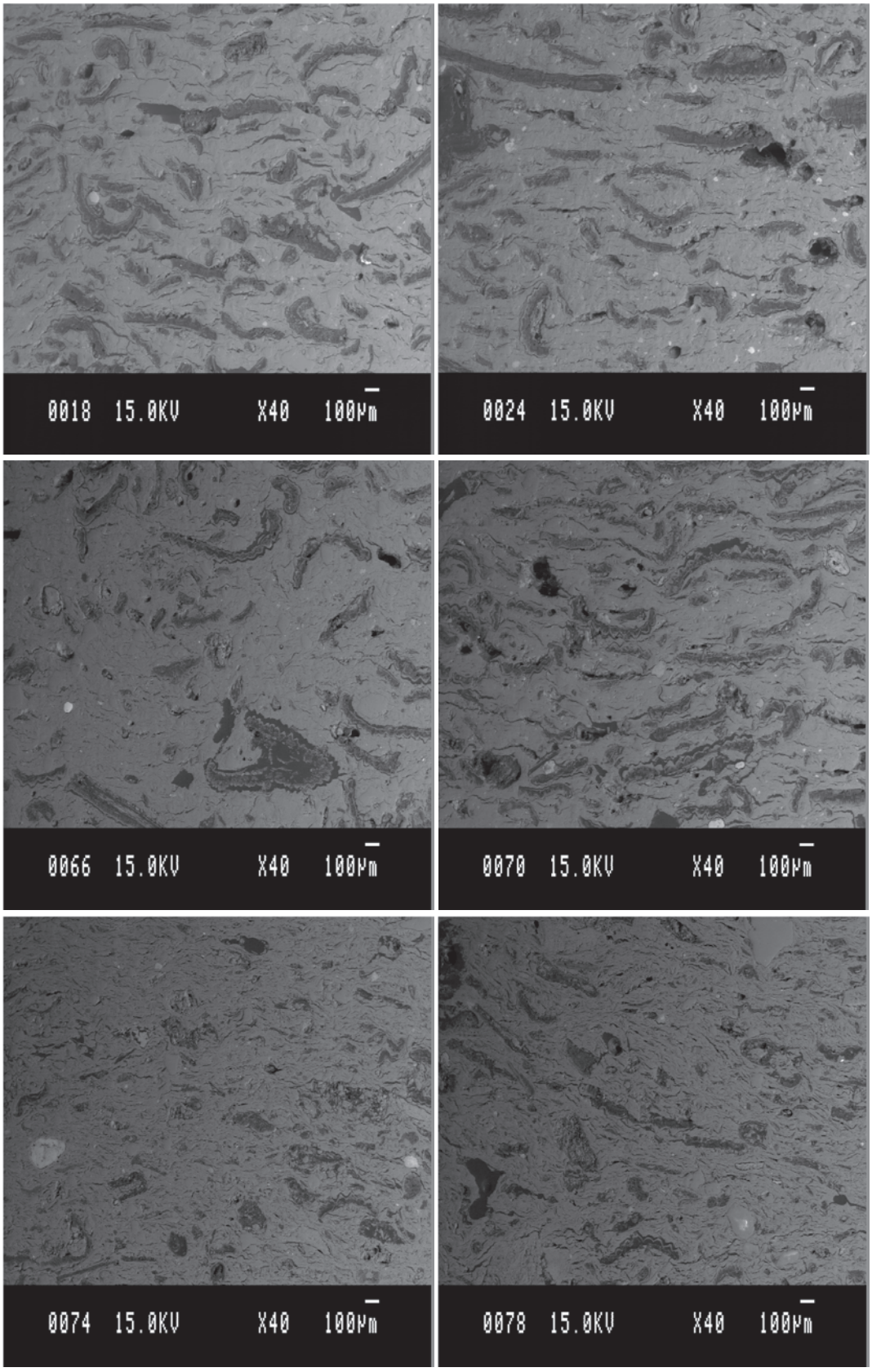


FIG. 5:12 Images of the ceramic fabric from Phimai black samples 1-6 from Ban Suai

VI IRON AGE MORTUARY CERAMICS: FABRIC CHARACTERISATION

CARMEN SARJEANT

INTRODUCTION

This section describes the analysis and results of a chemical analysis of the fabrics from sampled ceramic vessels that were recovered from Iron Age burial contexts. This characterisation includes the temper and clay selections of prehistoric potters for Iron Age mortuary ceramic vessels and tracks modifications in ceramic technology during this period. The Iron Age ceramic sequence is also related to the earlier identified ceramic technologies of the Bronze Age (Sarjeant 2011).

METHOD

Ceramic vessel samples were collected during the 2006 to 2007 excavation season from the material excavated in the 2005 to 2006 and 2006 to 2007 seasons. A small sherd was selected from ceramic vessels found in burials of Iron Age mortuary phases 1 and 2. Form and decoration were recorded at the time of sherd collection. Photographs were acquired at a later date once reconstructions were completed to support these recordings. When possible, more than one sherd was collected from a vessel: one from the upper portion and one from the lower portion of the pot, for example a rim and a body piece. Often multiple samples were gathered from different vessels with a similar form. These sherds were transported to New Zealand to analyse the ceramic fabrics with the electron microprobe, located in the Geology Department of the University of Otago, Dunedin.

A total of 80 sherds were sampled from 65 different ceramic vessels from Iron Age burial contexts (see table 6:1). The number of sherds sampled from each phase was determined by the number of burials and available materials for sampling.

The ceramics were analysed with an electron microprobe. This method was selected because it provides separate chemical analyses of the clay matrix and nonplastic grains. Other methods can involve the crushing of samples which mix the clay and temper additives of a ceramic fabric. This includes the commonly employed methods in ceramic analyses which provide either chemical (such as PIXE-PIGME, INAA, XRF and XRD) or optical (thin section petrography) results. The electron microprobe can be used to conduct both chemical and visual analyses of ceramic fabrics. Some tempers added in ceramic manufacture in Southeast Asia are botanical. Since these cannot be analysed chemically, they are identified visually. Petrography has been used independently from the chemical analysis of the clay matrix for such identifications (e.g. Vincent 1988, 2004; Voelker 2002, 2007). While conducting the chemical analysis of the clay matrices and mineral contents, visual observations of the tempers, grain size and texture were achieved with the electron microprobe simultaneously in this study (as utilised by Summerhayes 2000).

TABLE 6:1 *The number of sampled vessels and sherds from each mortuary phase*

Mortuary phase	Number of vessels	Number of sherds
Iron Age 1	61	75
Iron Age 2	4	5

The scientific analysis of ceramic fabrics was conducted on all sampled vessels following sherd preparation in resin briquettes. Pottery was analysed using an electron microprobe (JEOL Superprobe JXA-8600) with an EDS (Energy Dispersive Spectrometer) attachment. Machine conditions used a negative potential of 15KeV accelerating voltage. Backscatter micrographs were taken of the ceramic fabrics at 40, 80, 160 and 600 times magnification. Non-plastic inclusions, including manually added temper and natural mineral grains, and the potting clay matrices were analysed for chemical composition with the EDS of the electron microprobe. This microprobe was regularly calibrated and programmed to recognise concentrations of silicate element oxides that are frequently identified in ceramic fabrics (sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium, calcium, titanium, vanadium, chromium, manganese, iron, and nickel). The minerals were identified from chemical compositions, according to Deer *et al.* (1966).

For clay matrix characterisations, each sample was analysed five times to record the concentrations of each element. The concentration values were averaged, normalised and multivariate statistics were employed to consider all elements within the ceramic fabrics. The calculated averages were transformed into logarithm values and were the dataset for a Principal Component Analysis (PCA) in the MVARCH program (Wright 1991).

RESULTS

Temper

Six temper groups were identified in the sample. The non-

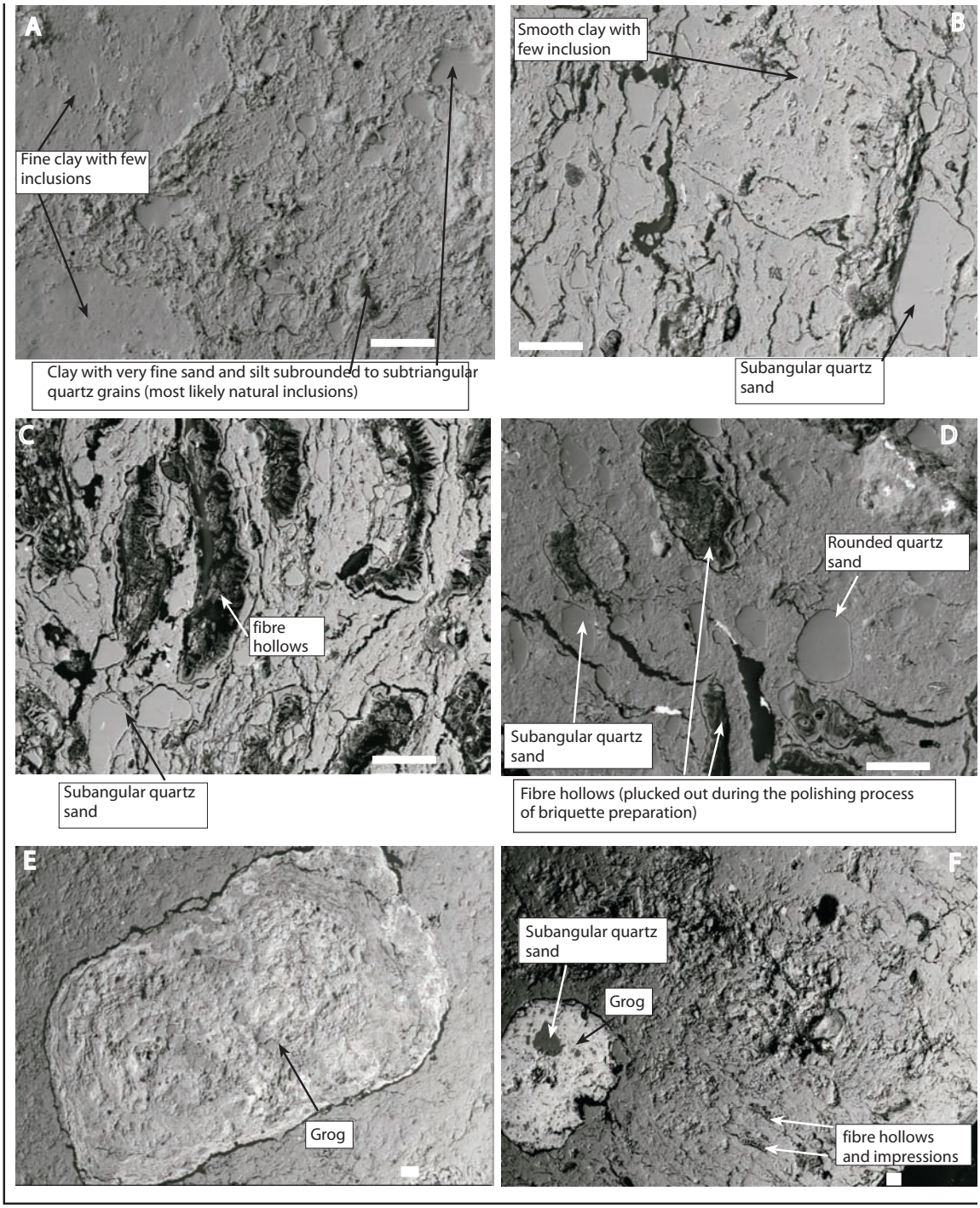


FIG. 6:1 The six identified temper groups.
A. Temper group one: untempered. Body sherd from pot cat. 26515, burial 543, Bronze Age 2. Fabric appears untempered although two clays are mixed in this vessel since a smooth clay and a relatively coarser clay with naturally occurring quartz grains are evident. These two clays do not suggest combining two different sources but more likely a coarse and fine clay within a single source Magnification x160. Imaging at 15.0keV. Scale 100µm. B. Temper group two: quartz sand. Body sherd from pot cat. 23254, burial 557, Bronze Age 4. Fabric matrix has quartz sand inclusions within smooth clay with few inclusions. Magnification x160. Imaging at 15.0keV. Scale 100µm.C. Temper group three: quartz sand and fibre. Body sherd from pot cat. 24931, burial 404.1, Iron Age 1. Fabric includes fibre hollows and subrounded and subangular fine to very fine quartz sand grains. Magnification x160. Imaging at 15.0keV. Scale 100µm.D. Temper group four: quartz sand, fibre and shell. Body sherd from pot cat. 23019, burial 471, Iron Age 2. Fabric is rice tempered with quartz sand. Shell is not visible in this image. Magnification x160. Imaging at 15.0keV. Scale 100µm.E. Temper group five: quartz sand and grog. Body sherd pot cat. 18815, burial 445, Bronze Age 2. A large grog piece is within the ceramic fabric: the crushed pottery was fired twice in the manufacture of this vessel. Both the grog and clay matrix within the fabric have a similar chemical composition, suggesting they were both made from the same clay source. Magnification x40. Imaging at 15.0keV. Scale 100µm.F. Temper group six: quartz sand, grog and fibre. Rim sherd from pot cat. 25620, burial 478, Iron Age 1. Fabric consists of small fibre particles, grog and quartz sand. Magnification x40. Imaging at 15.0keV. Scale 100µm.

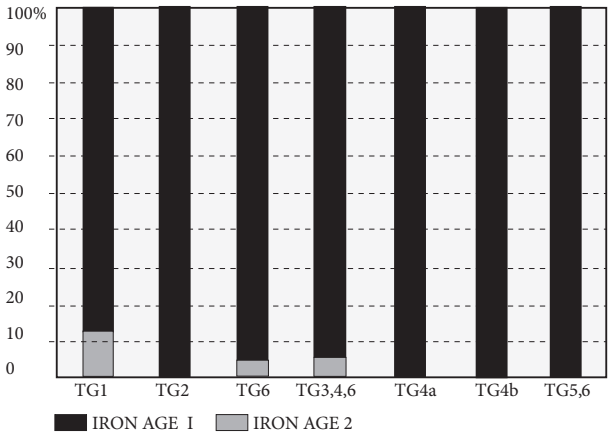


FIG. 6:2 The proportion of ceramic vessels with each temper group. TG 1: untempered/smooth clay matrix. TG2: quartz sand. TG3, 4, 6: fibre only. TG4a: shell included. TG4b: fibre and shell. TG5, 6: grog

plastic temper inclusions included quartz sand, fibre, shell, and pottery or fired clay fragments (grog). Untempered vessels were identified as chemically consistent clay matrices with few larger inclusions. Fibre temper is applied to all tempers with botanical remains that are most likely rice chaff. The tempers are described according to their material contents and photographically (Fig. 6:1).

The distribution of these temper groups across the sequence indicated a predominance of fibre tempering during the Iron Age phases (Fig. 6:2, Table 6:2). This was a continuation of the introduction of fibre tempering from Bronze Age 5 mortuary vessels.

Non-plastic inclusions

The other non-plastic inclusions in the fabrics were identified as minerals. Quartz was the most common mineral inclusion, however almandine, haematite and rutile were also frequently identified. Other clay minerals that were not identified were present alongside kaolinite and illite. Smaller quantities of alkali feldspar, apatite, calcium oxide, chromite, gypsum and mica group minerals were identified.

Clay matrix groups

The clay matrices of the ceramic fabrics were characterised chemically. The PCA of the clay matrix data indicated that the first principal component displayed the greatest variability between phosphorus and manganese oxides. The second component had the second greatest variability in titanium and manganese oxides. The third greatest variability was observed in sodium and iron oxides (Table 6:3).

One cluster was identified for the studied assemblage when plotted (Figs. 6:3-4). This suggests that the studied ceramics shared a similar chemical composition of the clays within the fabrics throughout the sequence, indicating they were made locally from a few nearby sources. However, the plotted points indicate there was some variation in chemical composition with some outliers present. These outliers do not necessarily indicate another source for clay acquisition as the main cluster of the Iron Age samples is quite spread and indicative of variability in the chemical composition of the local clay sources. There was no confirmed relationship between vessel form and clay matrix composition.

DISCUSSION: CERAMIC TECHNOLOGY FROM THE BRONZE TO IRON AGE

The earliest change in ceramic technology was in fibre tempering at Bronze Age 4, as discussed in the preceding volume in this series. This technology continued into the Iron Age. The vessel forms associated with the Iron Age were introduced in Bronze Age 5. Lastly, the clay selection method changed when variability in clay composition increased at Iron Age 1. Fabric and morphological changes occurred at different times of the Ban Non Wat mortuary sequence. Within the fabric itself, temper and clay selection changes occurred at different times. It is this fragmentary mode of change within ceramic technology that suggests a gradual development of an Iron Age ceramic tradition, rather than a rapid transition in methods from the Bronze to Iron Age. The sequence for fabrics of Iron Age mortuary ceramics is as follows:

- Iron Age 1 ceramics continued the assemblage introduced in Bronze Age 4, including large round-bodied and cord-marked wares, dishes, and round-bodied and cord-marked wares with a vertical neck. These vessels were commonly fibre tempered. Some vessels were tempered with fibre in the thin body and quartz sand or untempered in the thicker rim portion. They were made from local clays.
- Iron Age 2 ceramics continued the assemblage in Iron Age 1 and introduced Phimai Black wares, including dishes. These vessels were commonly fibre tempered. They were made from local clays.

The tempering choice for fibre for the manufacture of pre-existing Bronze Age forms at Bronze Age 4 indicates

TABLE 6:2 *Quantity of ceramic vessels with each temper group. TG = Temper Group.*

Mortuary phase	Untempered/ smooth clay matrix (TG1)	Quartz sand (TG2)	Fibre included (TG3, TG4, TG6)	Fibre only (TG3)	Shell included (TG4)	Fibre and shell (TG4)	Grog (TG5, TG6)
Iron Age 1	7	6	58	52	10	10	3
Iron Age 2	1	0	3	3	0	0	0

TABLE 6:3. *The first, second and third principal components for each element obtained in PCA with MVARCH (Wright 1991).*

Element Oxide	1st PC	2nd PC	3rd PC
Na_2O	0.02	0.11	**-0.38**
MgO	0.08	0.14	0.09
Al_2O_3	0.06	0.16	0.08
SiO_2	0.05	0.14	0.06
P_2O_3	**-0.71**	-0.38	0.02
SO_3	–	–	–
Cl	–	–	–
K_2O	-0.19	0.03	-0.08
CaO	-0.09	-0.4	0.09
TiO_2	0.08	**0.23**	0.03
$V2O_3$	–	–	–
Cr_2O_3	–	–	–
MnO	**0.64**	**-0.51**	-0.01
FeO	0.08	0.12	**0.10**
NiO	–	–	–

Note: those elements with infrequent occurrences within the analysed pottery were excluded from the Principal Component Analysis. The bold values indicate the highest and lowest values within each principal component. Therefore, phosphorus and manganese load heavily for the first principal component, titanium and manganese load heavily for the second principal component, and sodium and iron load heavily for the third principal component

that this tempering method was in use before the typical Iron Age vessel forms were produced. Fibre tempering was present in 50% of the sample from Bronze Age 4 burial contexts and by Iron Age 1 the method was evident in 88% of the sampled ceramics. Bronze Age 4 was a time of technological change in temper that was followed by a morphological change in ceramic vessel forms during Bronze Age 5. The transitional period between Bronze Age 4 and 5 established the ceramic technology employed by later Iron Age potters.

The final change to ceramic technology was in clay selection. This study did not produce strong evidence of local and non-local clay sources for ceramic manufacture. There was no indication that the vessels found at Ban Non Wat were made at a site other than Ban Non Wat. Most of the clay matrix data suggested that the ceramics were made from a single, reasonably uniform, clay composition. Uniformity in clay composition was especially evident amongst the ceramics within Bronze Age burials. From the early Iron Age, clay selection diversified and variability in clay composition increased, suggesting that more than a few local similar clay sources were exploited for ceramic manufacture. This study does not confirm contact with another pottery making area at this time and no one clay source was differentiated from the local sources. It is possible that local potters selected certain clays for ceramic manufacture in a different manner to previous methods. Less attention may have been given to the closest source and clay requirements are likely to have increased with growth in production, specialisation and population size during the Iron Age. A consistency or standardisation for the manufacture of mortuary ceramic vessels was evident in vessel forms and temper choice during the Iron Age, but not in clay selection.

The appearance of fibre tempering during Bronze Age 4 marks an important transition point in ceramic technology at Ban Non Wat. The locally made vessels of Ban Non Wat were not tempered with fibre in Bronze Age 3 and the method appears to have been adopted quickly at the advent of Bronze Age 4. With some of the most reliable dates for the Ban Non Wat sequence recently available, the potential first use of fibre tempering for mortuary ceramic manufacture can be dated. Higham and Higham (2009) have identified the beginning of Bronze Age 4 at around 790 to 740 BC. This indicates that initial fibre tempering commenced as early as 2800 years ago at Ban Non Wat.

Vincent (1988:186, 218) stated that the Khorat Plateau may have been introduced to temper techniques incorporating fibre from an external southern origin, and moved within the plateau from south to north. Vincent (1988:101) hypothesised that bleb tempering in local Khorat Plateau ceramic manufacture began later than 500 BC, as the Iron Age commenced. The earliest and most reliable dates for local production of fibre tempered ceramics within the Khorat Plateau are from Ban Non Wat and most certainly pre-date the Iron Age.

O'Reilly (2007:585-6) has noted similarities amongst the ceramics of the Iron Age site on the Khorat Plateau, Non Muang Kao, Noen U-Loke, Ban Prasat, and now Ban Non Wat. There is not only cultural continuity across this space with the presence of Phimai Black wares in the Iron Age but also in the transition from the Bronze to Iron ages. O'Reilly (2007) identified some early Iron Age vessel forms with precursors in Bronze Age assemblages. The forms at Ban Non Wat show this transition in morphology from Bronze Age 4, and particularly from Bronze Age 5. The evidence presented here supports this claim since the technology for ceramic manufacture exhibits continuity from the mid Bronze Age with the introduction of fibre tempering. The Noen U-Loke ceramics date to the Iron Age and Voelker (2007:487-493) noted that rice chaff is the preferred tempering material to the point of exclusivity from 200 AD. Similar occurrences were evident at Ban Non Wat from 400 BC.

CONCLUSION

Ceramic forms and fabrics were observed to change more than once throughout the Bronze and Iron ages of Ban Non Wat to result in some continuity in ceramic manufacture. Form, temper and clay selection changed during this sequence at different times. Stylistically, a small change was observed in pot forms between Bronze Age 3 and 4, and a further substantial modification in form was iden-



FIG. 6:3 First and second principal components of Iron Age mortuary vessel PCA of clay matrices.

tified between Bronze Age 4 and 5. The forms identified in Bronze Age 5 continued into the Iron Age, and by Iron Age 2 a further addition was made to the ceramic assemblage with the introduction of Phimai Black wares within the upper Mun Valley region. The next transformation in ceramic manufacture was observed in temper selection. The use of quartz sand, grog and no temper in Bronze Age 2 and 3 was superseded by fibre tempering at Bronze Age 4, however the former tempering techniques were retained in some ceramic vessels. This new method of fibre tempering became dominant and persisted into the Iron Age, and continues to be applied by Southeast Asian potters today. The final transition was observed in clay selection. The clay chemical composition within the ceramic fabrics was reasonably uniform throughout the sequence, although increased procurement of clay from perhaps a wider local area is evidenced at the beginning of the Iron Age. Local ceramic production utilised the local clay resources, adopted new tempering techniques from external areas, and modified vessel forms with changing socio-political organisation from the Bronze to Iron ages.



FIG. 6:4 First and third principal components of Iron Age mortuary vessel PCA of clay matrices.

Fibre tempering techniques appear to have been adopted rapidly by Khorat Plateau potters. The evidence from Ban Non Wat suggests that this introduction may have been as early as 2800 years ago. Developing from previous research that suggests fibre tempering was introduced at the beginning of the Iron Age, the current findings confirm the continued use of fibre temper on the Khorat Plateau from the mid-Bronze Age. Further research on the Neolithic ceramics may reveal the use of fibre tempering at an earlier date prior to its absence in early Bronze Age mortuary vessels.

VII ANALYSIS AND COMPARISON OF GLASS BEADS FROM BAN NON WAT AND NOEN U-LOKE

ALISON CARTER AND JAMES LANKTON

Glass beads and ornaments are ubiquitous at Iron Age period sites across Southeast Asia and recent research has highlighted the diversity of glass types found in both South and Southeast Asia during this period (e.g. Dussubieux *et al.* 2010; Lankton and Dussubieux 2006; Lankton *et al.* 2008). Chemical compositional analysis can assist in identifying the different types of glass found at a site, which in turn allows archaeologists to understand how trade networks may have been changing over time or how people at particular sites may have been interacting with one another. This process is analogous to identifying geological sources for stone artifacts, although variables such as the possible use of similar glass recipes in multiple locations, as well as the persistence of particular recipes over hundreds of years, can make the identification of glass source areas more complex.

This report presents the results of compositional analysis of glass beads and artifacts from the sites of Ban Non Wat (BNW) and Noen U-Loke (NUL) using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). In this report we will address the different types of glass found at BNW and NUL. We will then explore several research questions. First, how do the glass types at BNW and NUL compare to one another? Second, how do the glass types at each site change over time? Lastly, do the different glass compositional types shed any light on relationships with other sites in Southeast Asia or participation in specific trade networks? The results show that similar types of glass were found at both sites, although in different quantities. They also indicate a change in glass types over time, reflecting changing trade and interaction networks.

EARLY GLASS IN SOUTH AND SOUTHEAST ASIA

Ancient glasses were made from three important components: silica, fluxing agents, and stabilizing agents. The primary component of glass is silica (SiO_2), the source of which was generally sand or quartz pebbles (Henderson 2000). Because silica has a high melting point, fluxing agents were added in order to facilitate the melting process. The two principal fluxing agents were potassium oxide (potash, K_2O) or sodium oxide (soda, Na_2O). These fluxing agents were often derived from plant sources, including such high-soda desert plants as *Salicornia* or *Sasola*; however soda from mineral deposits was also used (Henderson 2000). The magnesia (MgO) levels in a sample are useful for determining if the glass was made using a mineral vs. plant ash flux. Glass made with a mineral alkali flux generally has below 1.5 weight percent (wt%) MgO, while glasses made with a plant ash flux have MgO levels above 1.5 wt% (Sayre and Smith 1961; 1967). The last important component of glass was the stabilizer, which prevented the glass from dissolving in water; the most common stabilizers were lime (calcium oxide, CaO) and alumina (aluminium oxide, Al_2O_3) (Turner 1956). Other elements found in glass include intentionally added opacifiers or colouring agents, such as antimony, tin, cobalt, copper, lead and iron, along with naturally occurring impurities. Glass recipes can vary depending on the different types and amounts of silica, fluxing agents, and stabilizers used.

THE GLASS ARTIFACTS FROM BAN NON WAT

Over 800 glass artifacts, primarily beads, have been identified in seven seasons of excavation at the site of BNW. Glass artifacts were selected for analysis on two separate occasions. The first group of 14 artifacts from the 2005-2006 field season was analyzed in 2008. A second group of 15 glass artifacts from multiple excavation seasons was analyzed in 2010. The samples were selected to represent the range of glass artifacts recovered from the site and several were from burial contexts. Radiocarbon dates from the extensive excavations at this site allow many of these artifacts to be put into an absolute chronology (Table 7:1) (Higham and Higham 2009). The burials and layers at both BNW and NUL represent the entire Iron Age period in the upper Mun Valley. Higham has divided each site into cultural phases (Iron Age 1-4) and mortuary phases (MP) that roughly correspond to one another (Higham and Higham 2009; Higham and Kijngam 2009; Higham 2011). At Noen U-Loke, MP2 equates with IA1, MP3 is IA2, MP4 is IA3 and MP5 is IA4.

The majority of the glass artifacts studied were small, drawn, monochromatic beads called Indo-Pacific beads, the most common bead types found in Southeast Asia (see Francis 1990, 2002). Indo-Pacific beads were made by drawing glass into long, hollow tubes and then cutting them to make individual beads. When viewed closely, these beads often show longitudinal striations from the tube-drawing process. After the beads have been cut, they are often heated to round the edges, and as a result, Indo-Pacific beads can be found in many shapes from tubular to oblate (Francis 2002). In addition to these beads, several other bead types were identified at BNW, including a flattened bicone (20009: numbers refer to the catalogue number of each artefacts), two coiled beads (19501 and 24505), earring or bangle fragments (n=9), a fragment of

vessel glass (18014), and one other unidentified blue glass fragment (5090). From the group selected, five earring and bangle fragments were too weathered to produce confident results (18066, 19773, 19780, 3073, and 8253). Compositional analysis from the remaining 24 artifacts will be discussed in further detail below.

METHODOLOGY

The glass beads and artifacts were analyzed by Carter in the LA-ICP-MS laboratory at the Field Museum in Chicago, Illinois, managed by Dr. Laure Dussubieux (for additional details on this technique and its performance see Dussubieux *et al*. 2009). LA-ICP-MS is an ideal technique for analyzing archaeological artifacts because it requires no sample preparation and is virtually non-destructive, leaving only a small trace invisible to the naked eye. The equipment used is a Varian ICP-MS connected to a New Wave UP213 laser. LA-ICP-MS is composed of three major components. The first is the laser sampling system. Samples were placed in a quartz chamber with continuous argon gas flow-through and a laser beam measuring 55 microns in diameter was focused on the glass sample. About ten percent of the minute glass particles released are picked up by the argon gas and transported to the second component, an argon plasma torch. The 8000°C plasma rapidly dissociates the glass particles into constituent ions, and these ions pass through the third major component of the system, a quadrupole mass spectrometer. The quadrupole flight path through the spectrometer separates the ions by mass and charge before they are measured in the ion detector. Detection limits for most elements range from 10 parts per billion (ppb) to 1 part per million (ppm), with an accuracy of 5-10% depending on the elements and their concentrations. A total of 54 elements were recorded in the final results. The analytical protocol and calculation methods used were adapted from Gratuze (1999).

RESULTS AND DISCUSSION

Full chemical compositional results for all samples are presented in Appendix 1, with major and minor elements reported as weight percent (wt%) for oxides, and trace elements as parts per million. In the current study, seven different glass types were identified. We first consider the glass artifacts from BNW and then continue with the glass artifacts from NUL. Lastly, questions raised in the introduction are addressed.

Potash glass

Four artifacts were identified as being made from potash glass. Potash glass is fairly common in Southeast Asia, as potash glass artifacts in the form of rings, earrings, bangles, and beads have been found at multiple sites across the region. Although no primary production sites for potash glass have been identified, the presence of at least three different sub-types suggests that multiple manufacturing centres were involved (Lankton and Dussubieux 2006). The three sub-types vary in the amounts of CaO and Al_2O_3, and include: potash glass with moderate amounts of CaO and Al_2O_3 (m-K-Ca-Al), potash glass with low calcium oxide (m-K-Al), and potash glass with low alumina (m-Ka-Ca).

All potash glass artifacts from BNW were classified as belonging to the m-K-Ca-Al potash sub-group; they included three earring fragments (17673, 17671, and 19013) and one unidentified fragment of glass (5090). All objects were blue or blue-green in colour. Two of the samples (17673 and 17671) were found in a burial context dated to the Iron Age 1 period (400-200 BC) while the third sample (19013) was dated to the later Late Iron Age period (AD 200-400). The unidentified glass object is from square X, layer 2:10 (late Iron Age).

Similar glass earring or bangle fragments have been identified at other sites in Cambodia and Thailand. For example, blue glass ring, earring, or bangle fragments made from m-K-Ca-Al glass have been found at the sites of Phum Snay and Prohear in Cambodia (Carter 2011. A comparable blue earring fragment was also recorded at the Lopburi province site of Promtin Tai, although the sample was too weathered to determine its composition accurately (Lertcharnrit and Carter 2010). Potash glass beads are also common at the Cambodian sites of Prohear, Village 10.8, and Bit Meas (Carter 2011). No potash glass beads have yet been excavated at BNW, however they have been identified at NUL (discussed further below). It is likely that the five weathered earring and bangle fragments also belong in this category, although their corrosion makes this difficult to confirm.

Although primary glass workshops, where glass was melted from its raw materials, have not been identified, scholars have suggested various locations that may have produced potash glass. For example, the large quantity of potash glass with moderate CaO and Al_2O_3, along with evidence for glass working, at the site of Arikamedu, India, points toward this location as a possible primary manufacturing centre (Lankton and Dussubieux 2006). Potash glass is also fairly common at the peninsular Thai site of Khao Sam Kaeo, where there is evidence for secondary glass working in the form of bracelet manufacture using potash glass (Lankton and Dussubieux 2012 in press). The low-alumina potash glass type remains poorly understood, but most likely dates to the 4th to 2nd centuries BC, with most examples found in Thailand at the site of Ban Don Ta Phet Lastly, large numbers of the low-CaO glass artifacts been found in many areas of Southeast Asia, with dates ranging from the 4th to the 2nd century BC into the 2nd century AD (Lankton and Dussubieux 2006). Important variations in trace element concentrations within this group, and indeed for m-K-Ca-Al glass as well, suggest the presence of multiple primary production sites, possibly including northern Viet Nam or southern China. Until glass

production workshops are identified archaeologically, the exact manufacturing location(s) for potash glass, with its various sub-types, remains unknown.

High-alumina mineral soda glass (m-Na-Al Type 1)

Ten glass beads were classified as high-alumina mineral soda glass (m-Na-Al). This compositional group is the most common type of glass found in Southeast Asia. Dussubieux *et al.* (2010) have identified five different subtypes of mineral soda alumina glass, of which m-Na-Al Type 1, identified by its relatively low uranium and high barium content, is the most prevalent during the Iron Age of Southeast Asia. The m-Na-Al Type 1 glass is often found in a wide variety of colours including opaque red, orange, yellow, green, light blue, black and translucent light blue, although not medium or dark purplish blue coloured with cobalt. The m-Na-Al Type 1 glass is believed to have been manufactured in Sri Lanka and South India (Dussubieux 2001; Dussubieux *et al.* 2010; Dussubieux and Gratuze 2012 in press). Lankton and Dussubieux (2012 in press) have noted a regional shift from potash glass to high-alumina soda glass at sites across Southeast Asia around the turn of millennium BC/AD. The reasons and meaning for this shift are still under debate (discussed below).

All the m-Na-Al Type 1 glass beads at BNW were found in layer 3 to layer 1 (approx. 200 BC- AD 600). Seven of the glass beads (15506) were from burial 266, an infant jar burial dated to the late Iron Age, approximately AD 400-600 (Higham and Kijngam 2006:73). The burial contained 112 glass beads, the majority of which were yellow (n=55), as well as light blue (n=14), dark blue (n=26), red (n=9), orange (n=6), white (n=1) and a single black glass bead. One dark blue bead from this burial appears to be another type, m-Na-Ca-Al (discussed below). In addition to the glass beads the burial also included bronze bangles and an agate pendant. Three other glass beads from non-burial contexts were also placed in the m-Na-Al Type 1 category. All three beads were from Layer 2 and have been dated to approximately 200-400 AD. They included a yellow bead (20002), a greenish-blue bead (20523), and an orange bead (20519). The orange bead has higher levels of MgO than the other m-Na-Al Type 1 beads, typical of many opaque orange glass beads found in Asia.

Based on similarities in colour and form, it is believed that approximately 232 additional beads in burial and non-burial contexts may also be classified as high-alumina mineral soda glass (Fig. 7:1). These include Indo-Pacific beads in red, orange, yellow, green, turquoise blue, black, and white colours. The majority of these Indo-Pacific beads were found in Layer 2. Orange, yellow, and light blue beads were the most common glass colour types found at BNW. It is possible that some of the yellow beads are actually lead glass (see below) and not high-alumina mineral soda glass, but this cannot be confirmed without additional compositional analysis.

Lead glass beads

Four beads from BNW had high levels of PbO (30-50 wt%), classifying them as lead glass. The lead glass beads include two coiled light blue beads (19501 and 24505), an opaque blue flattened bi-cone bead (20009), and a yellow oblate bead (20512). All four date to the Late Iron Age period (200-400 AD). During initial analysis, one bead (19501) was described as a possible collared bead, however, during later excavations additional similar beads were found that appear to have been wound or coiled, and this classification was reassessed. In this method, the beads are produced by winding or coiling glass around a metal

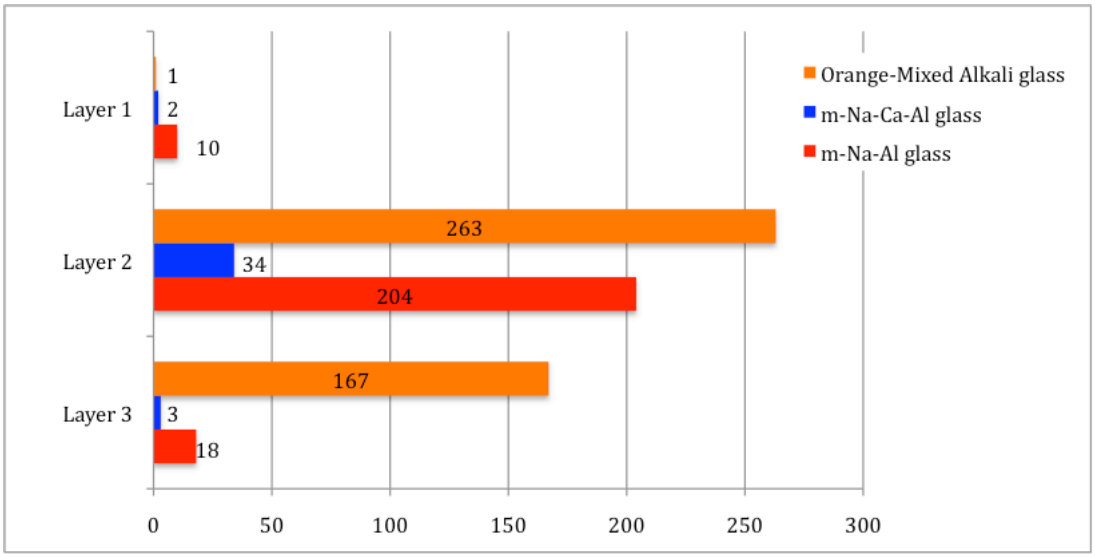


Fig. 7:1. An estimate of the quantity of the mixed alkali, m-Na-Ca-Al, and m-Na Al glass types over time at Ban Non Wat. These numbers are estimates and with additional compositional analysis it may be found that quantities of each type could vary.

rod. An additional bead from a group of 16 was analyzed in the current study (24505). These beads look remarkably similar to Chinese coil beads described by Francis (2002, colour plate 16). However, Francis argues that the earliest Chinese coil beads date to the eighth century AD and that these beads were not common until the decline of Indo-Pacific beads during the 12th century AD (Francis 2002:76). These beads may represent early examples of this bead type that become common during a later period.

Lead beads are rare at Southeast Asian archaeological sites. Dussubieux (2001) only identified six: three from the site of Angkor Borei, Cambodia (2nd century BC-2nd century AD) and three from the later 9th century AD site of Sarawak in Indonesia. Recent research indicates that there are also lead glass beads at the Sa Huynh site of Lai Nghi in Vietnam (Karsten Brabender, pers. comm.). A yellow lead glass bead was also discovered at the site of Prohear (Carter 2011). It is possible that with continued study lead glass beads could be found to be more common.

There also appears to be considerable variability within the lead glass type. The lead glass beads at Angkor Borei were notable for their high barium content, a characteristic usually thought to indicate a Chinese origin (Stark and Dussubieux 2002). In contrast, the lead glass beads from BNW do not have high barium content. Of the four lead glass beads at BNW, cat. 20512 has extremely low levels of CaO and high levels of SnO_2 in comparison to the other samples, and cats. 20009 and 24505 have much higher levels of Na_2O. It is possible that these beads belong to the early period high-lead glasses without barium, which are characterized as containing higher levels of arsenic (Brill *et al.* 1991). The BNW samples do contain elevated levels of arsenic in comparison to the other beads studied; especially cat. 20512 that contained 3876 ppm arsenic. It is clear that further research is needed to better understand these beads and the lead glass type. Lead isotope analyses may assist in better understanding when and where these beads were manufactured (e.g. Henderson *et al.* 2005).

Mineral soda glass with variable amounts of alumina and lime (m-Na-Ca-Al)

Thus far, only one bead has been identified as mineral soda glass with variable amounts of alumina and lime, although there are probably additional beads that fall into this category. This bead was one of a group of seven similar beads found amongst a larger group of high-alumina mineral soda glass beads in burial 266 (discussed above). The beads are unusual in that they are tubular with sharp, not rounded, edges and coloured with cobalt. This type of glass is sometimes difficult to identify due to the wide variability in its composition, and especially its similarity to high-alumina soda glass (Dussubieux and Gratuze 2010). However, m-Na-Al Type 1 beads were not coloured with cobalt (Dussubieux *et al.* 2010), allowing us to more confidently place this artifact in the m-Na-Ca-Al category. Figure 7:1 presents an estimate of the additional m-Na-Ca-Al glass beads found at BNW based solely on their dark cobalt blue colour. As with the high-alumina mineral soda glass, most of the dark blue cobalt glass beads were found in Layer 2 (approx AD 300-500). This type of glass can also be found in other colours, and previous studies have also identified potash glass beads in a dark cobalt blue colour.

The m-Na-Ca-Al glass type has been found at locations across south India, Sri Lanka, and Southeast Asia (Carter 2011; Dussubieux and Gratuze 2010; Lankton and Dussubieux 2012 in press), and the variations in major and trace elements make it likely that there is more than one 'm-Na-Ca-Al' glass, with different types having different archaeological meanings. The manufacturing locations may include Arikamedu, India, where the glass previously identified as 'Arika' has an m-Na-Ca-Al composition (Dussubieux and Gratuze 2012 in press). Similar m-Na-Ca-Al glass has been found at the site of Phu Khao Thong, Thailand (Dussubieux and Gratuze 2010), although it remains rare at other, seemingly contemporaneous, peninsular sites. A different m-Na-Ca-Al glass, often cobalt blue, was probably produced at Khuan Lukpat on the west coast of the Thai/Malay Peninsula (Lankton and Dussubieux 2012 in press).

Soda-lime glass with plant-ash alkali source (v-Na-Ca)

Two artifacts were classified as soda-lime glass with a plant-ash alkali source (v-Na-Ca). The first is a fragment of a glass vessel (18014) that dates to the Late Iron Age period (AD 200-400). The other is a light blue glass fragment (18), which may come from an earring or bangle. The glass fragment was found in square Y layer 2, which dates to the later Iron Age based on the presence of Phimai black pottery (Higham and Kijngam 2009:137). Soda-lime glass with a plant-ash alkali source was the earliest glass produced, dating to the mid-2nd millennium BC in western Asia and Egypt, and most likely continued to be produced in Mesopotamia even while glass makers in the Roman world changed to a mineral soda (trona or natron) flux. The v-Na-Ca composition of the vessel glass from BNW is quite similar to that of a group of high magnesia (HMG type 1) glass fragments from the Sasanian-controlled site of Veh Ardasir (3rd-6th centuries AD) in Central Iraq (Mirti *et al.* 2008), and its presence in Southeast Asia may be interpreted in the context of increased control of Indian Ocean trade by the Sasanians during the 4th- 6th centuries CE (Lankton and Dussubieux 2006).

Mixed-alkali glass

An orange disc bead (cat. 20514) is the only sample to be classified as mixed-alkali glass, however there are numerous additional beads that may also fall in this category. In contrast to the ubiquitous Indo-Pacific glass beads that were drawn from long tubes, many mixed-alkali opaque orange disc beads appear to have been wrapped (Saitowitz and Reid 2001). In this proposed method, a flat glass

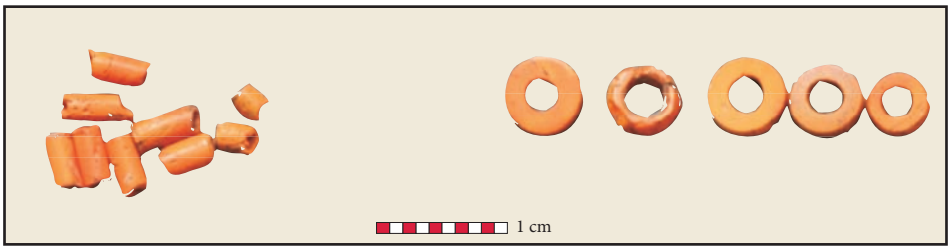


FIG. 7:2 Examples of orange mixed alkali glass beads from Noen U-Loke. Both types of beads are believed to have been wrapped, not drawn as with Indo-Pacific beads. The disc shaped beads (NUL-030) are on the right; the tube shaped beads (NUL-028) are on the left

sheet is wrapped around a metal rod to form a long tube from which the glass disc beads were sliced. Large numbers of these beads have been found at sites in Northeast Thailand, including NUL. Based on compositional work on beads from NUL, a second form of mixed-alkali glass bead has been identified: a small, short tubular bead that also appears to have been wrapped (Fig. 7:2). Figure 7:1 illustrates the estimated quantity of orange opaque mixed-alkali beads found at BNW in burial and non-burial contexts. A few stray orange wrapped beads were identified in Layer 4, however the majority of the beads appear in Layers 3 and 2 (approx 200 BC-AD 400). Based on typology alone, these beads were the most abundant bead type found at the site, with nearly twice as many found as the high-alumina mineral soda glass. However, previous studies have found that disc beads have also been made from potash and m-Na-Al glass, so this assumption would have to be tested with further compositional analysis.

The high number of orange opaque disc beads at both BNW and NUL is unusual when compared to other sites in Southeast Asia (see Lankton and Dussubieux 2012 in press). Mixed-alkali glass is present, although rare, at the peninsular Thai site of Khao Sam Kaeo (Lankton and Dussubieux 2012 in press). Additional orange wrapped beads have been found near Ban Non Wat at the sites of Non Muang Kao (Saitowitz and Reid 2001) and possibly Ban Bon Noen (Pilditch 1992). No beads of this type have yet been found in Cambodia. Similar orange and red opaque disc beads have also been reported at sites in southern India and Sri Lanka, where they may have been manufactured, as well as Chombeung, Thailand, Giong Ca Vo, Vietnam (Dussubieux 2001; Lankton and Dussubieux

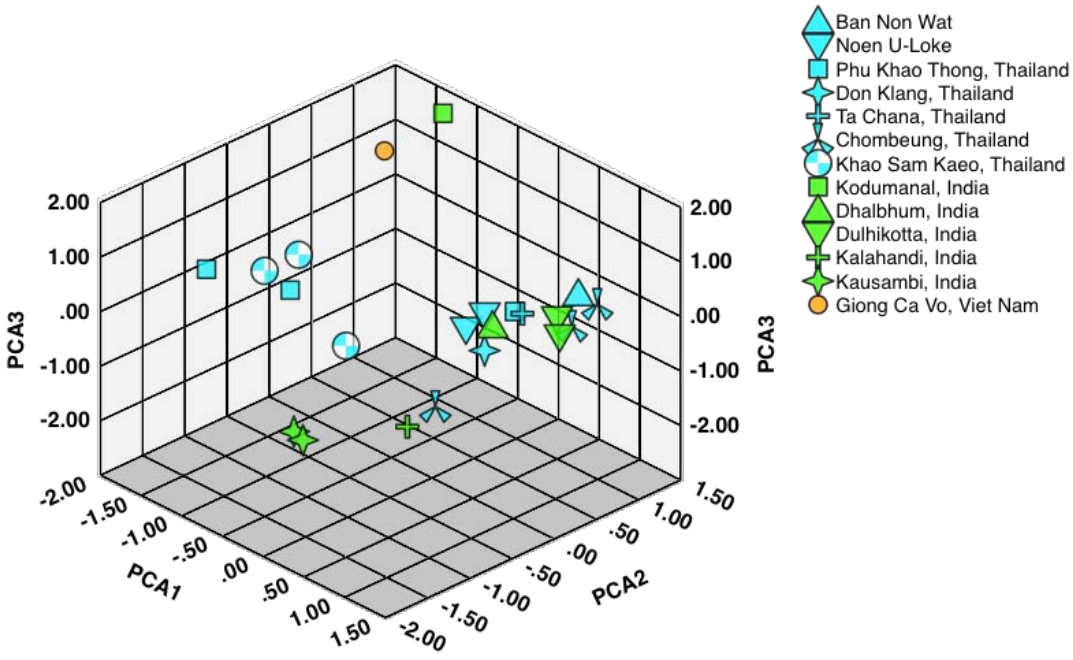


FIG. 7:3 A 3D PCA scatterplot of the compositions of opaque orange mixed alkali beads from various sites in South and Southeast Asia. The scatterplot indicates there may be several different types of mixed alkali glass in circulation. Beads from sites in Thailand are blue, beads from sites in India are green, and a bead from a site in Viet Nam is orange. Data for the scatterplot taken from Dussubieux 2001 and from unpublished data courtesy of Laure Dussubieux and Bernard Gratuze.

2006), Ban Chiang (White 1982), and the peninsular Thai site of Ta Chana (Pongpanich 2006:51). However, Francis notes that many orange and red disc beads were not wrapped, but instead made from solid canes of glass that were sliced into discs and then perforated by drilling (Francis 2002:136-7). While these disc beads appear to share a similar glass type and bead shape as the objects found at Ban Non Wat, their manufacturing method would appear to distinguish them from the wrapped beads found in Northeast Thailand.

In order better to understand where the BNW bead falls within the spectrum of mixed-alkali glass, the composition of this bead was compared to orange mixed-alkali glass beads from several other sites in South and Southeast Asia. The compositions were evaluated using principal component analysis (PCA). PCA is an ideal exploratory method for reducing and simplifying a large number of linked variables, such as the elements produced in LA-ICP-MS analysis, into components (see Baxter 1994). Figure 7:3 shows the first three principal components, which account for 69.5% of the variance, graphed as a scatterplot. The scatterplot shows multiple possible groups of mixed-alkali glass beads, with those from the peninsular Thai sites of Khao Sam Kaeo and Phu Khao Thong being distinct from the mixed-alkali glass found at other sites in India and Southeast Asia. However, the BNW and NUL mixed-alkali glass may share a compositional similarity with beads found at the peninsular Thai site of Ta Chana, the central Thai site of Chombeung, and the northeast Thai site of Don Khlang, as well as two sites in India: Dhalbhum and Dulhikotta. It should be noted that these groupings are only preliminary and cannot yet tell us where or when the beads were manufactured. Additional research on both the composition and manufacturing method of mixed-alkali beads is needed before confidently distinguishing between these clusters. Indeed, future research may find that the distinctions between the groups will change. However, this preliminary analysis does indicate the presence of several types of mixed-alkali glass in circulation during the Iron Age period.

Unknown glass type

Two beads found in layer 1 were of an unusual potash-lime glass type, with a plant-ash flux. One glass bead, colourless, was about 10mm in diameter and was found in square Y, while the other, transparent greenish-blue bead and approximately 8mm in diameter, was found in square A4. Both beads appear to have been wound. The beads have high levels of MgO (approximately 5 wt%) and CaO (13-15 wt%), as well as 6-10 wt% K_2O and 5 wt% Al_2O_3. The beads are similar in composition to wound beads found in burials of members of the Ma, K'Ho, and Ru tribes in Viet Nam, dating from the 16th-18th centuries AD (Brill 1999). These beads fall well outside the Iron Age period, the focus of this report, and therefore will not be explored in depth.

GLASS BEADS FROM NOEN U-LOKE

Over 800 glass beads and artifacts have been uncovered at BNW, however the over 7000 glass beads uncovered in burials at the nearby site of Noen U-Loke (NUL) dwarf this number (Talbot 2007). This difference is especially striking when we consider that over 900 m² have been excavated at BNW during the 2002-2007 field seasons, while only 220 m² were excavated at NUL over two seasons. Approximately 50 glass beads, as well as an object described as glassy slag found on a piece of black ceramic were previously analyzed by Saitowitz and Reid (2001), who used electron probe microanalysis (EPMA) to measure the major elements and LA-ICP-MS to analyze trace elements. Most of the beads analyzed were Indo-Pacific trade beads, however they also identified several orange wrapped beads discussed above, and a group of bi-colour beads with a red core and orange outer layer. Of the beads they analyzed, Saitowitz and Reid found that the majority (n=37) were high-alumina mineral soda glass (m-Na-Al Type 1); five beads were mixed-alkali; four were described as low-alumina potash glass (m-K-Ca); three were soda-lime glass with plant-ash alkali (v-Na-Ca); and two were high-lime mineral soda glass (m-Na-Ca-Al).

Although their report was admirable, Saitowitz and Reid did not provide a context for the beads they analyzed, making it difficult to determine if there was a change over time in the quantity or type of glass at the site. In order to better understand the complete NUL glass bead assemblage, glass bead artifacts from Noen U-Loke were examined and recorded by Carter at the Phimai National Museum in 2010. Unfortunately, not all of the beads could be recorded as some did not have their associated context information and others were not available for study. Nevertheless, this analysis provides a more comprehensive understanding of the entire glass bead collection from NUL than previously discussed.

Additionally, LA-ICP-MS analysis has greatly expanded since Saitowitz and Reid's original report. Therefore, an additional 29 beads from NUL were analyzed as part of the current study (Table 7:2). The same methodology and procedure were followed as described above. It should be noted that two of the 29 beads will not be included in the current discussion. The first, NUL-011, was too corroded to provide confident results. The other, NUL-017, is an unusual polychrome bead that lacks adequate provenance information. The results from the remaining 27 artifacts will be briefly summarized and compared to the broader collection of NUL glass beads recorded at the Phimai museum as well as those noted in the NUL excavation report (Higham *et al.* 2007).

2009 analysis of Noen U-Loke glass beads

Four beads were classified as potash glass beads. Although three of these (NUL-006, NUL-010, and NUL-029) have relatively low levels of CaO, they should probably be clas-

sified as m-K-Ca-Al glass, since they lack the high rubidium and high rubidium/strontium ratios that characterize the m-K-Al potash glass subtype. NUL-016, a dark blue-purple bead, was classified as m-K-Ca-Al glass as well, the same glass subtype as that found at Ban Non Wat. Three of these beads were found in an IA4 context (AD 400-600), however one bead (NUL-029) was found in burial 37 (IA2A: 100 BC- AD 200). This wide spread in composition and date confirms our earlier suggestion that more than one primary production centre should account for the m-K-Ca-Al glass found in Southeast and South Asia. Seventeen of the glass beads sampled fell into the high-alumina mineral soda glass compositional type (m-Na-Al Type 1). These Indo-Pacific beads came in a variety of colours including black, blue, blue-green, grey, turquoise, white and yellow. Nine of the m-Na-Al beads were from IA4 (400-600 AD) burial 8, the burial of a young adult also containing pottery vessels and an iron knife and sickle (Higham *et al.* 2007:137). Other glass beads were from IA3A (AD 200-400), including one from burial 105, a rich burial of an adult male, which contained 494 glass beads in a variety of colours as well as bronze jewellery, an iron point, and a silver bracelet (Higham *et al.* 2007)

Also found in burial 8 were bi-colour glass beads, also classified as m-Na-Al Type 1. These Indo-Pacific beads have a core of red glass and an outer layer of orange glass. Although they are uncommon, similar bi-colour beads have also been found at sites in South India and Sri Lanka (Dussubieux and Gratuze 2012 in press), as well as Phum Snay (Carter 2011) and Angkor Borei, Cambodia (Dussubieux 2001), Khlong Thom and Takua Pa in peninsular Thailand, Sungai Mas, Malaysia (Francis 2002), and Ban Non Noen in Central Thailand (Pilditch 1992). Four beads were classified as m-Na-Ca-Al glass: NUL-003, NUL-005, NUL-007 and NUL-015. As with the m-Na-Ca-Al glass found at BNW, their compositions were similar in many respects to high-alumina mineral soda glass, but all four were coloured with cobalt. Two of the beads were broken, but all appear to be tubular beads with sharp edges, similar to the BNW bead discussed above. These beads were found in contexts associated with IA3A and 4 (approximately AD 200-600). Two orange opaque beads from NUL were identified as being mixed-alkali beads: NUL-028 a tubular bead and NUL-030 a disc bead. Both appear to have been wrapped, as discussed above (Fig. 7:2). The beads were from burial 37, an adult female from IA2A (100 BC- AD 200) and found with over 200 similar beads, as well as agate beads, bronze finger rings, and a pig offering (Higham *et al.* 2007:156).

ARCHAEOLOGICAL QUESTIONS

How do the glass beads at BNW and NUL compare to one another?

Returning to the questions asked during the introduction, we must first ask how the glass artifacts at BNW and NUL compare one with the other. The sites are just 1.8 km apart and so it is unsurprising that they have similar types of glass. Glass types found at both sites include: m-Na-Al Type 1, potash glass, mixed-alkali glass, m-Na-Ca-Al, and v-Na-Ca glasses. However, there are a few notable differences between the two sites. A small group of lead glass beads has been identified at BNW, but no similar beads have been identified at NUL. Potash glass earring and bangle fragments have been identified at BNW, but no potash glass beads like those found at NUL have been uncovered. Perhaps the most obvious difference is the much larger quantity of beads and artifacts found in burials at NUL. Only thirteen Iron Age burials at BNW had glass artifacts, and of these only four had more than 50 beads. Conversely, the number of glass beads in burials is much higher at NUL, with 53 burials containing glass beads, and at least 12 burials having more than 50 beads. While the earliest glass artifacts appear at BNW during the Iron Age 1 period (420-100 BC), glass does not appear at NUL until IA2 (100 BC-AD 200), with a peak in the quantity of glass beads during IA2 and IA3 (AD 200-400) (Talbot 2007). Part of the discrepancy in the quantity of beads could be related to the dates of occupation at both sites. The majority of burials at BNW date to the earlier Iron Age 1 period, whereas the later Iron Age period and its accompanying increase in mortuary wealth is better represented at NUL (Higham and Higham 2009). Nevertheless, when we look at both sites together, we are able to see a broad shift in glass types over time.

How do glass types change over time at BNW and NUL?

The earliest glass artifacts are not beads, but blue glass earrings found at BNW (Higham and Kijngam 2009). These objects were found in occupation contexts as well as burials (357, 235, 237, and 101) dating to the Iron Age 1 period (420-200 BC). Based on the current LA-ICP-MS study, we know that these earrings were made from potash glass. Lankton and Dussubieux (2012 in press) have noted a regional shift from potash glass to high-alumina mineral soda glass at sites across Southeast Asia around the 2nd century BC- 2nd century AD. However, Carter (2011) has also identified roughly contemporary sites in Cambodia, falling within the 200 BC- AD 200 time frame, that have distinctly different and non-overlapping distributions of glass. For example, no high-alumina mineral soda glass has been identified at the site of Prohear, which is dominated by potash glass beads. In contrast, the site of Angkor Borei has large quantities of high-alumina mineral soda glass but no potash glass (see also Dussubieux 2001). Although the precision of radiocarbon dates for this period may be questioned, if we accept the current dating for the graves at Prohear and Angkor Borei, this raises the question that the difference in glass-type distribution is related not only to a temporal shift in the availability of glass, but also to the presence of two distinct glass bead

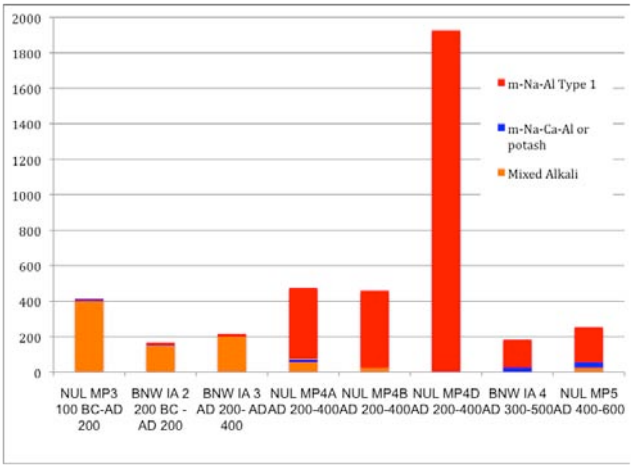


FIG. 7:4 An estimate of the quantity of different glass types at Ban Non Wat and Noen U-Loke over time.

trading networks.

The potash glass artifacts from BNW (n=4) and NUL (n= 8) are instructive in this regard. While potash glass is rare at most Southeast Asian sites after the 1st century AD, four of the NUL potash glass beads identified in the current study were from mortuary phase 5, dated from AD 400-600. This observation is consistent with potash glass beads, often cobalt blue, found at Arikamedu, Phu Khao Thong, and in Eastern Han tombs in northern Vietnam (Dussubieux 2001). In addition, potash glass beads are relatively common in Korean graves into the 5th century AD (Lankton and Lee 2006).

The dominance of opaque orange mixed-alkali glass seems to be characteristic of BNW and NUL and perhaps other sites in the Northeast Thailand. These beads are first seen in Iron Age 2 burials at BNW (200 BC- AD 200) and IA2 burials at NUL (100 BC- AD 200). However, they began to decline around AD 200 when they were replaced by high-alumina mineral soda glass in multiple colours. Figure 7:4 demonstrates the change in the quantities of three types of glass found at NUL and BNW over time. The figure is not representative of all the glass beads uncovered at both sites, as not all of the beads were available to be recorded. For example, exact numbers of the glass beads found at NUL IA3C are unavailable, as are specifics regarding over 700 beads found in a burial during IA2B. Nevertheless, it does allow one to see the general distribution of glass types over time and space. We still do not know where these beads were made, although their limited circulation and compositional similarity to other beads found in Thailand may point toward a nearby manufacturing centre.

The introduction of high-alumina mineral soda glass brought higher quantities of beads in a variety of different and new colours. This is best reflected at Noen U-Loke, which has a more extensive late Iron Age period component. Mortuary rituals were also changing during this period, as larger quantities of glass beads were being placed in subadult burials (Talbot 2007:338). The large number of glass beads found in certain burials, such as the over 1719 light blue glass beads from burial 13, also hint at the large numbers of beads that were available through exchange networks during this period and may have been brought to the site in a single exchange event. Nevertheless, the number of glass beads at the site declined by IA4, with only 500 found in burials, and NUL appears to have been abandoned shortly after this phase.

What do the glass artifacts tell us about the relationship between Ban Non Wat and Noen U-Loke, and their participation in trade networks with other sites in South and Southeast Asia?

Compositional analysis of glass beads from BNW and NUL allows us to identify changing glass types over time, which in turn may be related to changing trade and exchange networks. While we still do not know where potash glass artifacts were being made, potash glass beads and artifacts have been found in high quantities at Dong Son, Sa Huynh, and sites in peninsular Thailand which were participating in South China Sea exchange networks. The relatively low number of potash glass artifacts and beads indicate that BNW and NUL were perhaps only peripherally involved in these early glass trade networks, which may have been focused on coastal sites.

By 100 BC, orange mixed-alkali glass beads were present at sites in Northeast Thailand. As discussed above, the unique distribution of this artifact at sites in Northeast Thailand is notable, however this is not the only artifact with a fairly restricted distribution at sites in Northeast Thailand. Theunissen (2007) has also highlighted the limited distribution of notched agate pendants at sites in this region. This pattern could be related to personal preference for specific types of beads or could be related to their relative isolation from maritime exchange networks (Theunissen 2007:373). Similar reasons could be considered for the distribution of mixed-alkali glass beads. While both artifacts may have originated in a distant location, their restricted distribution suggests the importance of these prestige objects within the Northeast Thailand interaction sphere.

In fact, it does not appear that people at BNW and NUL were participating in broader exchange networks until the appearance of high-alumina mineral soda glass beads, which were believed to have been imported from manufacturing sites in South Asia and possibly peninsular Thailand. We do not know if these beads, made from a different type of glass and found in new colours, were considered to be exotic or different from the earlier glass beads found at these sites. However, when these beads appear in Southeast Asia, they are traded widely across the landscape. The m-Na-Al Type 1 beads appear at NUL during IA3 (AD 200-400) and at BNW during IA4 (AD 400-600). It was during IA3 at NUL that we also see an increase in the quantity of grave goods with certain individ-

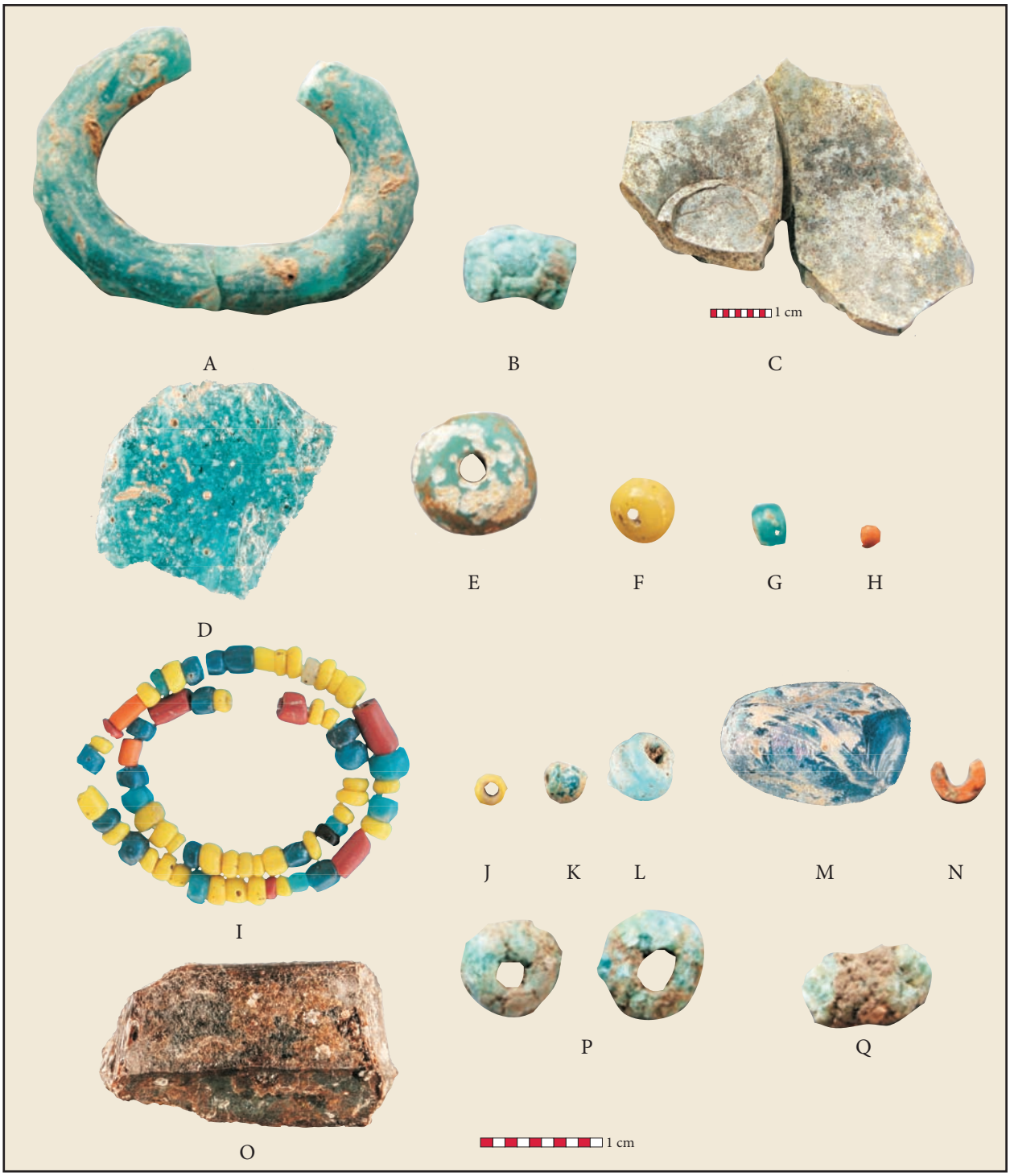


FIG. 7:5 The analysed glass from Ban Non Wat. A. cat. 17673 burial 235, B. cat. 17671 burial 235, C. cat. 18014 E7 2:7, (actual size), D. cat. 5090 X1 2:10, E. cat. 20009 G2 2:2, F. cat. 20002 G5 2:2, G. cat. 20523 G6 2:7, H. cat 20519 G6 2:5 I. cat. 15506 burial 266 actual size, J. cat. 20512 G6 2:5, K. cat. 19501 F7 2:1, L. cat. 24505 E4 2:5/6, M. cat. 18 Y1 2:5, N. cat. 20514 G6 2:5, O. cat. 3073 B3 4:6, P. cat. 18066 burial 377 Q. cat. 19870 burial 377

uals, evidence for additional stress within the community, and perhaps for changing social organization (Higham *et al.* 2007; Talbot 2007). IA3 also coincides with a broader trend of increasing interaction between sites in Southeast Asia and more intense contact with South Asia (Bellina and Glover 2004). These changes were part of the beginning of the long-term processes that culminated in the development of early states and ultimately the Kingdom of Angkor.

Table 7:1 *Glass artifacts from Ban Non Wat analyzed by LA-ICP-MS*

Cat. No	Artifact	Colour	Context Information	Period	Date	Compositional Group
17673	Earring fragment	Light blue	Burial 235	Iron Age I	400-200 BC	m-K-CA-Al
17671	Earring fragment	Light blue	Burial 235	Iron Age I	400-200 BC	m-K-CA-Al
19013	Earring fragment	Light blue	F6 2:6	Late Iron Age	AD 200-400	m-K-CA-Al
5090	Glass fragment	Blue	X1 2:10	Iron Age	100 BC- AD 400	m-K-Ca-Al
20002	Oblate bead	Yellow	G5 2:2	Late Iron Age	AD 200-400	m-Na-Al Type 1
20523	Oblate bead	Greenish blue	G6 2:7	Late Iron Age	AD 200-400	m-Na-Al Type 1
20519	Oblate bead	Orange	G6 2:5	Late Iron Age	AD 200-400	m-Na-Al Type 1
15506-orange	Oblate bead	Orange	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
15506-yellow	Oblate bead	Yellow	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
15506-turquoise	Oblate bead	Turquoise	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
15506-dark blue 1	Oblate bead	Dark Blue	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
15506-black	Oblate bead	Black	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
15506-white	Oblate bead	White	Burial 266	Late Iron Age	AD 300-500	m-Na-Al Type 1
20512	Oblate bead	Yellow	G6 2:5	Late Iron Age	AD 200-400	Lead
20009	Flattened bicone bead	Light blue	G5 2:2	Late Iron Age	AD 200-400	Lead
19501	Coiled bead	Light blue	F7 2:1	Late Iron Age	AD 200-400	Lead
24505	Coiled glass	Blue	E4 2:5/6	Late Iron Age	AD 200-400	Lead
15506-dark blue 2	Oblate bead	Dark Blue	Burial 266	Late Iron Age	AD 300-500	m-Na-Ca-Al
18	Bangle fragment?	Blue	Y1 2:5	Later Iron Age	200 BC-AD 200?	v-Na-Ca
	Vessel	Transparent blue-green	E7 2:7	Late Iron Age	AD 200-400	v-Na-Ca
20514	Wrapped disc bead	Orange	G6 2:5	Late Iron Age	AD 200-400	Mixed alkali
393	Large oblate bead	Greenish-blue	A4 1:2	Historic	16th-18th century AD?	Unknown-
4	Large oblate bead	Clear	Y1 1:5	Historic	16th-18th century AD?	Unknown
3073	Bangle fragment	Greenish-brown	B3 4:6	Unknown	Unknown	Weathered
burial	Bangle fragment	Blue	A3 1:5	Unknown	Unknown	Weathered
18066	Oblate bead	Greenish blue	Burial 259	Iron Age I	400-200 BC	Weathered
19773	Earring?	Greenish blue	Burial 357	Iron Age I	400-200 BC	Weathered
19780	Earring fragment	Greenish blue	Burial 357	Iron Age I	400-200 BC	Weathered

CONCLUSION

Glass beads, as well as agate and carnelian artifacts, have often been considered indicators of contact with India. However, Theunissen (2007; Theunissen *et al.* 2000) has criticized the long-held belief that the presence of artifacts of an Indian origin at a site was equivalent to Indian influence, especially at inland sites. Recent research on glass

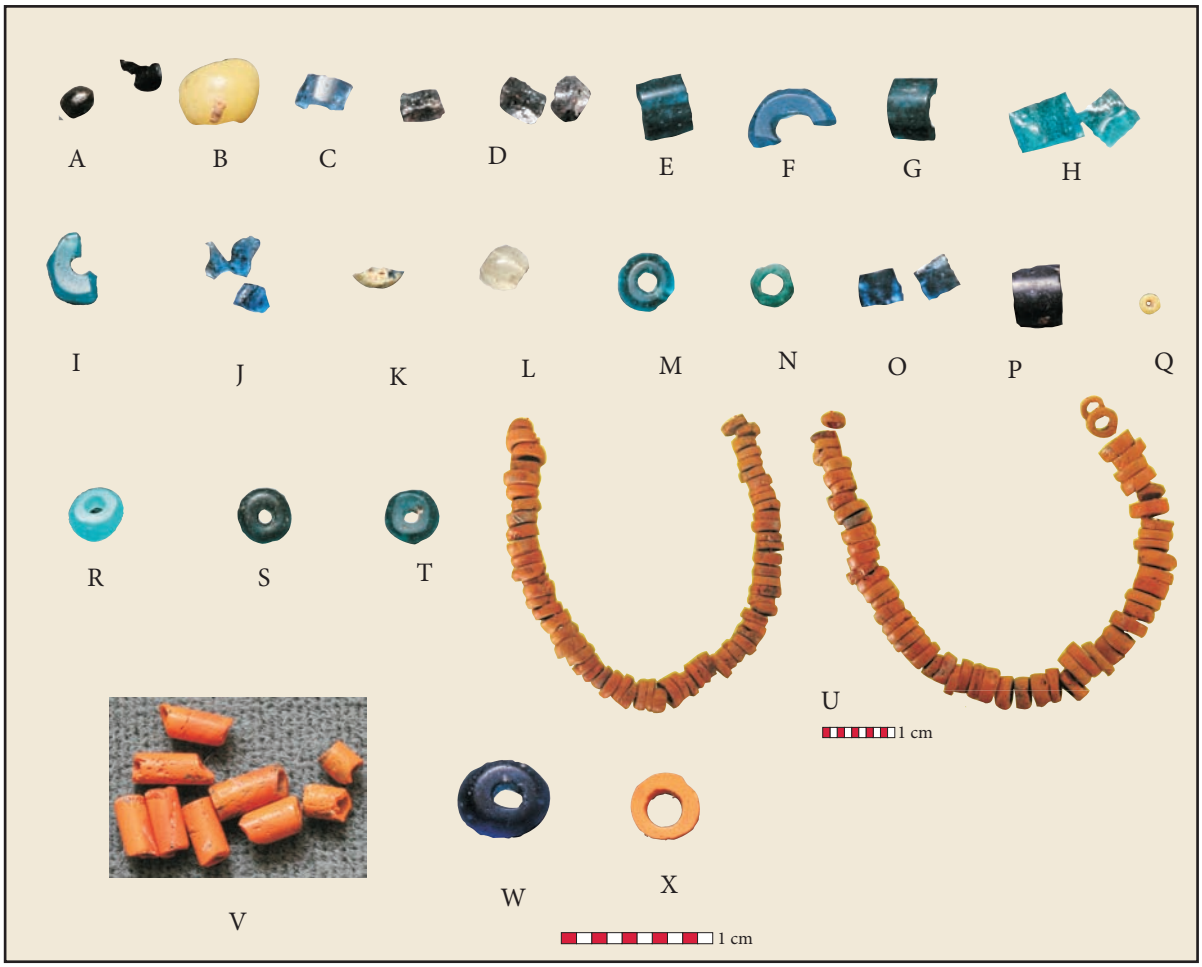


Fig. 7:6 The analysed glass beads from Noen U-Loke. A cat. 1465, B, cat. 141, C. cat.1457, D. 1417, E. cat. 1414 F. cat. 1414, G. cat. 1457 H. cat. 1457, I. cat. 1457, J. cat. 207K. cat. 1417, L. cat. 1501, M. cat. 1417, N. cat. 1417, O. cat. 1414, P. cat. 1414, Q. cat. 207, R. cat. 207, S. cat. 207, T. cat. 207, U. cat. 207, V. burial 37, W. burial 37, X. burial 37

confirms this argument, as it appears that many early glass artifacts may actually have been produced in Southeast Asia (e.g. Lankton and Dussubieux 2012 in press; Lankton *et al.* 2008). The presence of glass artifacts whose manufacturing locations are unknown adds to the complexity of these exchange networks. Early Iron Age people in Northeast Thailand appear to have had an important but localized interaction sphere in which blue potash-glass earrings, mixed-alkali glass beads, and notched agate pendants were important prestige objects. These artifacts may have originated in exotic locations, but their controlled distribution highlights the importance of these local interaction networks for Iron Age people, especially as related to increasing socio-political complexity (Higham 2011). With compositional analysis of glass beads and artifacts we are better able to see and understand these important trade and interaction networks and their changes over time.

Acknowledgements

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TABLE 7:2 Glass beads from Noen U-Loke analyzed by LA-ICP-MS

Sample ID for analysis	Cat. No	Artifact	Color	Context Information	Period	Date	Compositional Group
NUL-001	1465	Broken oblate bead	Black translucent	X1 3:13	MP4A	AD 200-400	m-Na-Al
NUL-002	141	Broken oblate bead	Yellow opaque	3:6 Feature 1	N/A	AD 250-650	m-Na-Al
NUL-003	1457	Broken short cylinder	Blue translucent	T9B3	MP4A	AD 200-400	m-Na-Ca-Al
NUL-004	1417	Broken oblate bead	Grey translucent	T9B9	N/A	Unknown	m-Na-Al
NUL-005	1414	Broken short cylinder	Dark blue translucent	T9B2	MP5	AD 400-600	m-Na-Ca-Al
NUL-006	1414	Broken oblate bead	Dark Blue Trans broken	T9B1	MP5	AD 400-600	m-K-Al, Low CaO or m-K-Ca-Al
NUL-007	1457	Broken short cylinder	Dark Blue Trans Broken	T9B8	MP4A	AD 200-400	m-Na-Ca-Al
NUL-008	1457	Broken oblate bead	Dark turquoise translucent	T9B4	MP4A	AD 200-400	m-Na-Al
NUL-009	1457	Broken oblate bead	Dark blue turquoise	T9 B7	MP4A	AD 200-400	m-Na-Al
NUL-010	207	Broken oblate bead	Bright blue translucent	Burial 8	MP5	AD 400-600	m-K-Al, Low CaO or m-K-Ca-Al
NUL-011	1417	Broken oblate bead	Corroded	3:9 Feature 1 T9 B10	MP3A	100 BC- AD 200	v-Na-Ca
NUL-012	1502	Broken oblate bead	White translucent	Burial 105	MP4A	AD 200-400	m-Na-Al
NUL-013	1417	Oblate bead	Dark turquoise translucent	3:9 Feature 1	N/A	AD 250-650	m-Na-Al
NUL-014	1417	Broken short cylinder	Blue-green translucent	3:9 Feature 1	N/A	AD 250-650	m-Na-Al
NUL-015	1414	Broken oblate bead	Dark Blue Trans Broken	T8B8	MP5	AD 400-600	m-Na-Ca-Al
NUL-016	1414	Broken short cylinder	Dark blue/ purple translucent	T8B8	MP5	AD 400-600	m-K-Ca-Al
NUL-017	N/A	Broken barrel bead	Red, white, blue, yellow opaque mixed glass	Unknown	N/A	Unknown	v-Na-Ca
NUL-019	207	Oblate seed bead	Yellow opaque	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-020	207	Oblate bead	Turquoise translucent	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-021	207	Oblate bead	Dark blue translucent	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-022	207	Oblate bead	Dark blue translucent	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-023	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-024	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-025	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600	m-Na-Al

TABLE 7:2 *Glass beads from Noen U-Loke analyzed by LA-ICP-MS* (cont.)

Sample ID for analysis	Cat. No	Artifact	Color	Context Information	Period	Date	Compositional Group
NUL-026	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-027	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600	m-Na-Al
NUL-028	492	Short tube	Orange opaque	Burial 37	MP3A	100 BC- AD 200	Mixed-Alkali
NUL-029	492	Oblate bead	Bright blue translucent	Burial 37	MP3A	100 BC- AD 200	m-K-Al, Low CaO or m-K-Ca-Al
NUL-030	492	Wound disc bead	Orange opaque	Burial 37	MP3A	100 BC- AD 200	Mixed-Alkali

TABLE 7:3 *The percentage composition of the glass samples from Ban Non Wat*

Cat.	Description	Glass Type	SiO2	Na2O	MgO	Al_2O_3	P_2O_3	K_2O	CaO	MnO	Fe_2O_3	CuO	SnO_2	PbO_2
5090	Blue glass fragment	m-K-Ca-Al	75.2	1.4	0.5	1.4	0.3	14.2	4.2%	0.0	0.7	1.6	0.0	0.1
17673	Blue earring fragment	m-K-Ca-Al	82.2	0.6	0.3	1.6	0.2	11.8	1.7%	0.0	0.5	0.8	0.0	0.0
17671	Blue earring fragment	m-K-Ca-Al	89.2	0.1	0.5	1.9	0.2	0.8	5.4%	0.0	0.5	1.1	0.0	0.0
19013	Blue earring fragment	m-K-Ca-Al	77.2	0.8	0.3	3.4	0.2	13.5	3.0%	0.0	0.3	0.8	0.0	0.0
15506	red bead	m-Na-Al Type 1	67.1	13.0	0.4	9.3	0.1	2.1	2.8%	0.1	1.8	2.2	0.2	0.4
15506	orange bead	m-Na-Al Type 1	55.9	12.6	0.8	12.6	0.2	1.9	3.2%	0.1	2.7	7.8	0.3	1.7
15506	yellow bead	m-Na-Al Type 1	65.3	13.9	0.3	8.6	0.0	2.3	1.7%	0.0	1.2	0.1	1.2	4.6
15506	turquoise bead	m-Na-Al Type 1	68.6	14.1	0.4	9.2	0.0	2.0	2.8	0.1	1.5	0.6	0.0	0.1
15506	dark blue bead	m-Na-Al Type 1	67.8	14.3	0.3	9.7	0.0	2.4	1.8	0.0	0.9	1.6	0.2	0.3
15506	black bead	m-Na-Al Type 1	74.8	12.0	0.4	6.8	0.0	1.7	1.4	0.1	2.1	0.0	0.0	0.0
15506	white bead	m-Na-Al Type 1	67.1	14.6	0.7	9.6	0.0	1.8	4.4	0.1	1.3	0.0	0.0	0.0
20002	yellow bead	m-Na-Al Type 1	63.6	18.5	0.3	7.1	0.0	1.5	2.7	0.1	2.6	0.1	0.3	2.3
20523	Blue bead	m-Na-Al Type 1	66.9	18.1	0.3	8.4	0.0	2.2	1.8	0.0	1.1	0.5	0.0	0.1
20519	orange bead	m-Na-Al Type 1	56.3	14.2	1.1	13.4	0.2	2.1	4.5	0.1	3.8	3.7	0.0	0.0
19501	blue coiled bead	lead glass	54.8	0.1	0.1	0.6	0.2	3.6	4.4	0.0	0.6	1.0	0.1	33.9
20009	blue flattened bicone bead	lead glass	45.7	1.9	0.1	0.2	0.0	9.6	4.8	0.0	0.2	0.9	0.1	35.9
20512	yellow bead	lead glass	36.6	0.2	0.1	0.6	0.0	8.6	0.2	0.0	0.3	0.1	3.5	49.5
24505	blue coiled bead	lead glass	40.0	2.0	0.2	0.2	0.0	9.8	4.2	0.0	0.2	0.8	0.0	42.1
15506	cobalt blue bead	m-Na-Ca-Al	72.3	13.2	0.4	5.4	0.1	1.0	4.1	1.3	1.4	0.0	0.0	0.0
18	blue bangle fragment?	v-Na-Ca	67.0	16.9	2.7	1.4	0.2	1.8	8.4	0.2	0.5	0.1	0.0	0.1
18014	transparent blue-green vessel glass	v-Na-Ca	61.1	16.8	3.5	2.3	0.4	2.8	8.8	3.0	0.8	0.0	0.0	0.0
20514	orange disc bead	mixed alkali	56.0	6.5	1.9	6.4	1.5	8.6	2.9	0.4	4.7	10.3	0.1	0.1
393	large green glass bead	unknown	57.7	3.5	5.3	5.8	0.1	9.7	15.9	0.0	0.6	0.7	0.1	0.1
4	large clear glass bead	unknown	58.5	3.9	5.8	5.3	0.0	6.0	19.1	0.0	0.4	0.0	0.0	0.0

TABLE 7:4 *The composition of the glass samples from Ban Non Wat expressed as parts per million*

Cat. no.	Description	Glass Type	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As	Rb
5090	Blue glass fragment	m-K-Ca-Al	5	7	57	3	478	14	12	50	54	26	98	117
17673	Blue earring fragment	m-K-Ca-Al	3	0.3	78	2	447	11	7	53	66	15	172	131
17671	Blue earring fragment	m-K-Ca-Al	2	1	97	2	378	16	5	31	24	19	47	19
19013	Blue earring fragment	m-K-Ca-Al	7	1	55	2	361	10	4	22	11	14	35	121
15506	red bead	m-Na-Al Type 1	8	5	18	4	2709	69	25	62	19	58	53	46
15506	orange bead	m-Na-Al Type 1	9	3	28	7	2454	97	52	103	25	161	190	46
15506	yellow bead	m-Na-Al Type 1	12	5	27	4	2438	63	21	10	5	17	23	40
15506	turquoise bead	m-Na-Al Type 1	8	6	21	5	2644	61	25	29	8	23	14	44
15506	dark blue bead	m-Na-Al Type 1	9	5	21	3	2083	70	20	38	12	31	33	43
15506	black bead	m-Na-Al Type 1	9	7	25	5	8277	65	44	10	8	32	4	36
15506	white bead	m-Na-Al Type 1	7	6	27	5	2532	79	21	8	4	15	13	37
20002	yellow bead	m-Na-Al Type 1	9	1	35	7	1715	73	35	9	6	18	172	47
20523	Blue bead	m-Na-Al Type 1	12	1	34	3	2023	85	28	16	6	36	5	55
20519	orange bead	m-Na-Al Type 1	14	1	46	9	2505	145	64	57	31	53	8	71
19501	blue coiled bead	lead glass	4	0.3	5	1	126	13	7	34	2	88	476	10
20009	blue flattened bicone bead	lead glass	6	0.2	2	1	46	2	1	16	1	82	306	6
20512	yellow bead	lead glass	27	0.5	2	0.4	34	4	1	10	1	50	3876	20
24505	blue coiled bead	lead glass	5	4	2	1	51	3	5	22	1	392	223	8
15506cob	cobalt blue bead	m-Na-Ca-Al	13	13	75	6	1250	102	14	82	595	48	14	20
18	blue bangle fragment?	v-Na-Ca	12	8	99	3	308	10	28	29	129	25	4	13
18014	transparent blue-green vessel glass	v-Na-Ca	12	1	96	3	797	23	75	20	186	508	15	11
20514	orange disc bead	mixed alkali	24	1	38	6	1213	43	25	213	149	874	318	142
393	large green glass bead	unknown	23	7	18	3	1140	17	16	16	7	66	26	17
4	large clear glass bead	unknown	15	7	14	3	1206	23	12	7	1	17	0.0	12

TABLE 7:4 *The composition of the glass samples from Ban Non Wat expressed as parts per million* (cont.)

Cat. no.	Description	Glass Type	Sr	Zr	Nb	Ag	Sb	Cs	Ba	La	Ce	Pr
5090	Blue glass fragment	m-K-Ca-Al	156	72	2	1	2	1	255	9	20	2
17673	Blue earring fragment	m-K-Ca-Al	34	103	2	1	1	1	140	10	19	2
17671	Blue earring fragment	m-K-Ca-Al	98	67	1	1	1	1	105	10	21	2
19013	Blue earring fragment	m-K-Ca-Al	88	72	2	1	1	1	227	10	18	2
15506	red bead	m-Na-Al Type 1	330	415	7	17	15	1	604	21	39	4
15506	orange bead	m-Na-Al Type 1	426	287	7	59	71	0.4	513	24	49	6
15506	yellow bead	m-Na-Al Type 1	298	566	8	3	2	0.3	1080	30	48	5
15506	turquoise bead	m-Na-Al Type 1	294	547	7	3	3	0.5	681	22	38	5
15506	dark blue bead	m-Na-Al Type 1	360	521	7	22	14	0.3	1348	31	49	5
15506	black bead	m-Na-Al Type 1	180	949	23	0	1	0.2	443	42	79	9
15506	white bead	m-Na-Al Type 1	429	229	7	1	1	0.4	699	23	36	5
20002	yellow bead	m-Na-Al Type 1	281	305	5	2	40	0.5	378	19	34	4
20523	Blue bead	m-Na-Al Type 1	339	559	7	5	1	1	1295	30	50	5
20519	orange bead	m-Na-Al Type 1	525	193	7	1	6	1	664	34	60	8
19501	blue coiled bead	lead glass	35	10	1	42	667	0.5	30	3	5	1
20009	blue flattened bicone bead	lead glass	31	4	0.2	37	309	0.2	17	1	3	0.3
20512	yellow bead	lead glass	13	2	0.5	94	1076	0.2	25	2	6	0.3
24505	blue coiled bead	lead glass	27	4	0.3	24	504	0.1	17	2	3	0.4
15506cob	cobalt blue bead	m-Na-Ca-Al	319	186	3	1	1	0.2	1602	13	131	4
18	blue bangle fragment?	v-Na-Ca	458	39	1	1	16	0.2	155	5	9	1
18014	transparent blue-green vessel glass	v-Na-Ca	568	106	3	0.2	1	0.2	293	8	18	2
20514	orange disc bead	mixed alkali	94	54	7	13	14	6	357	16	32	4
393	large green glass bead	unknown	319	121	5	3	17	0.2	158	7	20	3
4	large clear glass bead	unknown	269	263	7	0.4	1	0.2	125	5	10	2

TABLE 7:4 *The composition of the glass samples from Ban Non Wat expressed as parts per million* (cont.)

Cat. no.	Description	Glass Type	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu
5090	Blue glass fragment	m-K-Ca-Al	0.3	1	6	2	1	1	40	8	2	0.3
17673	Blue earring fragment	m-K-Ca-Al	0.2	0.1	7	1	1	1	34	8	2	0.3
17671	Blue earring fragment	m-K-Ca-Al	0.2	0.2	7	1	1	1	47	8	2	0.3
19013	Blue earring fragment	m-K-Ca-Al	0.2	0.1	8	1	1	2	74	8	2	0.3
15506	red bead	m-Na-Al Type 1	0.4	0.3	13	3	7	0.4	1	15	3	1
15506	orange bead	m-Na-Al Type 1	0.5	0.2	11	12	5	0.3	5	19	3	1
15506	yellow bead	m-Na-Al Type 1	1	0.0	10	0.2	4	0.4	2	19	3	1
15506	turquoise bead	m-Na-Al Type 1	1	0.4	15	0.4	11	1	1	17	3	1
15506	dark blue bead	m-Na-Al Type 1	1	1	9	3	5	0.4	1	18	3	1
15506	black bead	m-Na-Al Type 1	1	0.4	12	0.2	9	1	2	31	5	1
15506	white bead	m-Na-Al Type 1	0.4	0.4	18	0.1	3	1	1	19	3	1
20002	yellow bead	m-Na-Al Type 1	0.4	0.1	15	7	19	0.3	1	16	3	1
20523	Blue bead	m-Na-Al Type 1	0.4	0.2	8	1	7	0.2	1	17	3	1
20519	orange bead	m-Na-Al Type 1	0.5	1	15	0.3	5	0.3	2	27	5	1
19501	blue coiled bead	lead glass	0.1	0.4	3	12	0.4	0.2	1	2	0.5	0.1
20009	blue flattened bicone bead	lead glass	0.0	0.1	2	2	0.1	0.1	0.2	1	0.2	0.0
20512	yellow bead	lead glass	0.1	0.1	1	319	0.1	0.4	1	1	0.2	0.0
24505	blue coiled bead	lead glass	0.1	0.5	2	2	0.2	0.2	1	1	0.4	0.1
15506cob	cobalt blue bead	m-Na-Ca-Al	0.4	0.5	11	1	21	1	3	13	3	1
18	blue bangle fragment?	v-Na-Ca	0.2	1	4	0	1	1	2	3	1	0.3
18014	transparent blue-green vessel glass	v-Na-Ca	0.2	0.0	6	0	1	1	10	7	2	0.3
20514	orange disc bead	mixed alkali	1	0.2	13	20	14	4	13	13	3	0.5
393	large green glass bead	unknown	0.4	0.0	10	3	1	1	1	10	2	1
4	large clear glass bead	unknown	1	1	5	0.5	2	1	1	4	2	0.4

TABLE 7:4 *The composition of the glass samples from Ban Non Wat expressed as parts per million* (cont.)

Cat. no.	Description	Glass Type	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
5090	Blue glass fragment	m-K-Ca-Al	1	0.3	2	0.2	1	0.2	1	0.2	2	3
17673	Blue earring fragment	m-K-Ca-Al	1	0.2	1	0.2	1	0.1	1	0.1	3	5
17671	Blue earring fragment	m-K-Ca-Al	1	0.2	1	0.3	1	0.1	1	0.1	2	4
19013	Blue earring fragment	m-K-Ca-Al	1	0.2	1	0.3	1	0.1	1	0.1	2	4
15506	red bead	m-Na-Al Type 1	3	0.4	2	0.4	1	0.2	2	0.3	10	5
15506	orange bead	m-Na-Al Type 1	2	0.4	2	0.4	1	0.2	1	0.2	8	6
15506	yellow bead	m-Na-Al Type 1	2	0.3	2	0.4	1	0.2	1	0.2	14	14
15506	turquoise bead	m-Na-Al Type 1	2	0.4	2	1	2	0.2	2	0.3	14	6
15506	dark blue bead	m-Na-Al Type 1	2	0.3	2	0.3	1	0.2	1	0.2	13	14
15506	black bead	m-Na-Al Type 1	4	0.5	3	0.4	2	0.2	2	0.3	25	20
15506	white bead	m-Na-Al Type 1	2	0.5	3	1	2	0.3	2	0.4	5	5
20002	yellow bead	m-Na-Al Type 1	3	0.4	3	1	2	0.2	2	0.2	9	8
20523	Blue bead	m-Na-Al Type 1	2	0.3	1	0.3	1	0.1	1	0.2	16	14
20519	orange bead	m-Na-Al Type 1	4	0.5	3	1	1	0.2	1	0.2	5	7
19501	blue coiled bead	lead glass	0.4	0.1	0.5	0.1	0.3	0.03	0.2	0.0	0.3	1
20009	blue flattened bicone bead	lead glass	0.3	0.0	0.3	0.1	0.2	0.02	0.1	0.0	0.1	0.3
20512	yellow bead	lead glass	0.2	0.0	0.1	0.0	0.1	0.01	0.1	0.0	0.1	1
24505	blue coiled bead	lead glass	0.4	0.1	0.4	0.1	0.4	0.1	1	0.1	0.4	0.3
15506cob	cobalt blue bead	m-Na-Ca-Al	3	0.5	3	0.4	2	0.3	2	0.4	4	4
18	blue bangle fragment?	v-Na-Ca	1	0.2	1	0.2	1	0.3	1	0.2	2	1
18014	transparent blue-green vessel glass	v-Na-Ca	1	0.2	1	0.2	1	0.1	1	0.2	3	2
20514	orange disc bead	mixed alkali	2	0.4	2	0.5	1	0.2	1	0.2	2	8
393	large green glass bead	unknown	2	0.4	2	0.4	1	0.2	1	0.2	3	4
4	large clear glass bead	unknown	2	0.2	1	0.4	1	0.3	1	0.4	6	5

TABLE 7:5 *The percentage composition of the glass samples from Noen U-Loke*

ID	Description	Glass Type	SiO_2	Na_2O	MgO	Al_2O_3	P_2O3	K_2O
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	75.2	0.9	0.4	4.4	0.1	14.6
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	79.4	0.5	0.2	3.3	0.1	13.3
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	78.3	0.8	0.3	2.8	0.1	13.9
016	Dark blue-purple broken bead	m-K-Ca-Al	75.4	1.4	0.5	1.9	0.3	13.8
001	Brown/Black transparent broken bead	m-Na-Al Type 1	65.6	14.5	0.8	9.6	0.2	2.0
002	Yellow opaque broken bead	m-Na-Al Type 1	63.6	13.5	0.5	9.9	0.1	1.9
004	Transparent grey broken bead	m-Na-Al Type 1	63.5	18.2	0.3	9.5	0.0	2.4
008	Turquoise broken bead	m-Na-Al Type 1	68.1	16.8	0.3	6.8	0.0	1.7
009	Dark blue broken bead	m-Na-Al Type 1	60.5	19.8	0.3	10.2	0.1	1.9
012	White trans broken	m-Na-Al Type 1	70.0	14.2	0.5	8.5	0.0	2.1
013	Turquoise bead	m-Na-Al Type 1	67.9	16.3	0.4	7.2	0.0	2.4
014	Transparent blue-green bead	m-Na-Al Type 1	66.5	17.3	0.3	7.0	0.1	2.0
019	Opaque yellow bead	m-Na-Al Type 1	60.4	15.0	0.5	11.3	0.0	2.0
020	Turquoise bead	m-Na-Al Type 1	66.3	15.2	0.3	10.3	0.0	3.4
021	Turquoise bead	m-Na-Al Type 1	67.0	18.3	0.3	7.1	0.0	1.7
022	Turquoise bead	m-Na-Al Type 1	72.5	15.3	0.3	6.3	0.0	1.3
023	red/orange bead: orange glass	m-Na-Al Type 1	57.3	12.5	1.0	12.6	0.2	1.9
023	red/orange bead: red glass	m-Na-Al Type 1	64.7	12.8	0.9	12.2	0.1	1.9
024	red/orange bead: orange glass	m-Na-Al Type 1	56.8	12.9	1.0	13.0	0.2	1.7
024	red/orange bead: red glass	m-Na-Al Type 1	69.0	11.8	0.8	9.1	0.1	1.9
025	red/orange bead: orange glass	m-Na-Al Type 1	57.6	12.3	1.0	11.8	0.2	1.9
025	red/orange bead: red glass	m-Na-Al Type 1	64.1	12.3	0.9	12.3	0.1	2.1
026	red/orange bead: orange glass	m-Na-Al Type 1	57.8	12.7	0.9	12.1	0.2	1.7
026	red/orange bead: red glass	m-Na-Al Type 1	65.7	11.9	0.8	10.9	0.1	1.8
027	red/orange bead: orange glass	m-Na-Al Type 1	57.3	11.9	1.0	12.1	0.2	2.0
027	red/orange bead: red glass	m-Na-Al Type 1	63.0	12.1	0.9	12.8	0.1	2.2
003	Blue trans broken	m-Na-Ca-Al	73.1	14.6	0.3	3.9	0.1	0.8
015	dark Blue Trans Broken	m-Na-Ca-Al	71.6	11.7	0.6	5.0	0.1	1.3
005	dark Blue Trans Broken	m-Na-Ca-Al	66.5	15.9	0.3	6.5	0.0	1.4
007	dark Blue Trans Broken	m-Na-Ca-Al	65.7	18.5	0.3	7.3	0.0	1.9
028	opaque orange tubular bead	mixed alkali	61.7	5.9	2.2	6.8	1.6	7.7
030	opaque orange disc bead	mixed alkali	59.4	8.2	2.0	6.7	1.6	7.1

TABLE 7:5 *The percentage composition of the glass samples from Noen U-Loke* (cont.)

ID	Description	Glass Type	CaO	MnO	Fe_2O_3	CuO	SnO_2	PbO_2
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	1.0	1.4	1.3	0.1	0.0	0.2
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	0.6	1.1	1.3	0.1	0.0	0.0
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	0.8	1.3	1.2	0.2	0.0	0.1
016	Dark blue-purple broken bead	m-K-Ca-Al	2.1	2.6	1.6	0.0	0.0	0.0
001	Brown/Black transparent broken bead	m-Na-Al Type 1	4.3	0.1	1.9	0.1	0.0	0.1
002	Yellow opaque broken bead	m-Na-Al Type 1	3.5	0.1	1.6	0.0	0.6	4.1
004	Transparent grey broken bead	m-Na-Al Type 1	2.4	0.3	1.5	0.7	0.0	0.2
008	Turquoise broken bead	m-Na-Al Type 1	2.1	0.1	1.1	1.9	0.2	0.5
009	Dark blue broken bead	m-Na-Al Type 1	2.4	0.1	1.1	1.6	0.3	0.6
012	White trans broken	m-Na-Al Type 1	2.2	0.1	1.8	0.0	0.0	0.0
013	Turquoise bead	m-Na-Al Type 1	2.7	0.2	1.4	0.9	0.1	0.1
014	Transparent blue-green bead	m-Na-Al Type 1	2.3	0.1	1.3	2.1	0.3	0.5
019	Opaque yellow bead	m-Na-Al Type 1	3.0	0.0	1.1	0.0	1.3	4.9
020	Turquoise bead	m-Na-Al Type 1	1.9	0.0	0.8	0.9	0.1	0.1
021	Turquoise bead	m-Na-Al Type 1	2.5	0.2	1.3	0.9	0.1	0.1
022	Turquoise bead	m-Na-Al Type 1	1.4	0.3	1.0	1.0	0.0	0.0
023	red/orange bead: orange glass	m-Na-Al Type 1	3.9	0.1	2.8	4.6	0.5	2.3
023	red/orange bead: red glass	m-Na-Al Type 1	3.5	0.1	2.4	0.8	0.0	0.2
024	red/orange bead: orange glass	m-Na-Al Type 1	4.0	0.1	2.9	4.4	0.7	1.9
024	red/orange bead: red glass	m-Na-Al Type 1	2.7	0.1	2.2	1.3	0.1	0.4
025	red/orange bead: orange glass	m-Na-Al Type 1	4.0	0.1	2.8	5.0	0.5	2.4
025	red/orange bead: red glass	m-Na-Al Type 1	3.4	0.1	2.6	1.6	0.1	0.2
026	red/orange bead: orange glass	m-Na-Al Type 1	3.8	0.1	2.7	4.7	0.7	2.3
026	red/orange bead: red glass	m-Na-Al Type 1	3.9	0.1	2.5	1.6	0.1	0.2
027	red/orange bead: orange glass	m-Na-Al Type 1	4.1	0.1	2.7	5.0	0.6	2.5
027	red/orange bead: red glass	m-Na-Al Type 1	3.6	0.1	2.8	1.7	0.1	0.2
003	Blue trans broken	m-Na-Ca-Al	5.2	0.4	0.5	0.0	0.0	0.0
015	Dark Blue Trans Broken	m-Na-Ca-Al	5.9	1.4	1.2	0.1	0.0	0.0
005	Dark Blue Trans Broken	m-Na-Ca-Al	2.3	0.5	1.2	0.9	0.7	3.3
007	Dark Blue Trans Broken	m-Na-Ca-Al	2.5	0.7	1.2	0.8	0.2	0.5
028	opaue orange tubular bead	mixed alkali	2.5	0.4	3.5	7.2	0.2	0.1
030	opaque orange disc bead	mixed alkali	2.8	0.5	3.7	7.2	0.2	0.1

TABLE 7:5 *The composition of the glass samples from Noen U-Loke expressed as parts per million*

ID	Description	Glass Type	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	24	1	95	5	1059	45	15	47	275	14
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	17	2	99	4	795	55	9	47	406	3
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	20	1	86	4	742	51	2	66	410	5
016	Dark blue-purple broken bead	m-K-Ca-Al	13	4	128	9	714	80	14	108	642	3
001	Brown/Black transparent broken bead	m-Na-Al Type 1	8	1	30	4	3058	67	31	13	6	4
002	Yellow opaque broken bead	m-Na-Al Type 1	11	2	17	4	3027	63	24	8	5	6
004	Transparent grey broken bead	m-Na-Al Type 1	11	1	22	3	3543	58	27	18	9	13
008	Turquoise broken bead	m-Na-Al Type 1	9	1	23	3	2493	63	19	10	6	41
009	Dark blue broken bead	m-Na-Al Type 1	18	2	51	3	2650	77	13	21	11	13
012	White trans broken	m-Na-Al Type 1	9	1	21	4	6024	64	47	9	7	5
013	Turquoise bead	m-Na-Al Type 1	12	3	23	5	2627	66	27	17	7	9
014	Transparent blue-green bead	m-Na-Al Type 1	9	2	18	4	2733	67	22	22	8	104
019	Opaque yellow bead	m-Na-Al Type 1	10	1	24	4	1544	90	12	8	3	3
020	Turquoise bead	m-Na-Al Type 1	19	2	28	2	2004	68	11	11	4	8
021	Turquoise bead	m-Na-Al Type 1	10	1	23	3	2449	62	13	16	6	7
022	Turquoise bead	m-Na-Al Type 1	15	1	110	3	2482	45	25	11	5	34
023	red/orange bead: orange glass	m-Na-Al Type 1	11	1	44	7	2535	100	50	126	23	328
023	red/orange bead: red glass	m-Na-Al Type 1	12	1	54	7	2630	90	46	20	9	16
024	red/orange bead: orange glass	m-Na-Al Type 1	13	1	45	8	2613	102	47	107	25	250
024	red/orange bead: red glass	m-Na-Al Type 1	13	1	94	5	3269	81	46	38	13	31
025	red/orange bead: orange glass	m-Na-Al Type 1	12	1	43	7	2475	96	46	132	27	295
025	red/orange bead: red glass	m-Na-Al Type 1	12	1	51	7	2614	97	48	39	11	13
026	red/orange bead: orange glass	m-Na-Al Type 1	12	1	36	7	2702	103	49	99	31	227
026	red/orange bead: red glass	m-Na-Al Type 1	11	1	46	7	2831	121	52	40	11	22
027	red/orange bead: orange glass	m-Na-Al Type 1	12	1	42	7	2547	97	48	132	26	282
027	red/orange bead: red glass	m-Na-Al Type 1	12	1	51	8	2794	101	50	40	12	14
003	Blue trans broken	m-Na-Ca-Al	11	1	82	2	725	53	7	51	267	20
015	dark Blue Trans Broken	m-Na-Ca-Al	26	3	75	6	1670	55	12	112	677	7
005	dark Blue Trans Broken	m-Na-Ca-Al	12	1	16	3	2618	64	18	30	234	23
007	dark Blue Trans Broken	m-Na-Ca-Al	13	1	22	3	2604	69	18	24	157	22
028	opaque orange tubular bead	mixed alkali	29	2	44	6	1371	43	16	183	87	251
030	opaque orange disc bead	mixed alkali	27	2	50	6	1410	44	18	157	85	238

TABLE 7:5 *The composition of the glass samples from Noen U-Loke expressed as parts per million* (cont.)

ID	Description	Glass Type	As	Rb	Sr	Zr	Nb	Ag	Sb	Cs	Ba	La
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	384	51	155	5	1	0.1	1	4	1840	16
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	318	34	107	4	1	0.1	2	1	799	11
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	310	38	108	3	1	0.1	1	2	889	13
016	Dark blue-purple broken bead	m-K-Ca-Al	114	127	31	3	3	4	4	4	3314	12
001	Brown/Black transparent broken bead	m-Na-Al Type 1	52	415	519	7	2	0.1	0.3	1	723	25
002	Yellow opaque broken bead	m-Na-Al Type 1	50	447	474	7	7	0.1	0.5	0.5	785	29
004	Transparent grey broken bead	m-Na-Al Type 1	60	431	730	11	14	0.1	5	0.5	1719	48
008	Turquoise broken bead	m-Na-Al Type 1	30	258	350	6	16	0.3	9	0.4	443	16
009	Dark blue broken bead	m-Na-Al Type 1	30	497	478	8	28	0.3	5	0.3	867	20
012	White trans broken	m-Na-Al Type 1	54	308	685	15	0.4	0.1	0.3	0.4	650	34
013	Turquoise bead	m-Na-Al Type 1	59	284	556	9	8	1	6	1	726	23
014	Transparent blue-green bead	m-Na-Al Type 1	40	263	627	8	18	1	73	1	483	25
019	Opaque yellow bead	m-Na-Al Type 1	35	569	278	4	2	2	0.2	0.4	1033	23
020	Turquoise bead	m-Na-Al Type 1	78	382	392	6	4	0.1	1	0.3	1629	36
021	Turquoise bead	m-Na-Al Type 1	38	257	488	6	10	0.1	5	0.4	712	21
022	Turquoise bead	m-Na-Al Type 1	28	178	574	7	2	0.1	1	0.4	481	31
023	red/orange bead: orange glass	m-Na-Al Type 1	49	473	333	7	33	0.1	94	1	635	31
023	red/orange bead: red glass	m-Na-Al Type 1	47	438	392	7	31	0.1	5	1	596	28
024	red/orange bead: orange glass	m-Na-Al Type 1	40	515	371	7	41	0.2	184	1	683	34
024	red/orange bead: red glass	m-Na-Al Type 1	38	361	555	8	61	0.1	15	1	607	29
025	red/orange bead: orange glass	m-Na-Al Type 1	54	489	343	7	43	1	124	1	637	30
025	red/orange bead: red glass	m-Na-Al Type 1	48	455	387	7	68	0.1	8	1	636	30
026	red/orange bead: orange glass	m-Na-Al Type 1	41	477	416	7	64	2	94	1	661	33
026	red/orange bead: red glass	m-Na-Al Type 1	42	418	421	7	80	0.1	8	1	589	29
027	red/orange bead: orange glass	m-Na-Al Type 1	61	508	371	7	39	0.2	131	1	680	33
027	red/orange bead: red glass	m-Na-Al Type 1	59	484	420	7	66	0.1	8	1	684	33
003	Blue trans broken	m-Na-Ca-Al	11	381	147	2	0.2	0.1	0.3	0.2	839	8
015	dark Blue Trans Broken	m-Na-Ca-Al	21	443	287	7	1	1	2	1	1564	19
005	dark Blue Trans Broken	m-Na-Ca-Al	29	268	521	6	31	0.5	8	0.3	834	19
007	dark Blue Trans Broken	m-Na-Ca-Al	44	318	462	6	49	0.3	9	1	1018	20
028	opaque orange tubular bead	mixed alkali	163	76	46	7	13	1	16	7	396	15
030	opaque orange disc bead	mixed alkali	157	90	58	8	13	1	12	7	408	17

TABLE 7:5 *The composition of the glass samples from Noen U-Loke expressed as parts per million* (cont.)

ID	Description	Glass Type	Ce	Pr	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	67	4	0.3	0.2	12	0.2	1	0.4	4	12	3
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	75	3	0.2	0.4	10	0.1	1	0.3	1	10	3
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	93	4	0.3	0.2	11	1	1	0.5	1	14	3
016	Dark blue-purple broken bead	m-K-Ca-Al	152	4	1	1	10	1	2	1	43	13	5
001	Brown/Black transparent broken bead	m-Na-Al Type 1	45	5	1	0.3	17	0.1	11	0.3	1	18	4
002	Yellow opaque broken bead	m-Na-Al Type 1	49	6	0.4	0.2	15	0.1	8	0.2	0.4	20	4
004	Transparent grey broken bead	m-Na-Al Type 1	74	7	1	0.4	9	1	6	0.4	1	22	3
008	Turquoise broken bead	m-Na-Al Type 1	30	3	0.4	0.2	11	2	22	0.2	1	12	2
009	Dark blue broken bead	m-Na-Al Type 1	45	4	1	1	9	1	14	0.1	1	15	3
012	White trans broken	m-Na-Al Type 1	61	7	1	0.2	11	0.1	6	0.4	0.5	26	5
013	Turquoise bead	m-Na-Al Type 1	39	6	2	1	18	6	8	2	2	18	5
014	Transparent blue-green bead	m-Na-Al Type 1	46	6	1	0.5	13	15	7	1	2	17	4
019	Opaque yellow bead	m-Na-Al Type 1	37	5	1	0.1	9	0.2	10	0.4	0.4	19	3
020	Turquoise bead	m-Na-Al Type 1	59	6	0.4	0.3	9	0.4	6	0.1	1	20	3
021	Turquoise bead	m-Na-Al Type 1	35	4	0.4	0.3	16	6	6	0.3	1	16	3
022	Turquoise bead	m-Na-Al Type 1	51	6	0.4	0.4	10	1	10	0.3	1	18	3
023	red/orange bead: orange glass	m-Na-Al Type 1	60	7	0.5	0.3	13	17	6	0.4	3	25	5
023	red/orange bead: red glass	m-Na-Al Type 1	51	6	0.5	0.0	13	0.5	7	0.3	2	22	4
024	red/orange bead: orange glass	m-Na-Al Type 1	65	8	0.5	0.3	14	11	10	0.3	4	28	5
024	red/orange bead: red glass	m-Na-Al Type 1	50	7	1	0.4	15	1	6	0.4	2	23	4
025	red/orange bead: orange glass	m-Na-Al Type 1	57	7	0.4	0.2	13	16	7	0.3	3	25	5
025	red/orange bead: red glass	m-Na-Al Type 1	55	7	0.5	0.2	13	1	6	0.3	2	25	5
026	red/orange bead: orange glass	m-Na-Al Type 1	64	8	0.5	0.2	14	21	7	0.4	3	27	5
026	red/orange bead: red glass	m-Na-Al Type 1	52	6	0.4	0.1	14	1	6	0.3	2	23	4
027	red/orange bead: orange glass	m-Na-Al Type 1	61	8	0.5	1	14	17	7	0.4	2	27	5
027	red/orange bead: red glass	m-Na-Al Type 1	61	7	0.5	0.2	15	1	8	0.4	3	26	5
003	Blue trans broken	m-Na-Ca-Al	65	2	0.3	0.3	8	0.1	25	0.4	2	8	2
015	dark Blue Trans Broken	m-Na-Ca-Al	140	5	1	0.1	15	1	13	1	4	17	5
005	dark Blue Trans Broken	m-Na-Ca-Al	59	4	0.5	1	13	4	7	0.4	1	14	3
007	dark Blue Trans Broken	m-Na-Ca-Al	66	5	0.4	2	11	3	6	0.3	1	16	3
028	opaue orange tubular bead	mixed alkali	31	4	1	0.2	13	22	17	4	10	13	3
030	opaque orange disc bead	mixed alkali	38	4	1	0.4	15	16	21	4	10	15	3

TABLE 7:5 *The composition of the glass samples from Noen U-Loke expressed as parts per million* (cont.)

ID	Description	Glass Type	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
006	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	1	2	0.4	2	1	1	0.2	2	0.3	4	4
010	Dark blue broken bead	m-K-Al, low CaO or m-K-Ca-Al	1	2	0.4	2	0.4	1	0.2	1	0.2	2	3
029	Dark blue bead	m-K-Al, low CaO or m-K-Ca-Al	1	3	0.4	3	1	2	0.2	1	0.2	3	3
016	Dark blue-purple broken bead	m-K-Ca-Al	2	3	2	4	2	3	1	3	1	2	3
001	Brown/Black transparent broken bead	m-Na-Al Type 1	1	3	1	3	1	2	0.3	2	0.3	13	7
002	Yellow opaque broken bead	m-Na-Al Type 1	1	3	0.5	2	1	2	0.2	2	0.3	13	7
004	Transparent grey broken bead	m-Na-Al Type 1	1	2	0.3	1	0.3	1	0.1	1	0.2	19	19
008	Turquoise broken bead	m-Na-Al Type 1	1	2	0.3	2	0.4	1	0.2	1	0.3	9	7
009	Dark blue broken bead	m-Na-Al Type 1	1	2	0.3	2	0.4	1	0.2	1	0.2	12	9
012	White trans broken	m-Na-Al Type 1	1	3	0.4	2	0.4	1	0.2	1	0.2	17	16
013	Turquoise bead	m-Na-Al Type 1	2	4	2	4	2	3	2	4	2	17	9
014	Transparent blue-green bead	m-Na-Al Type 1	1	3	1	3	1	2	1	2	1	17	14
019	Opaque yellow bead	m-Na-Al Type 1	1	3	0.4	2	0.4	1	0.2	1	0.1	9	8
020	Turquoise bead	m-Na-Al Type 1	1	2	0.3	2	0.3	1	0.1	1	0.1	11	20
021	Turquoise bead	m-Na-Al Type 1	1	3	0.4	3	1	2	0.2	2	0.2	13	7
022	Turquoise bead	m-Na-Al Type 1	1	2	0.3	2	0.4	1	0.2	1	0.2	14	18
023	red/orange bead: orange glass	m-Na-Al Type 1	1	4	0.5	3	1	2	0.2	1	0.2	10	9
023	red/orange bead: red glass	m-Na-Al Type 1	1	3	0.4	2	0.4	1	0.2	1	0.2	11	9
024	red/orange bead: orange glass	m-Na-Al Type 1	1	4	1	3	1	2	0.3	2	0.2	11	9
024	red/orange bead: red glass	m-Na-Al Type 1	1	3	0.5	3	1	2	0.3	2	0.2	16	9
025	red/orange bead: orange glass	m-Na-Al Type 1	1	3	0.5	3	1	2	0.2	2	0.2	10	10
025	red/orange bead: red glass	m-Na-Al Type 1	1	3	0.4	3	1	2	0.2	1	0.2	11	9
026	red/orange bead: orange glass	m-Na-Al Type 1	1	3	0.5	3	1	2	0.2	2	0.3	12	10
026	red/orange bead: red glass	m-Na-Al Type 1	1	3	0.5	3	1	1	0.2	1	0.2	11	10
027	red/orange bead: orange glass	m-Na-Al Type 1	1	3	0.5	3	1	1	0.3	2	0.2	11	10
027	red/orange bead: red glass	m-Na-Al Type 1	1	4	1	3	1	2	0.3	2	0.3	13	10
003	Blue trans broken	m-Na-Ca-Al	1	2	0.3	2	0.4	1	0.2	1	0.2	4	4
015	dark Blue Trans Broken	m-Na-Ca-Al	2	4	1	4	1	3	1	3	1	8	6
005	dark Blue Trans Broken	m-Na-Ca-Al	1	2	0.4	2	1	1	0.3	2	0.3	13	6
007	dark Blue Trans Broken	m-Na-Ca-Al	1	3	0.4	2	1	2	0.3	2	0.5	12	7
028	opaue orange tubular bead	mixed alkali	0.4	2	0.3	2	0.4	1	0.2	1	0.2	2	9
030	opaque orange disc bead	mixed alkali	1	3	0.4	3	1	2	0.3	2	0.3	7	9

VIII THE SPINNING TOOLS

JUDITH CAMERON

This chapter provides the results of an analysis of the spindle whorls from Iron Age contexts at Ban Non Wat excavated from 2002-8. The spindle whorls from the Bronze Age and late Neolithic assemblages are discussed in previous volumes in this series (Higham and Kijngam 2011, 2012). The functional attributes of all of the whorls were measured and recorded for comparative purposes. These attributes included material composition, shape, diameter, weight, size of central perforation and height. Non-functional attributes such as decoration were also documented. Apart from providing insights into prehistoric fibre processing, the analysis of these securely provenanced spinning tools also provided a unique opportunity to investigate issues related to modes of production and social development in Southeast Asia.

DISTRIBUTION

Figures 8:1 and 2 show the distribution of the spinning tools in the Iron Age sequences. The majority of the 660 whorls investigated came from habitation layers but 119 came from burials. Significantly, there was a sharp increase in numbers in layer 4:1 with 88 whorls recovered. Although the tools were found in burials of all ages, some age differentiation was identified with greater numbers coming from adult burials which is unsurprising given that textile technology is a specialized craft requiring skill and technical knowledge.

MATERIAL COMPOSITION

A high degree of standardization in material composition was immediately observable with pottery the predominant material. Most whorls were well-fired, using the same high-quality clay that was used for pottery vessels which suggest that the whorls were locally made and belong to the same ceramic tradition as the larger pottery artefacts. The colour of each whorl was measured using a Munsell Soil Colour chart developed for the systematic classification of soil colours. This method measures three attributes of colour; hue which represents the dominant spectra, value which represents the relative lightness of colour and chroma which represents the relative purity or strength of the spectral colour. Three hues were identified: red (5 YR 5/5,2.5 YR 5/1) orange/yellow (7.5 YR 7/5, 5YR 6/5, 5YR 7/3, 5YR 6/4, 5 YR 6/5 and grey (7.5 YR 7/2, 7.5 YR 6/3, 7.5 5/2, 5 YR 5/5, 5 YR 8/2, 5YR 6/2, 5 YR 7/2, 5YR 6/1. The results reveal that brownish-grey (5YR 5/1) was the main hue, next commonest hue being dull orange (5 YR 6/3 and 5 YR 7/3).

Central perforations

At the general level, the size of the central perforation of the whorls is an important diagnostic attribute as it needs to be sufficiently large to take a spindle, the other component of the spinning tool. This measurement is crucial for smaller, ambiguous discs which might otherwise be

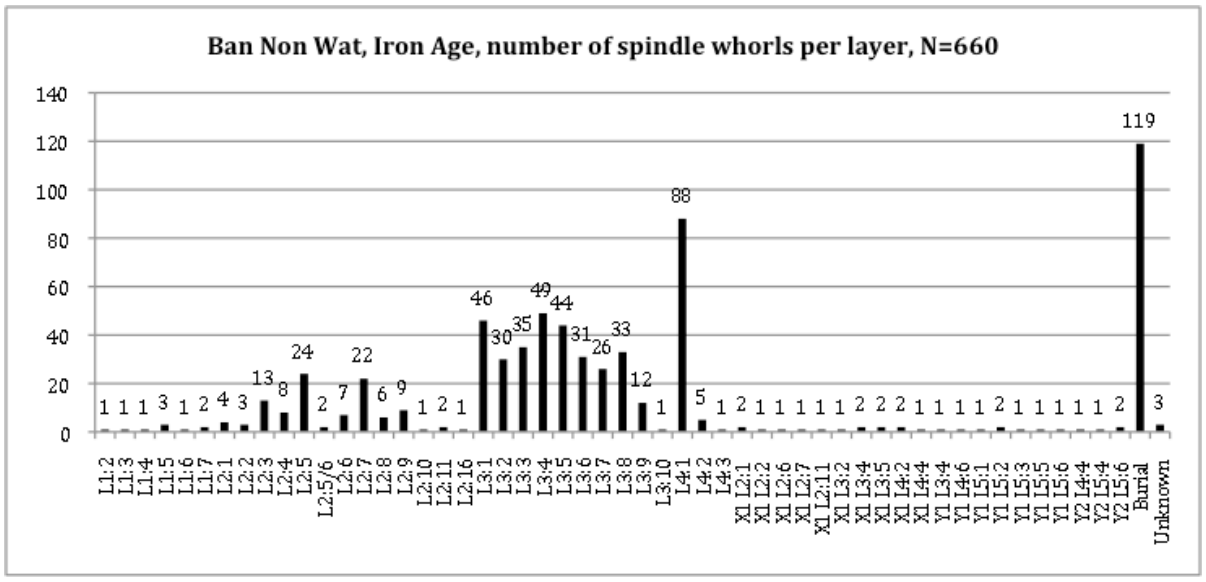


FIG. 8:1 Numbers of Iron Age spindle whorls per layer, N=660.

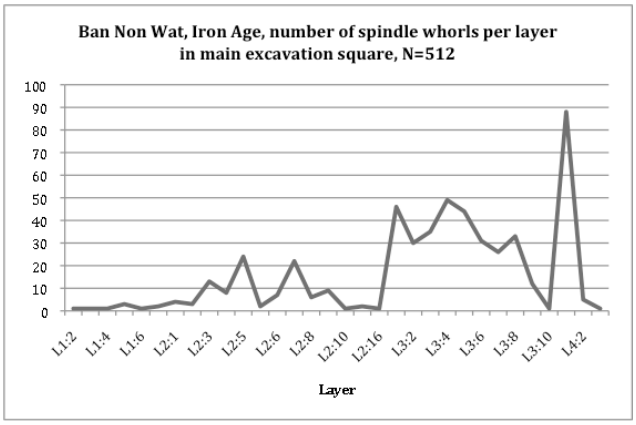


FIG. 8:2 The number of spindle whorls per layer in the main square

identified as beads or at Ban Non Wat, as counters. The central perforations of most of the Iron Age whorls measured between 3.5 and 4.5 mm which suggests the usage of thin spindles. Very few central perforations were not precisely in the centre which suggests a high level of spinning efficiency.

Weight

The weight of the Iron Age whorls indicates that those weighing around 10g predominate among the stratigraphically secure specimens. As large numbers were fragmentary, weights were adjusted to represent a complete whorl. Weights ranged from 5 to 20g with a few isolated examples slightly heavier (20-30g; Fig. 8:3).

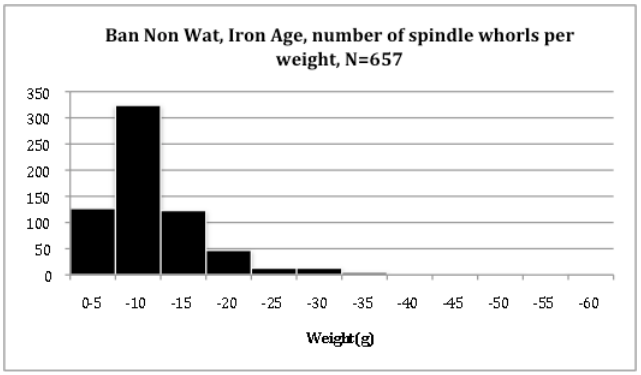


FIG. 8:3 The weight of the spindle whorls in the Iron Age layers, n=657

Diameter

The diameter of the whorls is shown in figure 8:4. Some were indeterminate from the remaining fragments. This attribute affects how tightly threads are spun. The results show a high degree of standardization. Those from the Iron Age layers measured between 20-45 mm with the majority clustering between 30-35 mm (Fig. 8:4). While these lie well within the range of prehistoric spindle whorls, they are smaller than earlier forms.

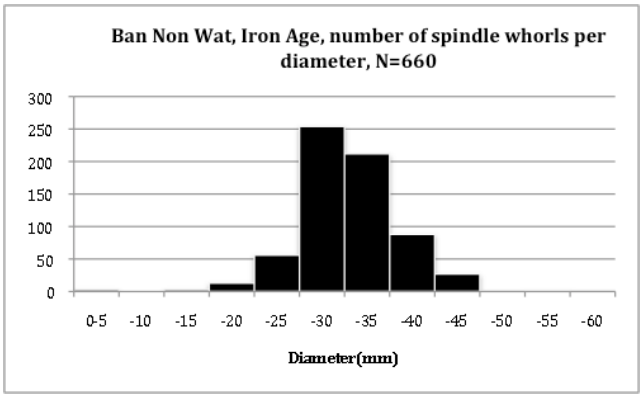


FIG. 8:4 The diameter of the whorls in the Iron Age layers, n=660

Maximum height

The maximum height of the Iron Age whorls did not vary substantially, with the greatest concentration between 10-15 mm.

Shape

Shape is an important functional attribute with four principal whorl types represented in the Iron Age sequences: discoidal, conical, biconical and a shape described as the "door knob" type (Cameron 2012). A very high level of standardization is indicated by the high percentage (97%) of conical types (Fig. 8:7) which suggests specialization. As the typology shows, this type commonly occurs at Southeast Asian sites although they do not usually predominate in this way (Fig. 8:8). These asymmetrical forms are wider at the base which makes them spin faster due to the action of centrifugal force. The flat top surface helps keep spun fibres on the spindle, a factor which probably accounts for the popularity of this shape at 1st millennium BC sites worldwide (Gleba 2008).

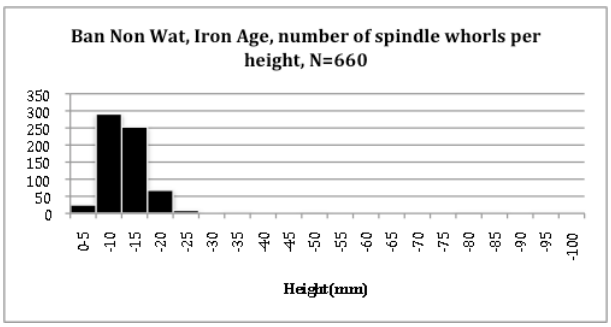


FIG. 8:5 The maximum height of the spindle whorls in the Iron Age layers, n=657

Although biconical types are also represented, they are far fewer (n=11). Eight basic flat discs with rounded and straight sides were also found. Textile scholars are generally agreed that this is the archetype whorl, appearing first in the archaeological record everywhere.

The Iron Age layers also produced a new, very distinc-

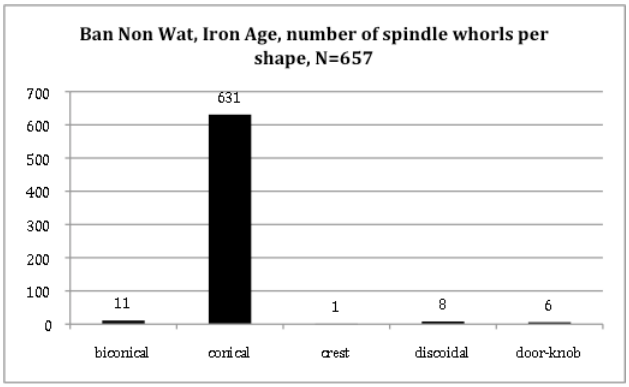


FIG. 8:6 The different shapes of the whorls in the Iron Age layers, n=657

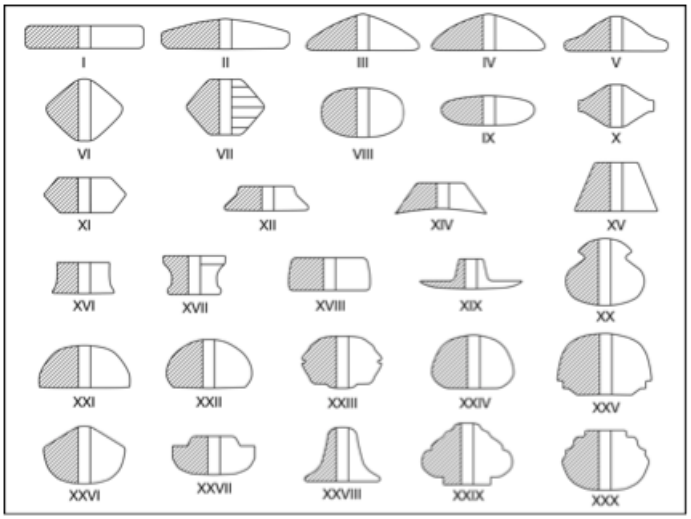


FIG. 8:7 Typology of Southeast Asian spindle whorls

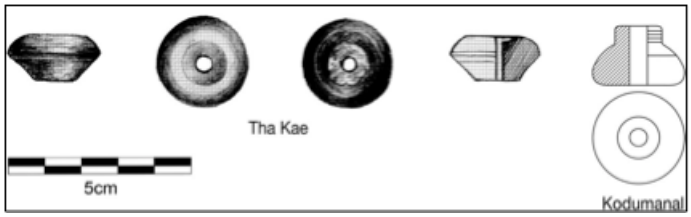


FIG. 8:8 Door knob shaped whorls from Tha Kae (Thailand) and Kodumanal (Tamilnadu) (Cameron 2).

tive type of spindle whorl called the "door-knob" type (Fig. 8:8), for its obvious connotations. This type of spindle whorls occurs along ancient trade routes in India as well as in Iron Age layers at Tha Kae, found in association with iron spindles and possibly cotton (Cameron 2011).

Decoration

Once Ban Non Wat potters had shaped some of the whorls, they decorated the outer surfaces using a number of different techniques, including slipping, incising, impressing and painting. Of these techniques, only stamping does not appear to have been used to decorate the larger pot-

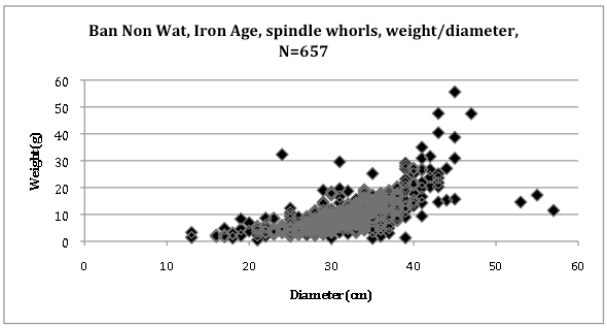


FIG. 8:9 the weight-diameter ratios of Iron Age spindle whorls. n=657

tery vessels. A single red-slipped whorl (cat. 26414) was found in burial 616. This technique was more commonly used to decorate larger pottery artefacts. Several other Iron Age burials contained whorls (cat. 18075 from B259, cat. 17464 from B319 and cat. 9600 from B6) which featured cloth impressions on their upper surfaces. Such impressions seem to be decorative although there is a possibility that they were functional, formed during the manufacturing process when the clay was wiped with a cloth before firing. Only two whorls (cats. 4650 and 17044) from the upper layers were stamped with concentric circles, probably using a small bamboo tube. Burial 237 contained two whorls, distinguished by red paint (discussed further below). By far the most common of the decorative techniques in the assemblage was incising, whereby lines were cut into the outer surfaces of the tools with a pointed instrument prior to firing.

DISCUSSION

There can be little doubt that workshop production is evidenced at Ban Non Wat, indicated by the very large numbers of whorls excavated at the site. When Youdi's 1975/6 excavations of Ban Don Ta Phet (Central Thailand) produced 153 spindle whorls, these were heralded as the largest number found in Thailand. Glover's (1990) later excavations of this site produced another 247 giving a total of 407, less than a third of those found at Ban Non Wat. The large numbers of whorls found at Ban Non Wat are not only unparalleled in Southeast Asia but also appear to exceed numbers recorded for Chinese and Indian sites. While finds exceeding 1,000 whorls are known elsewhere in the archaeological record, they are nonetheless rare. For example, Bronze Age Troy II (2600–2250 BC) produced 8-10,000 spindle whorls (Schliemann in Crowfoot 1954:435; Blegen 1963:435). However, it is worth noting that Schliemann removed over 250,000 m^3 in three years at Troy thereby producing 4 whorls per 100 m^3 whereas Higham and Thosarat opened

Table 8:1 Techniques used to decorate the Iron Age spindle whorls

Painted	Slipped	Impressed	Stamped	Incised
14106 (B237) 14141 (B237) 12519 (3) 2153 (B52)	26414 (B616)	18075 (B259) 17464 (B319) 9600 (B6)	17044 (3) 22237 (3)	174 (3), 367 (3), 1304 (2), 2017 (3), 4650 (3), 5152 (3), 5548 (3), 5573 (3), 7053 (3), 7534 (3), 8309 (3), 9019 (3), 9604 (3), 10042 (3), 16028 (3), 16147 (3), 17044 (3) 18097 (3), 19577 (3), 19570 (3), 19596 (3), 19949 (?), 20483 (3), 20415 (3), 20483 (3), 20554 (3), 20556 (3), 20559 (3), 21020 (2), 21064 (3), 21067 (3), 21095 (3), 21057 (3), 21096 (3), 21101 (3), 22337 (3), 22452 (3), 23059 (3), 24016 (3), 24593 (3), 25066 (3), 25069 (3), 25092 (3), 25103(3), 25104 (3), 25116 (3), 25527 (3), 26087 (?), 32354 (3).

3000 cubic metres in seven years at Ban Non Wat thereby producing 37 whorls per 100 m^3. Certainly, the very high density of whorls at Ban Non Wat indicates that spinning and weaving were very important economic activities in this strategic part of Thailand during the same transitional period of prehistory.

While there are clear parallels between the functional attributes of the Bronze Age and Iron Age spinning tools, there is also a number of unusual attributes of the Iron Age assemblage that suggest change. The standardization of the spindle whorls in the upper layers, particularly the predominance of conical forms, is significant. As the typology in figure 8:7 shows, a wide range of spindle whorl types have been identified at other Southeast Asian sites but this diversity is not evidenced in the upper layers. Admittedly, conical types are very basic forms, as attested by their widespread distribution at archaeological sites world-wide but there are patterns in the distribution of these basic forms in China that enable these types to be linked to specific fibres. Conical spindle whorls are common at Neolithic sites belonging to the Yangshao culture in the Yellow River valley where they were used to spin hemp fibres (*Cannabis sativa*). This correlation is also indicated by the decoration of the conical whorls.

While a degree of technological and artistic continuity is evidenced by the usage of the same decorative techniques that were used to decorate the whorls from the Bronze Age sequences discussed in the previous volume on the site (see Higham *et al* 2011), painted whorls appear in the upper Bronze Age and Iron Age layers. Previously (Cameron 2002), I have argued that Han Chinese influence is suggested by the appearance of painted whorls in the upper layers of Tanshishan sites in Southeast China. This seems far from co-incidental as this period coincides with the movement of Han Chinese into South China and considerable interaction in mainland and island Southeast Asia. Painted whorls also occur during the late Neolithic/Early Metal Age at Middle Yangtze sites belonging to the Qujialing culture. The occurrence of multiple painted conical whorls in a small number of burials suggests that the occupants of these graves were specialists, possibly high-ranking textile producers.

Many whorls were incised on one surface with a variety of simple, albeit distinctive motifs such as an inverted E, S (cat. 22337) and single lines ///. Such motifs occur on spindle whorls from Yangtze Valley sites from the Neolithic onwards. Potter's marks also occur on Neolithic pottery. While the meaning of these motifs is unclear, motifs such as the inverted E motif and /// lines resemble early Chinese characters, the latter being featured on oracle bones but although such motifs suggest a symbolic communication system, single characters do not constitute writing.

While most of our knowledge of early inter-regional trade is based on fragments and historical sources on the Silk Route that connected China to the Roman Empire during the Han dynasty, there can be little doubt that the textile trade was based on prehistoric trading networks. During the same period, textiles were also paid as taxes in China. Certainly, trade could have provided the rationale for the intensification of textile production at Ban Non Wat.

While it is held that the large numbers of whorls in the upper layers of the site indicate large-scale textile production, the rationale behind this intensification is less clear. Craft specialization trade and exchange existed in Southeast Asia as early as the Bronze Age but the scale of production at Ban Non Wat is unprecedented. While there is clearly a relationship between workshop production and social complexity, it is not immediately clear if this was a causal relationship as Childe (1931) proposed or if the craft specialization at Ban Non Wat was the result of developing socio-political complexity.

Nearby in China, craft specialization and workshop production were inextricably linked to the development of the state with textile workshops evidenced as early as the Shang dynasty. During the early dynastic period, taxes were paid to the state in grain and textiles and written accounts indicate that not only were textiles legal tender, silk textiles were often exchanged for slaves. Given Ban Non Wat's distance from China's political borders, it is doubtful that the workshops were organised by Chinese officials. Significantly, at that time in China, the government monopoly on handicraft production was broken (in the Spring and Autumn and Warring States period).

Craft specialization and workshop production was then organised by officials or wealthy merchants producing fabrics, particularly silk for elites. These textile workshops extended beyond the centre, evidenced by the weaving workshop on the tympanum of a bronze cowry container from *Shizhaishan* (Yunnan) and historical sources such as the Book of Master Guan specifically refers to merchants trading textiles for millet. This suggests that the local elites at Ban Non Wat organised textile workshops to engage in the inter-regional textile trade.

IX THE ADULT MALE BURIALS AND OTHER ADULTS OF IRON AGE PERIOD 1, NORTHERN GROUP

The Iron Age 1 cemetery has a singular distribution. The Iron Age graves follow in an easterly direction from the late Bronze Age burials. However, the cemetery divides into two groups based on the orientation of head. Those in the northern half had the head pointing in a northerly direction, and those in the southern half had the head orientated to the south (Fig. 9:1). Each group contains the graves of men, women, children and infants, and there are no stratigraphic grounds for considering them to be anything but contemporary. Graves on the western side were interred cheek by jowl, and were often very disturbed as a consequence, meaning that identifying the sex of the dead person is not always possible. As one progresses to the east, however, the burials were spaced and well preserved.

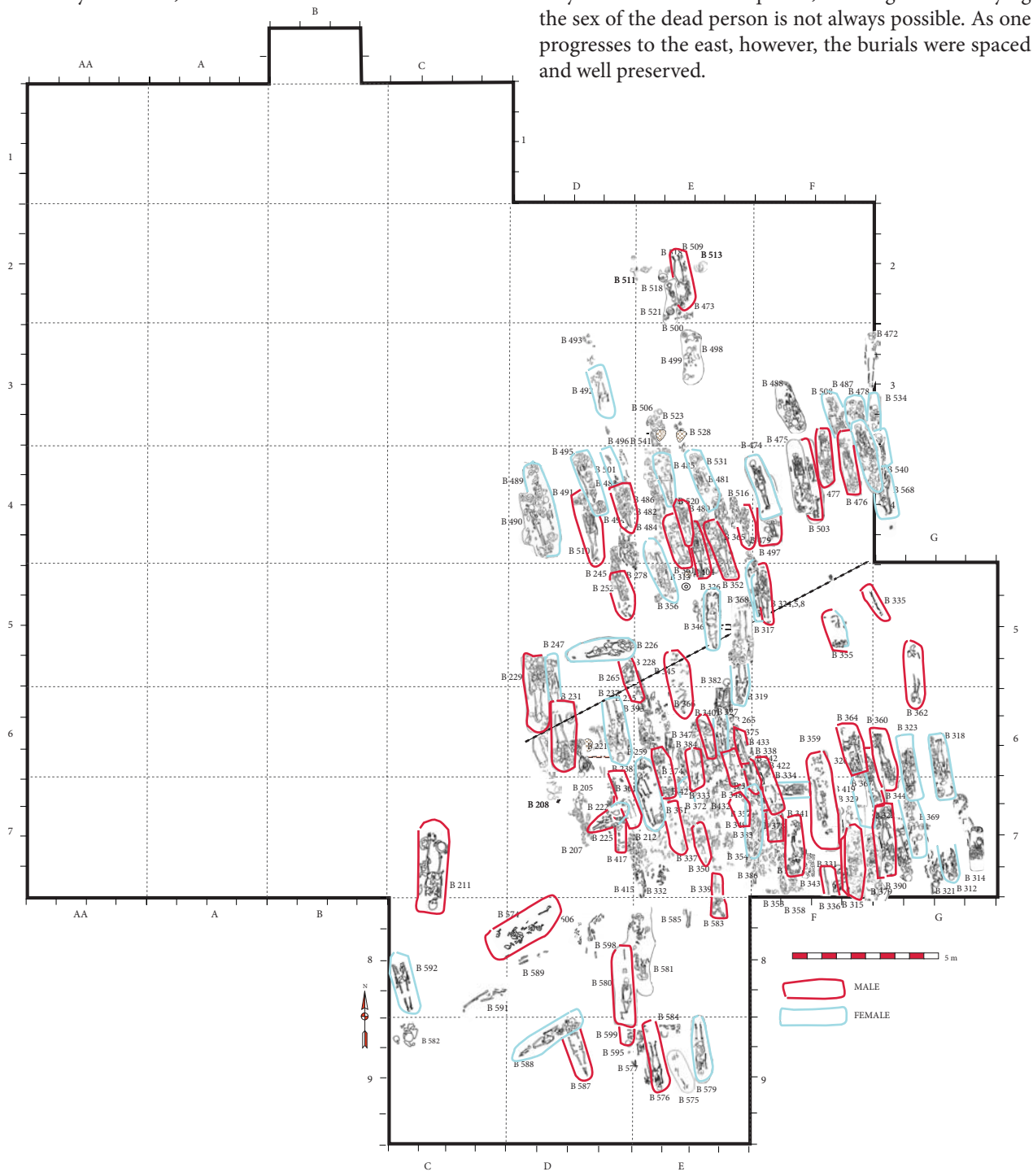


FIG. 9:1 The distribution of Iron Age 1 graves

TABLE 9:1 *The mortuary offerings for Iron Age 1 male and other adult burials, northern group*

burial no.	229	325	352	355	361	365	404	473	476	477	482	494	497	503	510	520	278	317	475	480	486	506
age	YA	MO	OA	Y-MA	YMA	OA	OA	YA	Adol	MA	YMA	A	MA	YA	MO	YA	OA	Y-MA	A	YA	YMA	Adol
orientation	355º	355º	350º	N	355º	N	N	160º	355º	355º	350º	350º	355º	340º	340º	355º	355º	180º	355º	355º	170º	350º
Sex	?M	M	M	?M	?M	M	?M	?M	?M	M	M	?M	?M	M	?M	?M						
depth (metres)	1.92	1.59	1.72	1.86	1.82	2.02	1.98	1.13	1.60	1.87	1.80	1.96	1.97	1.91	1.96	1.86	1.96	1.37	1.76	178	1.92	0
n pots	8	3	7	8	7	18	5	6	3	8	9	8	7	0	6	2	7	6	6	7	4	11
pot form 5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 41	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 45	3	1	2	0	0	0	2	0	2	1	2	1	1	0	2	1	0	3	2	3	0	2
pot form 48	0	0	0	0	0	2	0	0	0	1	1	2	1	0	0	0	2	0	1	0	0	2
pot form 49	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 51	2	1	0	6	3	4	1	0	0	2	2	4	2	0	0	0	3	3	2	3	1	3
pot form 52	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 55	0	0	3	0	1	0	1	0	1	3	2	1	1	0	2	0	1	0	1	3	3	3
pot form 56	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 60	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 61	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 62	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pot form 66	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bivalve shell	1	0	0	2	0	1	1	2	2	0	0	1	1	0	0	0	0	2	0	0	1	1
pig bones	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	1	0	0	1
red ochre	0	0	12	1	0	3	6	0	0	1	1	3	0	0	0	0	1	0	4	0	3	1
spindle whorl	0	0	2	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	1	0	2	0
fish skeleton	0	0	12	0	8	7	1	3	1	4	6	3	5	0	2	1	5	0	3	3	1	5
Bos bone	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0
buffalo bone	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
chicken bones	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
dog bone	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grey clay	0	1	1	0	0	0	1	0	0	1	2	0	0	0	0	1	0	0	1	0	1	0
bronze ring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bronze bangle	0	0	0	0	2	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	27	0
bronze arrowhead	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
bronze socketed implement	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
iron bangle	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
iron object	0	0	1	0	0	0	0	1	0	0	0	2	0	0	0	0	0	4	0	5	1	0
iron hoe	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
iron spear	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
whetstone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
iron blade	8	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
iron point	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pellet bow pellet	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
agate bead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
tin bead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

YA: young adult, MO: mid-old adult, OA: old adult, Adol: adolescent, YMA: young-mid adult

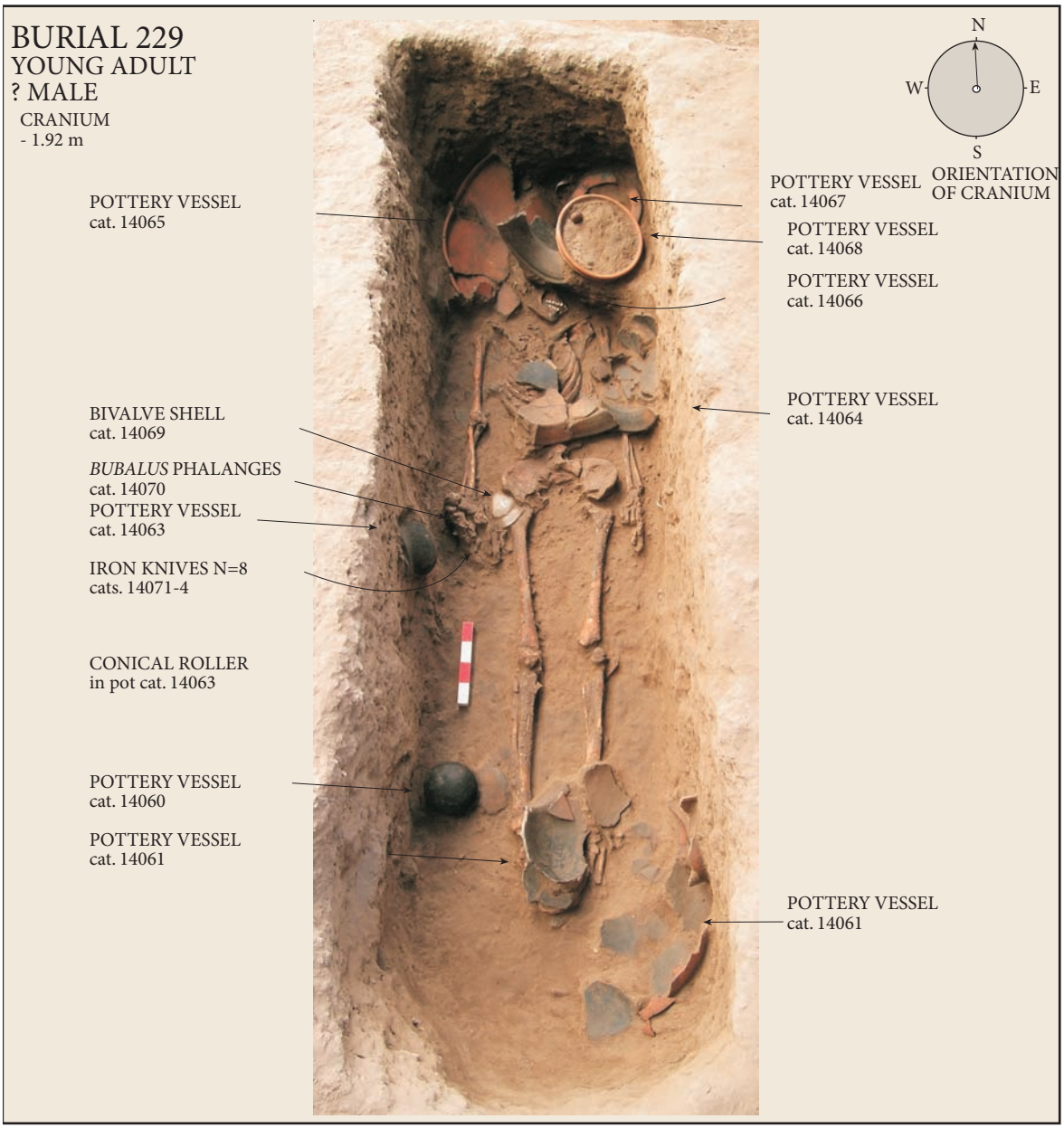


FIG. 9:2 Burial 229

Burial 229 involves a young adult probable male, interred at a depth of 1.92 m below datum, and orientated to the north. He was associated with eight ceramic pots. Three respectively are forms 45 and 56, and there are two of burial 51. They were distributed beyond and over the head, with three by or over the ankles. A bivalve shell was located by the right hand, along with articulating water buffalo phalanges. A set of iron knives were also found in this part of the grave, there being at least eight.



FIG. 9:3 Burial 229, showing the iron knives, bivalve shell and water buffalo bones. Scale 5 cm

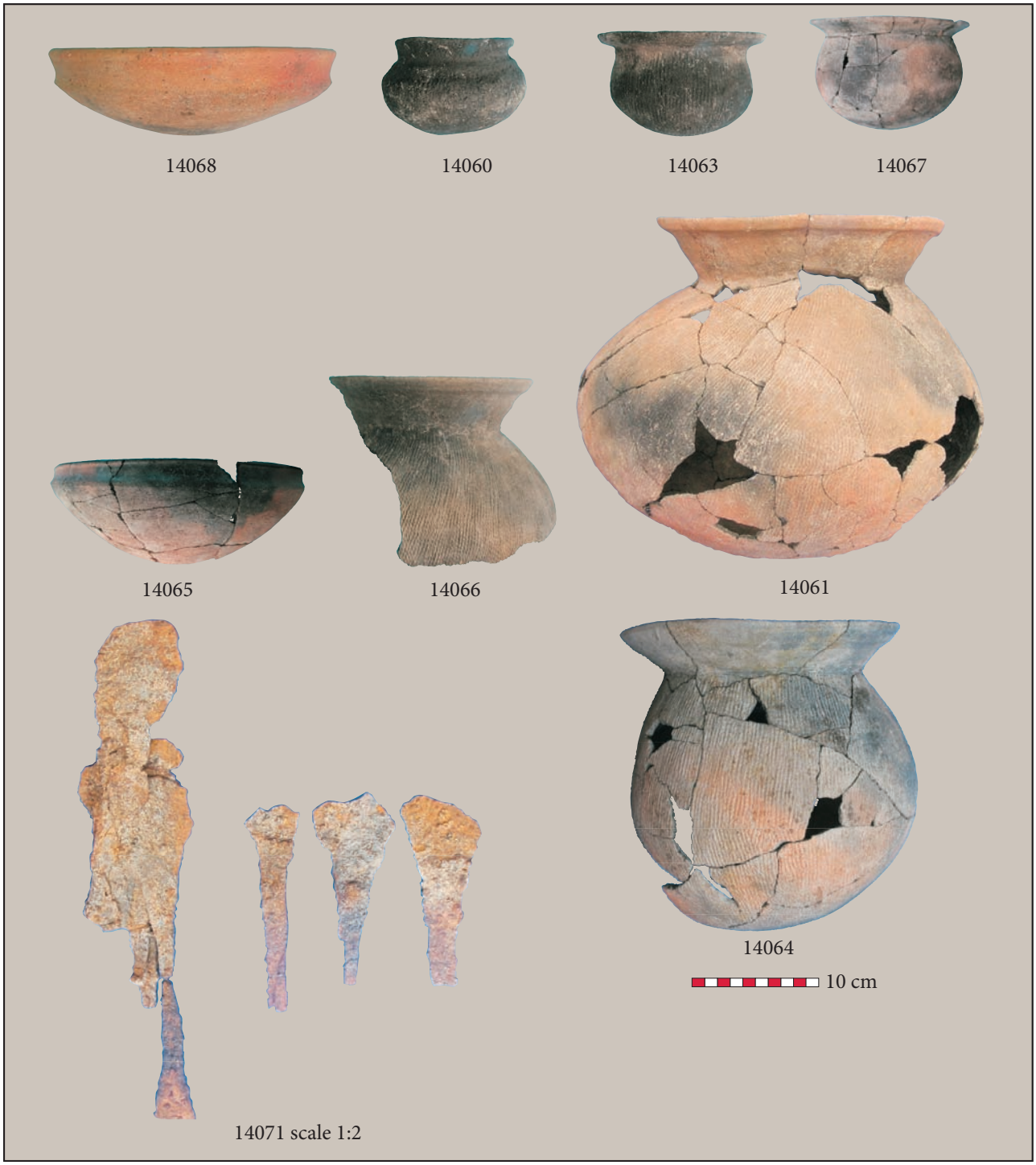


FIG. 9:4 The ceramic vessels and iron knives from burial 229

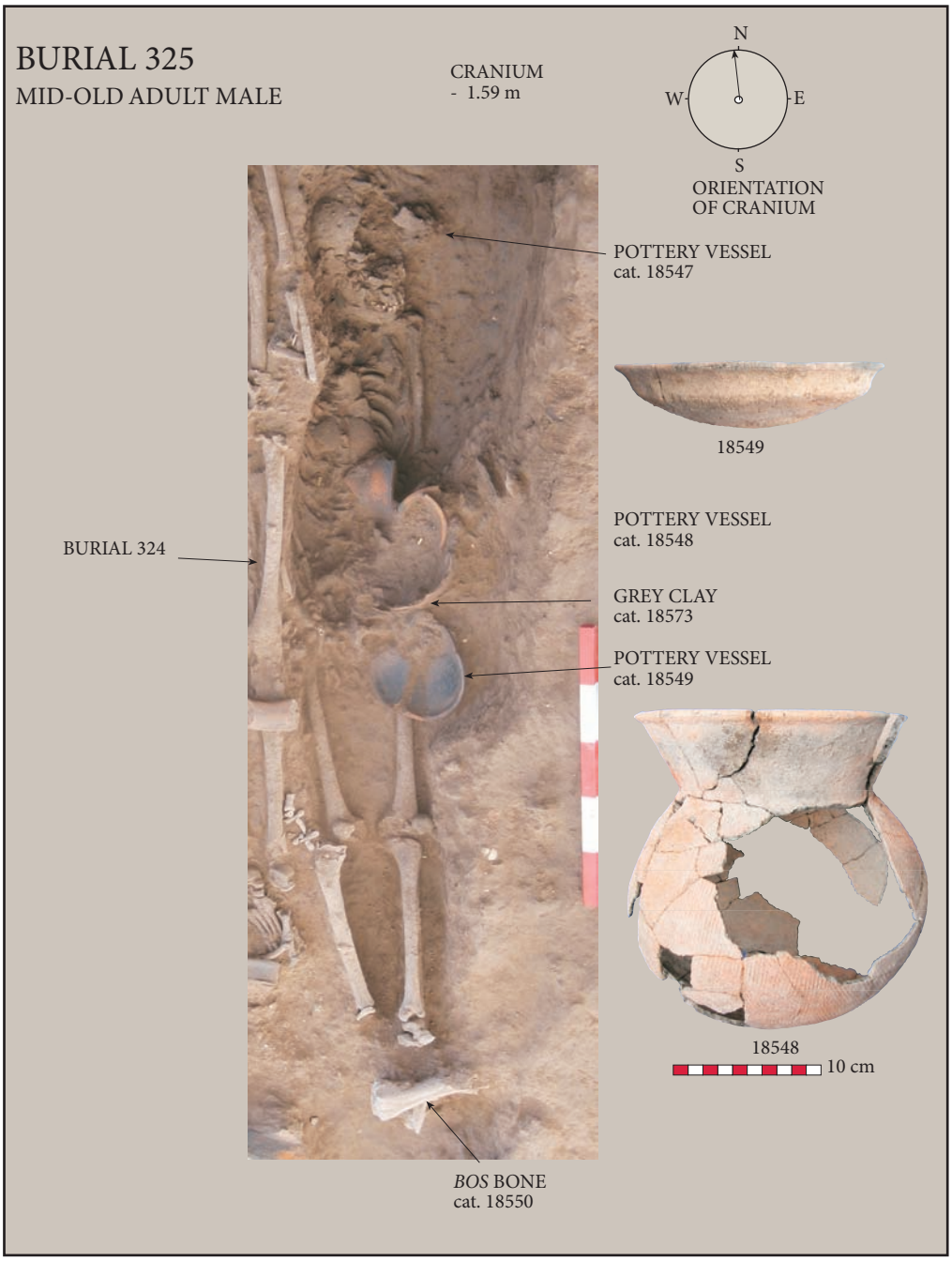


FIG. 9:5 Burial 325

Burial 325 was found at a depth of 1.59 m below datum, with the body orientated with the head 355° from the north. It was in the same grave as burials 324 and 328. It is relatively complete. Two pots of forms 45 and 51 were found over the left arm and femur Some grey clay was present under the abdomen and beyond the ankles lay a bovid metatarsal.

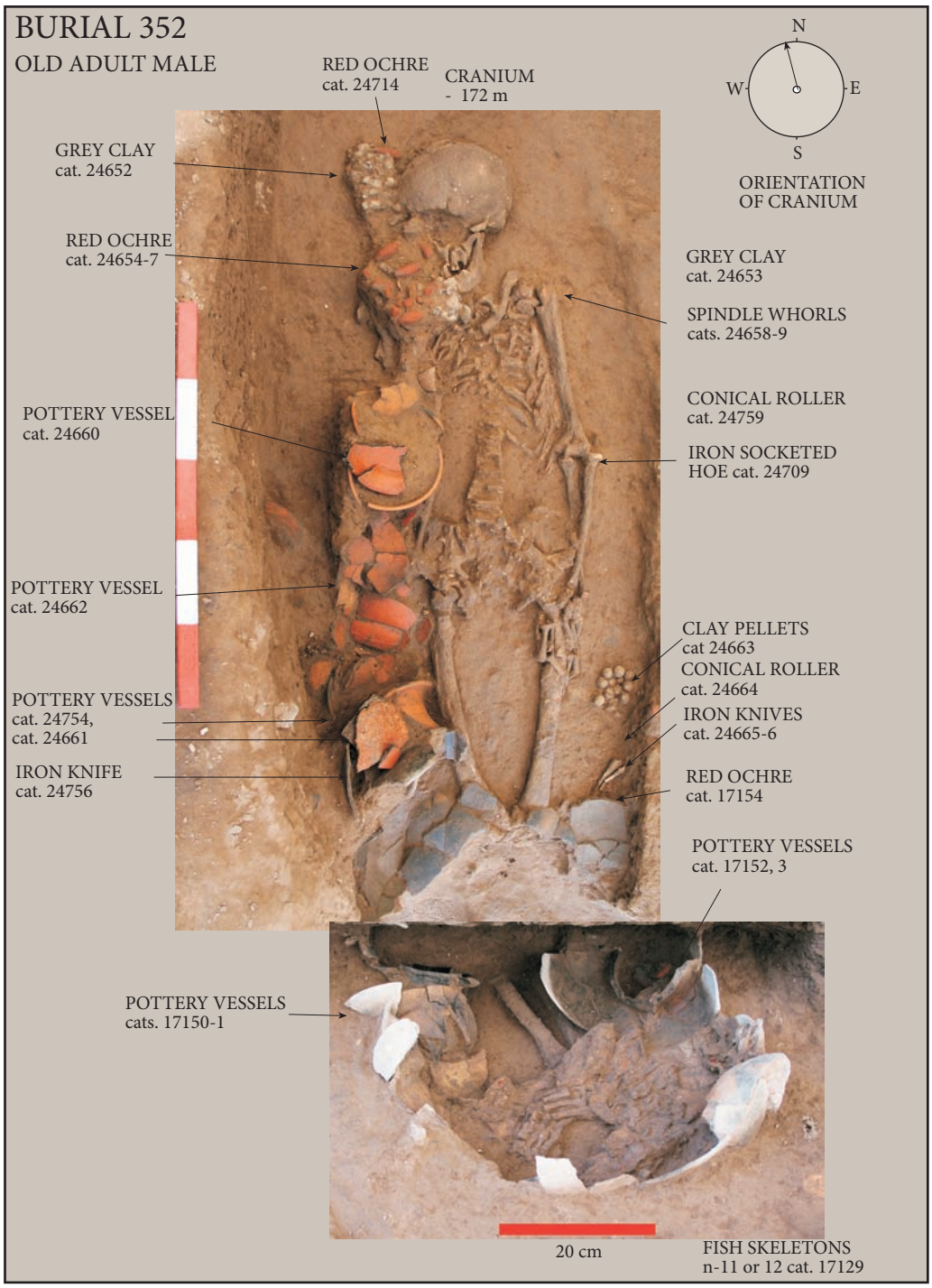


FIG. 9:6 Burial 352

Burial 352 was found at a depth of 1.73 m below datum, with the body orientated with the head 350° from north. It is the rich burial of an old man, uncovered over two seasons. Pots were found beyond the feet and lining the right hand side of the skeleton. Three are of form 55, and there are two respectively of form 45 and 52. This person was also interred with an iron knife by the right hand, two iron knives beside the left leg, and a socketed iron implement by the right elbow. Ten pellets of red ochre clustered beside the face, with another beyond the head and a further specimen left of the left leg. Grey clay lay beside the face as well. There were two spindle whorls at the left shoulder, and two of the enigmatic rollers, which may not have been intended as offerings. A cache of 12 pellet bow pellets beside the left hand however, was surely placed intentionally. The following fish were found: *Clarias* sp. 1R pectoral fin spine, *Hemibagrus*/*Mystus* 1R pectoral fin spine, *Channa* sp. 1 whole fish (crushed skull). Pot over feet, whole fish as follows: 8 *Channa striata*, 1 *Channa* sp., 1 *Clarias* sp., 1 *Clarias macrocephalus*.



FIG. 9:7 Mortuary offerings from burial 352

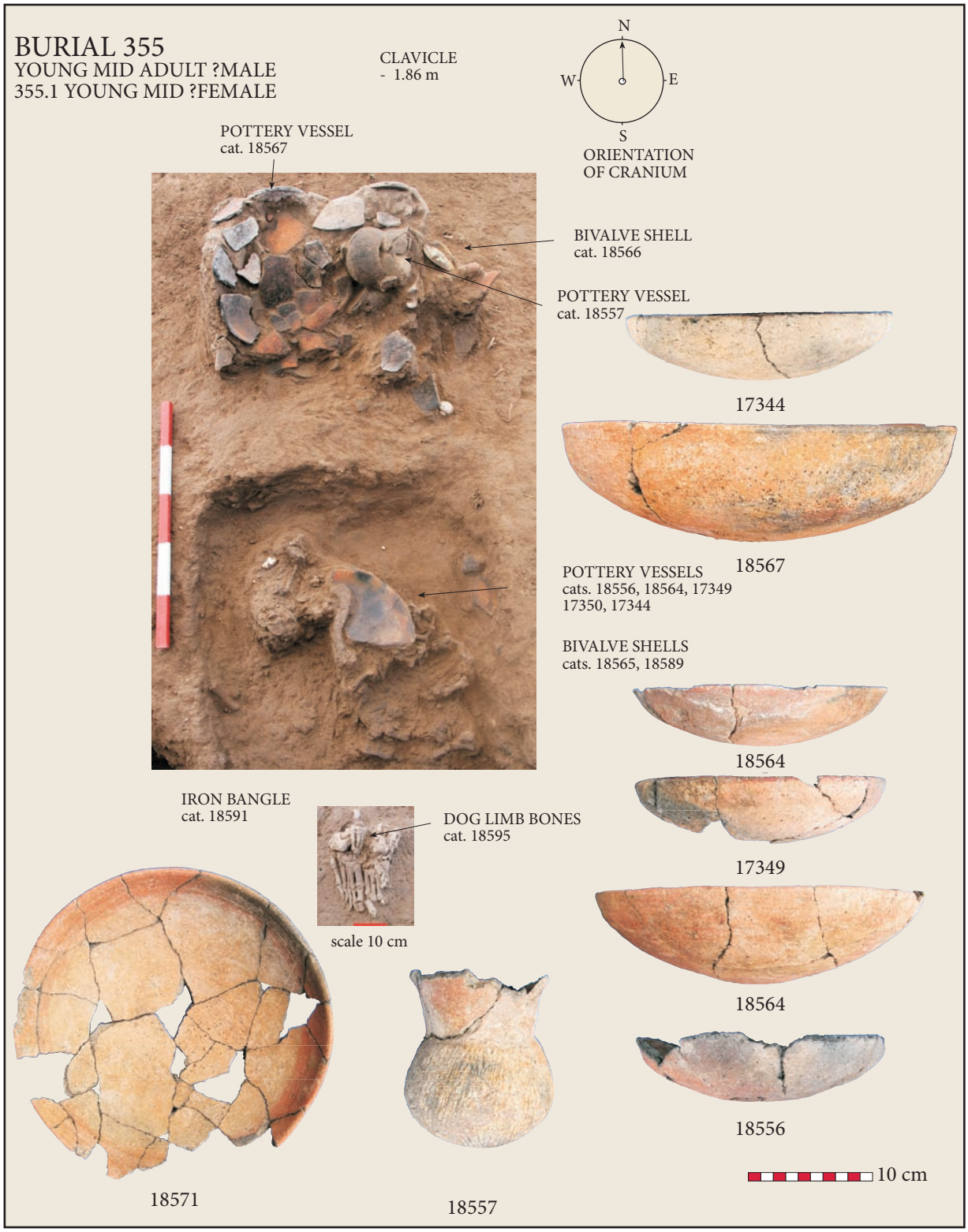


FIG. 9:8 Burial 355

Burial 355, that of a young to mid-adult man, was found at a depth of 1.86m, orientated with the head to the north. Some bones of a young to mid adult female were also present. It was associated with eight pottery vessels, six of form 51 and one of form 61. Other mortuary offerings comprised two bivalve shells, some red ochre, a chicken bone, dog bones, and an iron bangle.

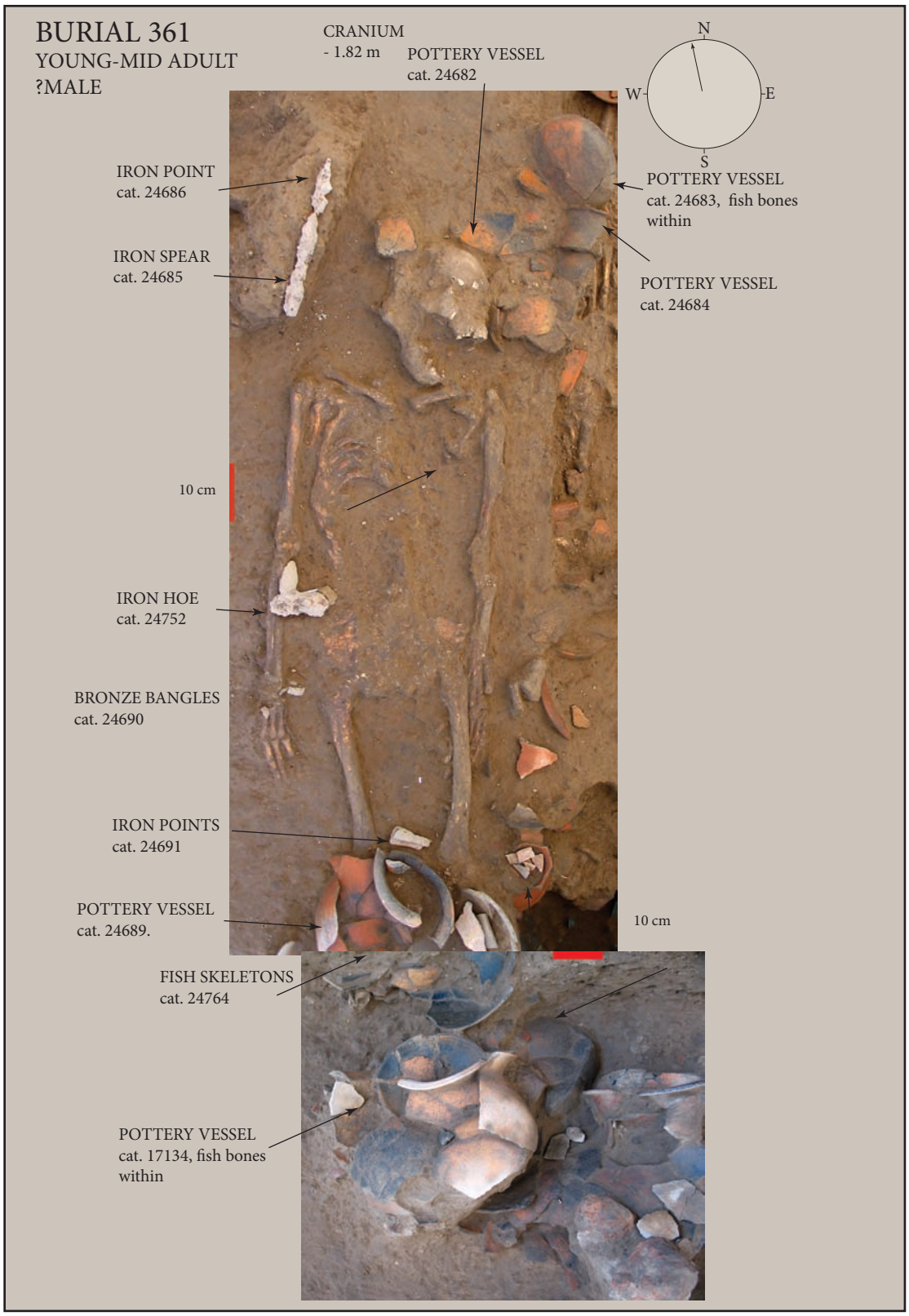


FIG. 9:9 Burial 361

Burial 361 was found at a depth of 1.82 m below datum, on an orientation 355° from north. It contained a young adult ?male. At least seven ceramic vessels were associated, beyond the head, over the ankles and beyond the feet. Three are of form 51, two of form 52 and one is form 55. This young to mid adult man wore two bronze bangles on the



FIG. 9:10 Ceramic vessels and iron artefacts from burial 361

right wrist. Several iron artefacts were also encountered: points between the knees, a hoe over the right elbow and a spear and a point beyond the head. Pot cat. 17134 contained the following fish bones: 9 fish vertebrae, *Clarias* sp. two left pectoral fin spines; one urohyal; four small fragments of skull; *Monopterus albus* one left dentary; *Anabas testudineus* one left cleithrum; a fragment of frontal bone; two fragments of skull; *Channa striata* 1 basioccipital and one right premaxilla. Pot cat. 24683 contained 5 fish vertebrae, *Clarias* sp. one urohyal, two small fragments of skull; *Monopterus albus* one urohyal. Fish bones cat. 24764 were found under under pot cat. 24689: *Anabas testudineus* a whole fish, *Channa striata* a whole fish.

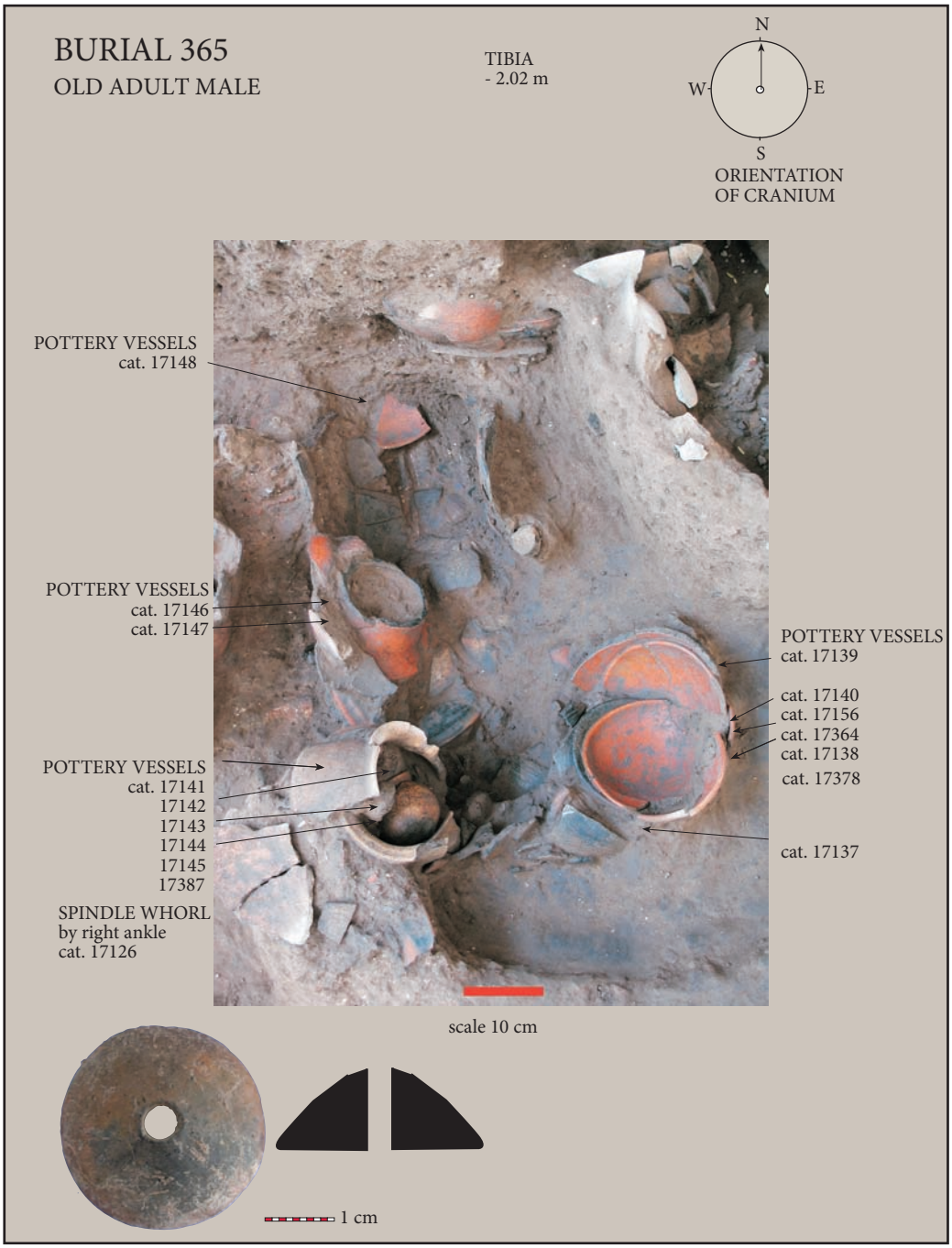


FIG. 9:11 Burial 365

Burial 365 was found at a depth of 2.02 m below datum, in a grave with the head orientated to the north. It contained the skeleton of an old man. The lower part of the body was found during the 2006 season, the upper part a year later. The upper body was badly disturbed by burials 352 and 480. Eighteen ceramic vessels were placed over the body, of which 12 could be assigned a form. Three are of the most unusual form 60, and one is also unusual, being form 61. There are four examples of form 51, two of form 48 and one each of forms 9 and 49. A spindle whorl was present beside the ankles. It is difficult to be sure of assignment where there was prehistoric disturbance due to the close proximity of burials, but it is likely that the following belong to this burial, being found in the area of the disturbed upper body: a bivalve shell over the face and three red ochre pellets by the left knee. the following fish remains were identified: 2 whole *Channa striata* among sherds of pot cat. 17164; *Clarias batrachus* 1 supraoccipital; 3 whole *Channa striata* by the L hand; 1 whole *Channa micropeltes* around pot cat. 24829.

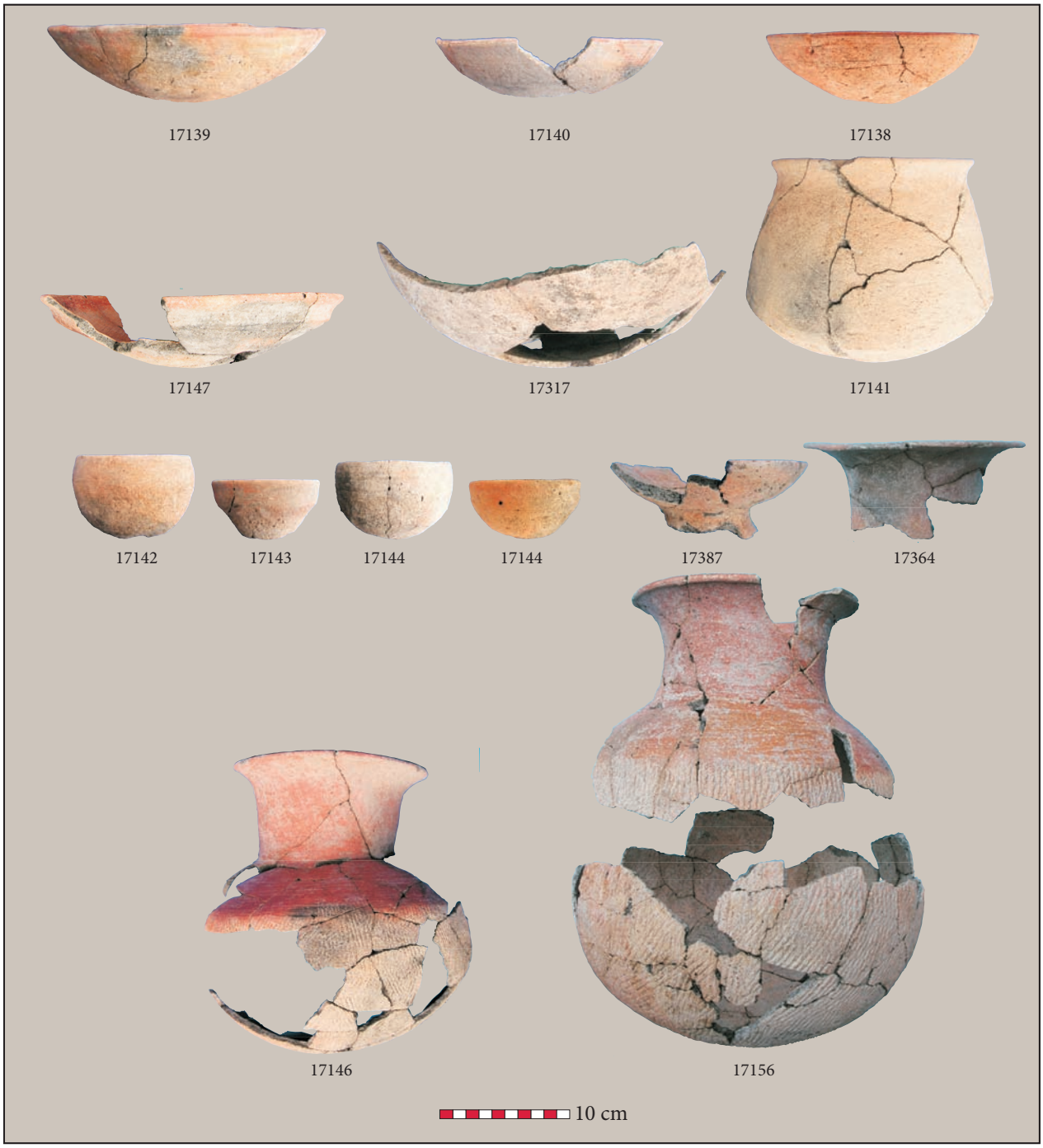


FIG. 9:12 Ceramic vessels from burial 365

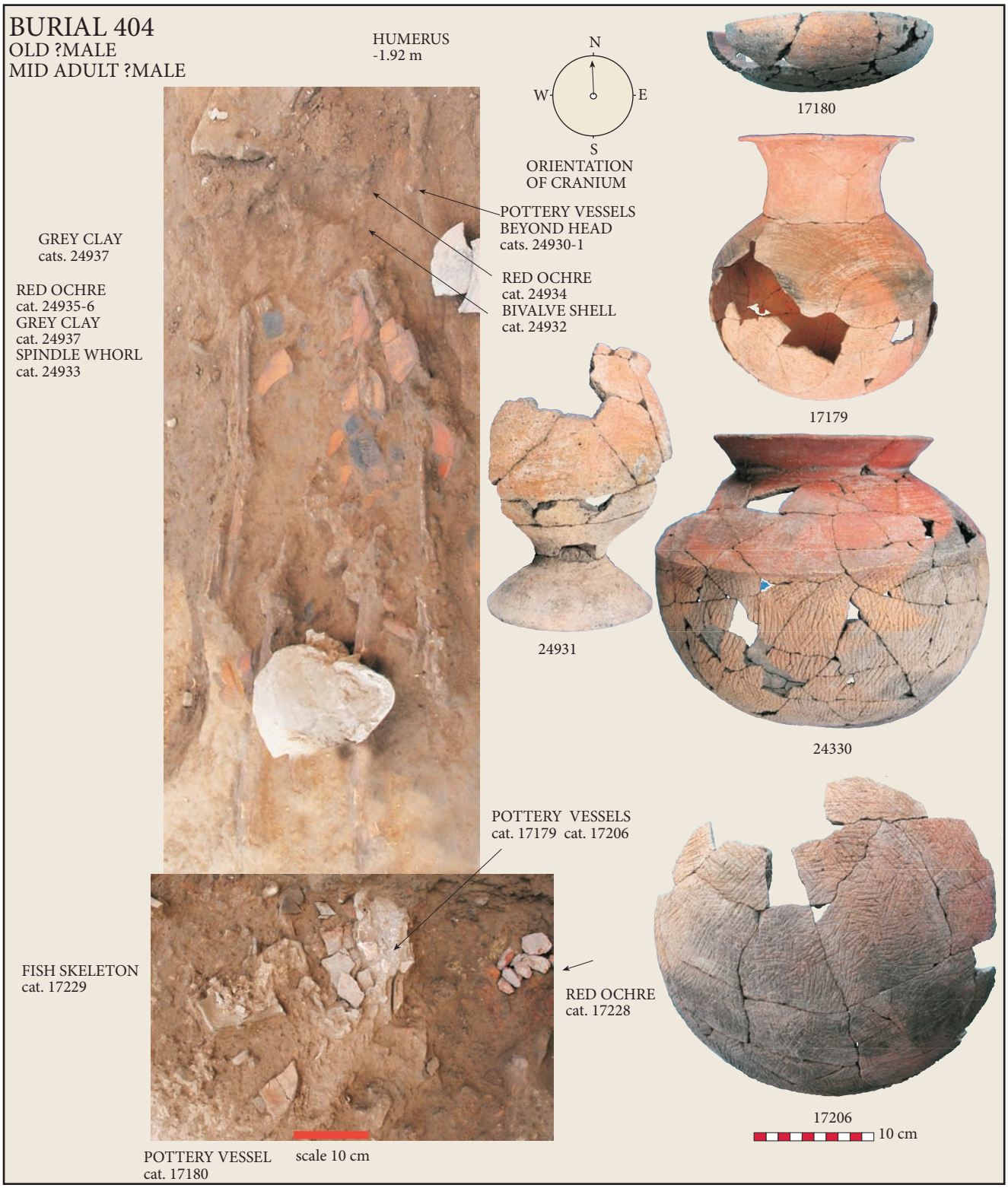


FIG. 9:13 Burial 404

Burial 404 was uncovered over two different seasons. It was very difficult, given the concentration of graves in this part of the site, to be sure of the affiliation of some artefacts and bones with this burial. Two individuals have been identified, one old and one mid adult, both male. Five pots were probably associated, being beyond the head and feet. One is of the rare form 66, and there is one of form 51, one of form 55 and two of form 45. A bivalve shell was located by the head, and the skeleton of the fish *Channa striata*, cat. 17229, was found over the ankles. Six pellets of red ochre were distributed of the ankles, in the vicinity of the neck and by the head. This same region also contained a spindle whorl and deposit of grey clay.



FIG. 9:14 Burial 473



FIG. 9:15 Burial 473, showing the bronze ring on the cranium. Scale 5 cm





FIG. 9:16 Burial 473, left, showing the fish skeleton cat. 23594 and FIG. 9:17 above, showing the pig bones by the right arm. Scales 5 cm

Burial 473 was found at a depth of 1.13 m below datum, with the body orientated with the head 160° from north. It is a most unusual burial and hard to place relative to others. It is located to the north of the Iron Age 1 cemetery, and is much higher than other early Iron Age burials. The pottery vessels also set this burial apart, with one of form 5 and the remainder of form 41. This person had a bronze ring between the eyes. There was also an iron artefact under the right hand and pig's limb bones by the right arm. Two bivalve shells were present, one also by the right arm and the other at the left shoulder. Three whole *Channa striata* fish skeletons were found in pot cat. 23591.

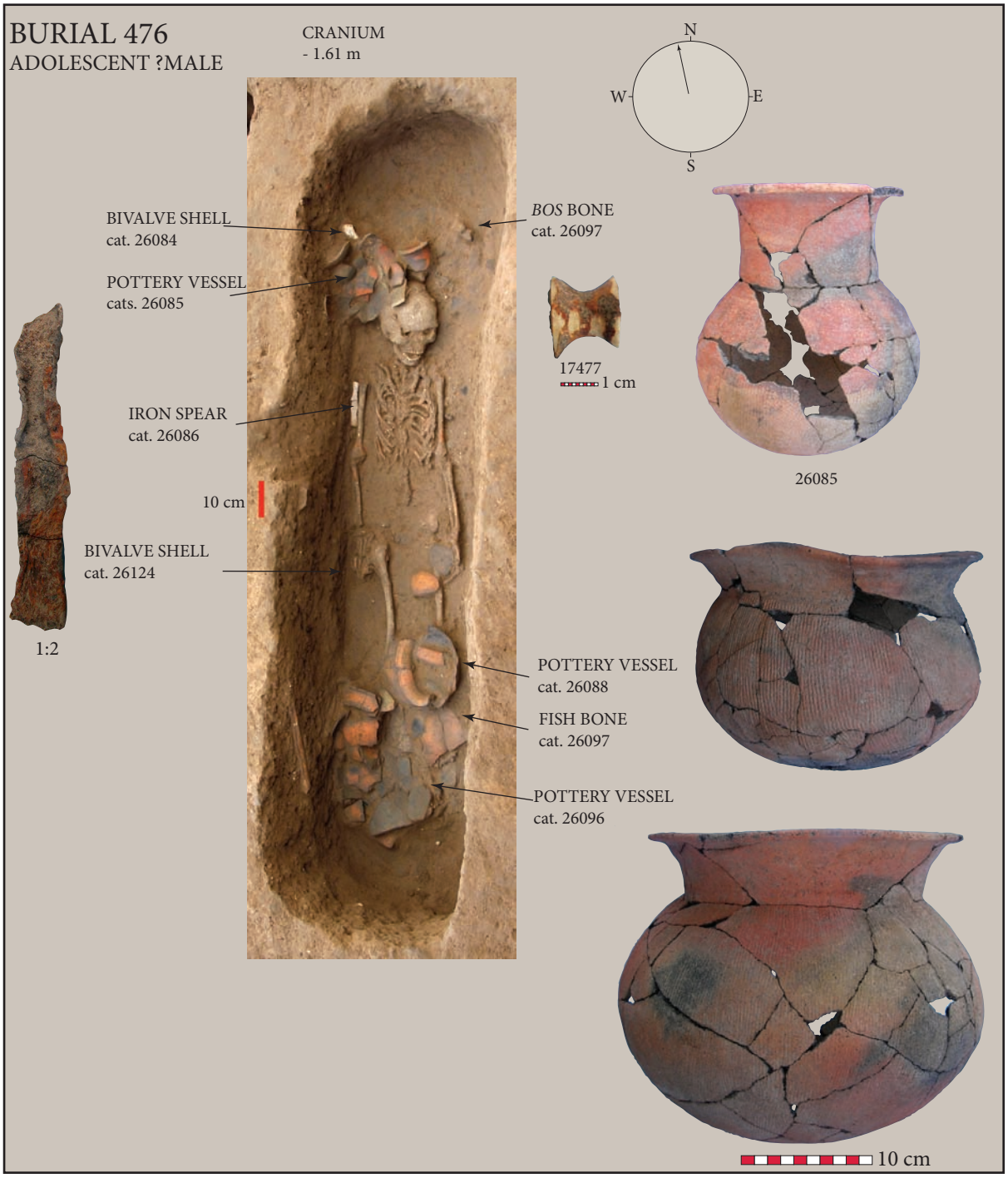


FIG. 9:18 Burial 476

Burial 476 was found intact. It was orientated with the head 355° from the north at a depth of 1.60 m below datum. It contained an adolescent ?male. A pottery vessel of form 55 lay beyond the head, and two pots of form 45 were found over the ankle area of the body. Two bivalve shells were recovered, one from beyond the head and the other by the right hand. Fish bones were found in the area of pot 26088 beyond the feed. A socketed iron spear was present lying alongside the upper right arm.

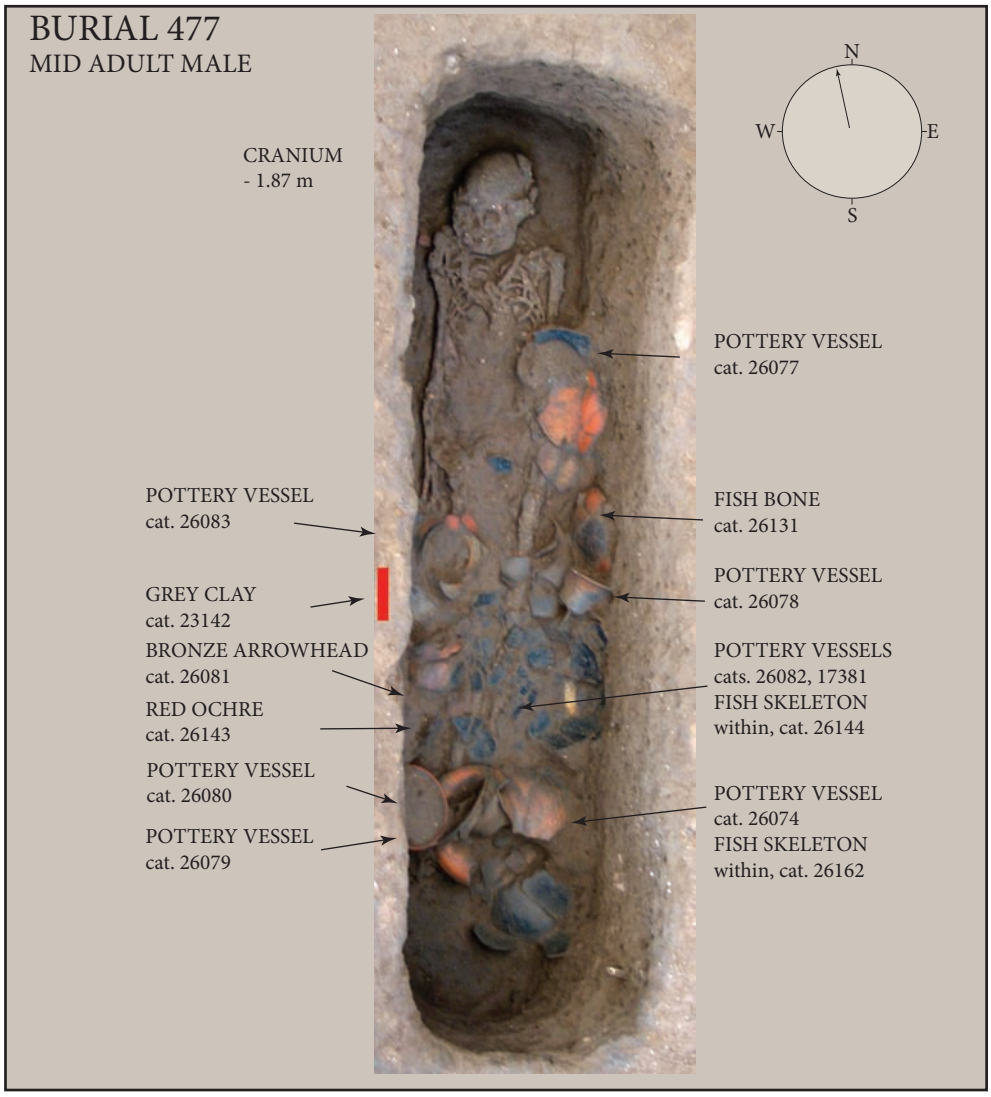


FIG. 9:19 Burial 477

Burial 477, that of a mid adult male, was complete and intact. It lay 1.87 m below datum, orientated with the head 355° from north. Eight ceramic vessels are found in association, distributed ove the lower body and the left arm. Of these, two are of form 51, three form 55 and one each of forms 45 and 48. Pot 26074 contained one right ceratohyal of *Monopterus albus* and two *Channa striata* skeletons. Pot cat. 26082 contained the skeleton of a *Channa striata.* Grey clay and red ochre were present by the right ankles, and a bronze arrowhead was found in the same area of the grave.



FIG. 9:20 Burial 477, showing the fish skeleton cat. 26131 within ceramic vessel cat. 26078. Scale 5 cm



FIG. 9:21 Mortuary offerings from burial 477

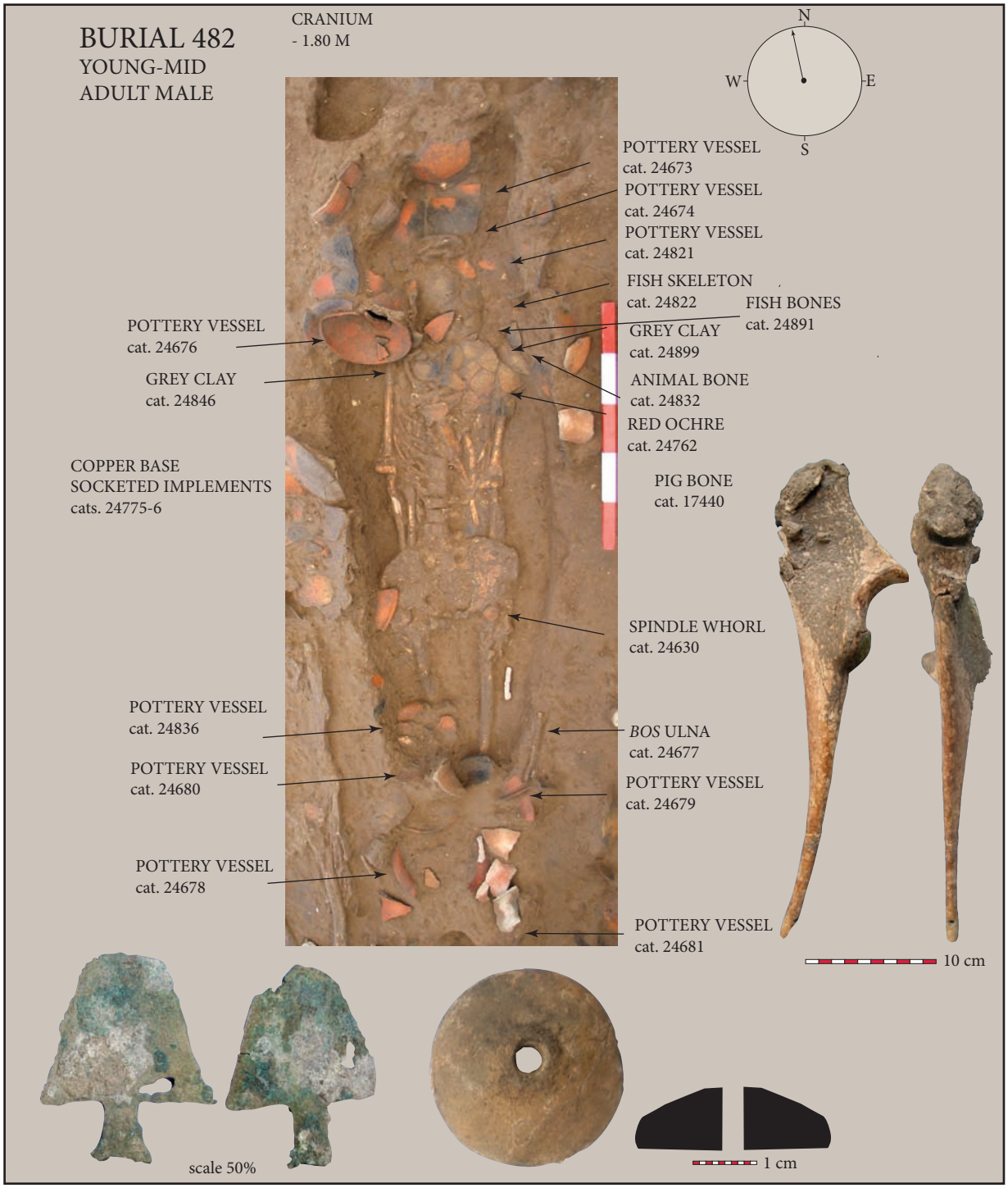


FIG. 9:22 Burial 482

Burial 482 was found at a depth of 1.80 m below datum, the grave orientated with the head 350° from north. Nine pottery vessels were found in association, five of which were found over and round the heads, the rest over and round the ankles. There are two respectively of forms 45, 51 and 55, and one of form 48. The remainder could not be reconstructed to form. Further mortuary offerings also clustered round the head: two fish skeletons, articulating pig bones, grey clay in two deposits and red ochre. Two copper-base thin socketed artefacts adhered to the right ulna. These resemble closely those found in the Khao Wong Prachan Valley to the west. A spindle whorl was found by the left hand, while there was a bovid ulna beside the left ankle. The following fish bones were found: four whole *Channa striata* to the left and beyond the head, cat. 24675; 1 whole *Channa striata* cat. 24832 at left arm; cat. 24891 a fish vertebra.

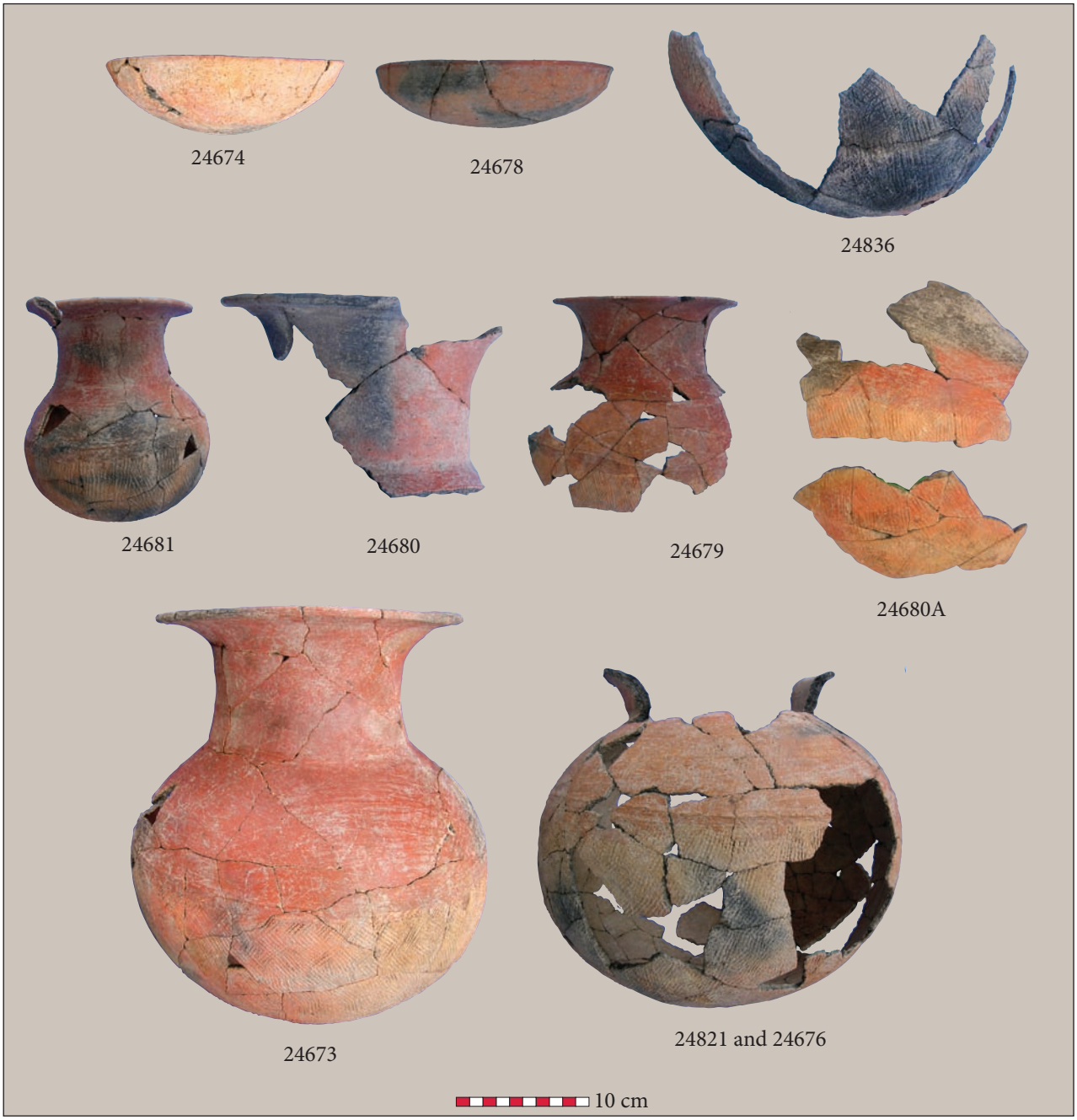


FIG. 9:23 Ceramic vessels from burial 482

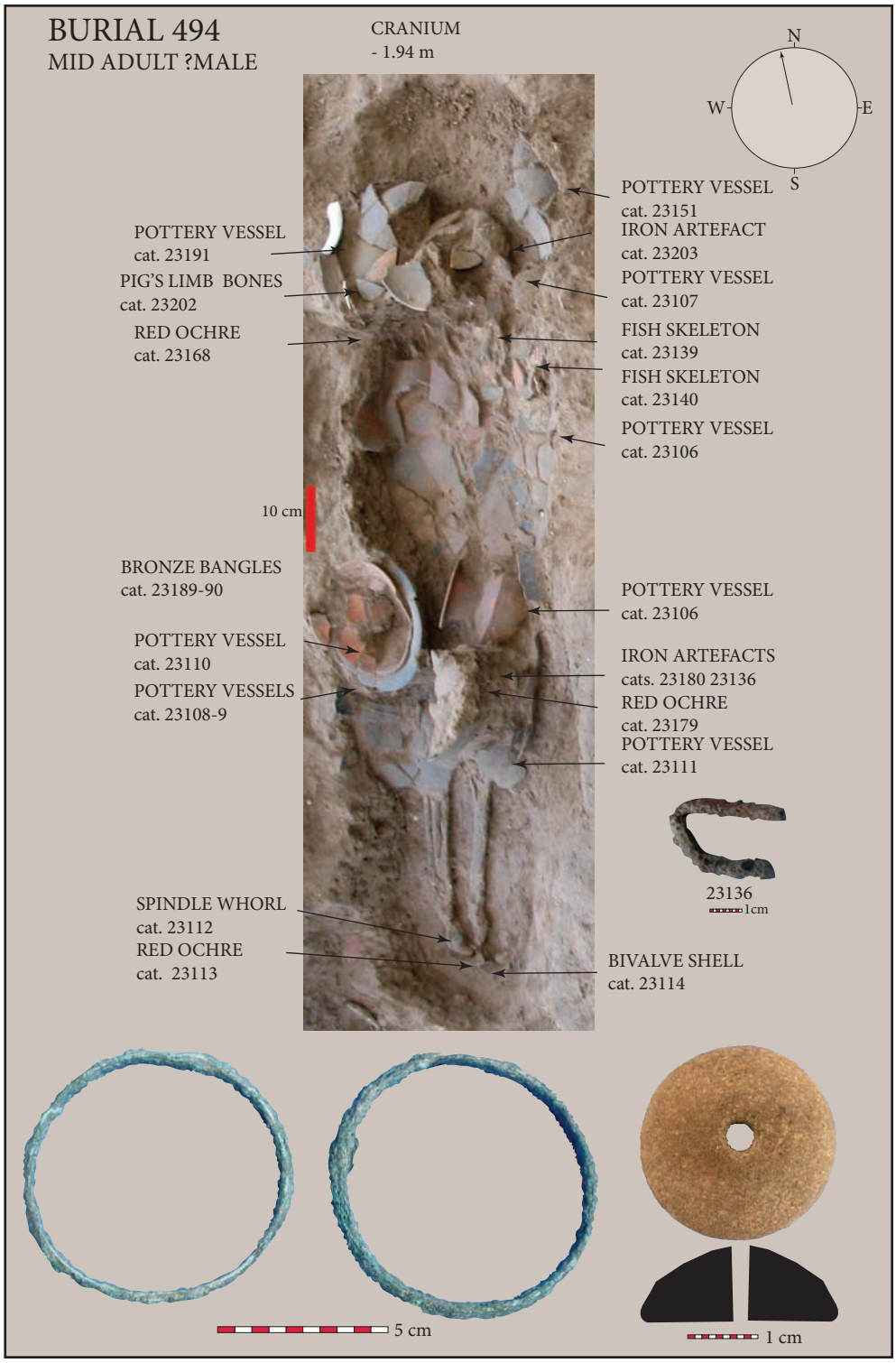


FIG. 9:24 Burial 494

Burial 494 was found at a depth of 1.94 m below datum, the grave orientated with the head 350° from north. Eight pottery vessels were found in association, four of form 51, two of form 48 and one each of forms 45 and 55. They were found over and beside the head and the pelvis. A bivalve shell, red ochre and a spindle whorl lay beside the ankles. Two iron artefacts of amorphous form were found, one between the upper legs and the other beyod the head. The fore limb bones of a pig were also found in this region of the grave along with a further deposit of red ochre. More red ochre was found among the pots over the pelvis. The following fish remains were recovered: *Channa striata* 1L dentary; 1R articular, 1 whole *Channa striata* and 1 whole *Channa striata* cat. 23174 at the left of the skull.

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FIG. 9:25 Ceramic vessels from burial 494



FIG. 9:26 Burial 497

Burial 497 was found at a depth of 1.97 m below datum, and orientated with the head 355° from north. Five of the seven pottery vessels found in association could be reconstructed. Two are of form 51, and there is one each of forms 45, 48 and 55. A bivalve shell lay by the right hand and three complete skeletons of the fish *Channa striata* together with two right pectoral fin spines and a fragment of neurocranium from *Clarias* sp. were found in pot cat. 26154.



FIG. 9:27 Burial 503.

Burial 503 was found at a depth of 1.91m below datum. It contained the skeleton of a young adult man interred with no mortuary offerings, with the head orientated 340° from north.

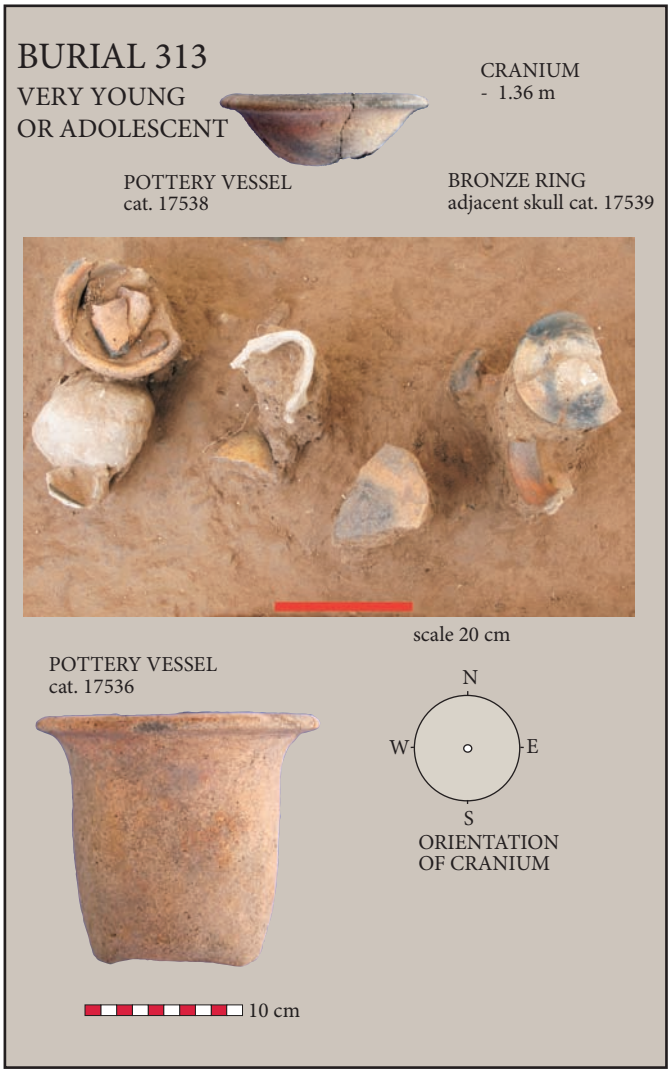


FIG. 9:28 Burial 313

Burial 313 was found at a depth of 1.36 m below datum. Only the skull and mandible were recovered together with two ceramic vessels and a bronze ring. The person died when very young or adolescent.

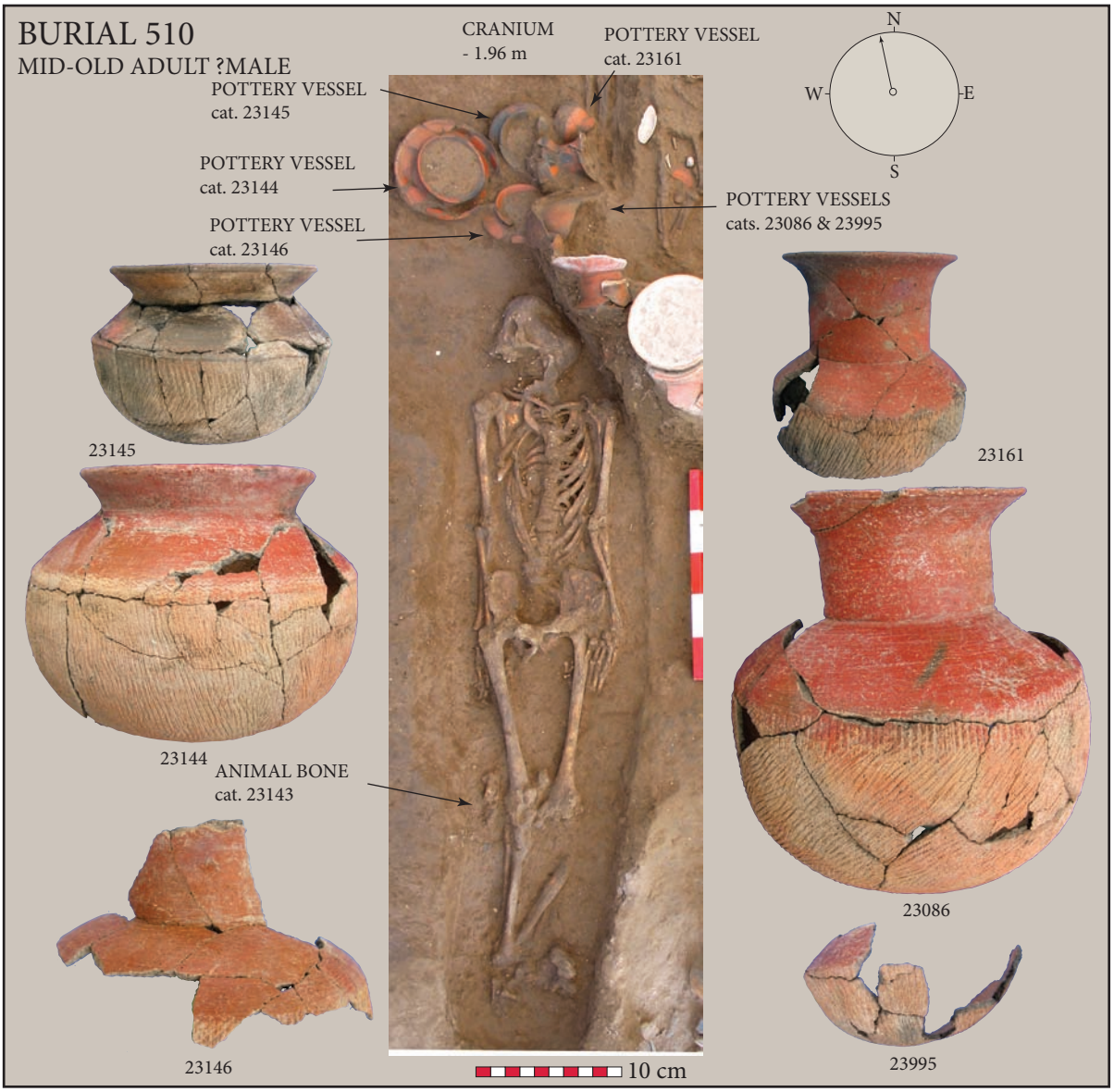


FIG. 9:29 Burial 510

Burial 510 was found at a depth of 1.96 m below datum, the grave orientated with the head 340° from north. Six ceramic vessels were associated, all beyond the head. Two are of form 45, two of form 55 and two cannot be fully reconstructed. The following fish bones were found in pot cat. 23145: *Clarias* sp. 1R supraorbital, *Channa striata* 1R maxilla.



FIG. 9:30 Burial 510, showing a close up view of the cranium. Scale 10cm

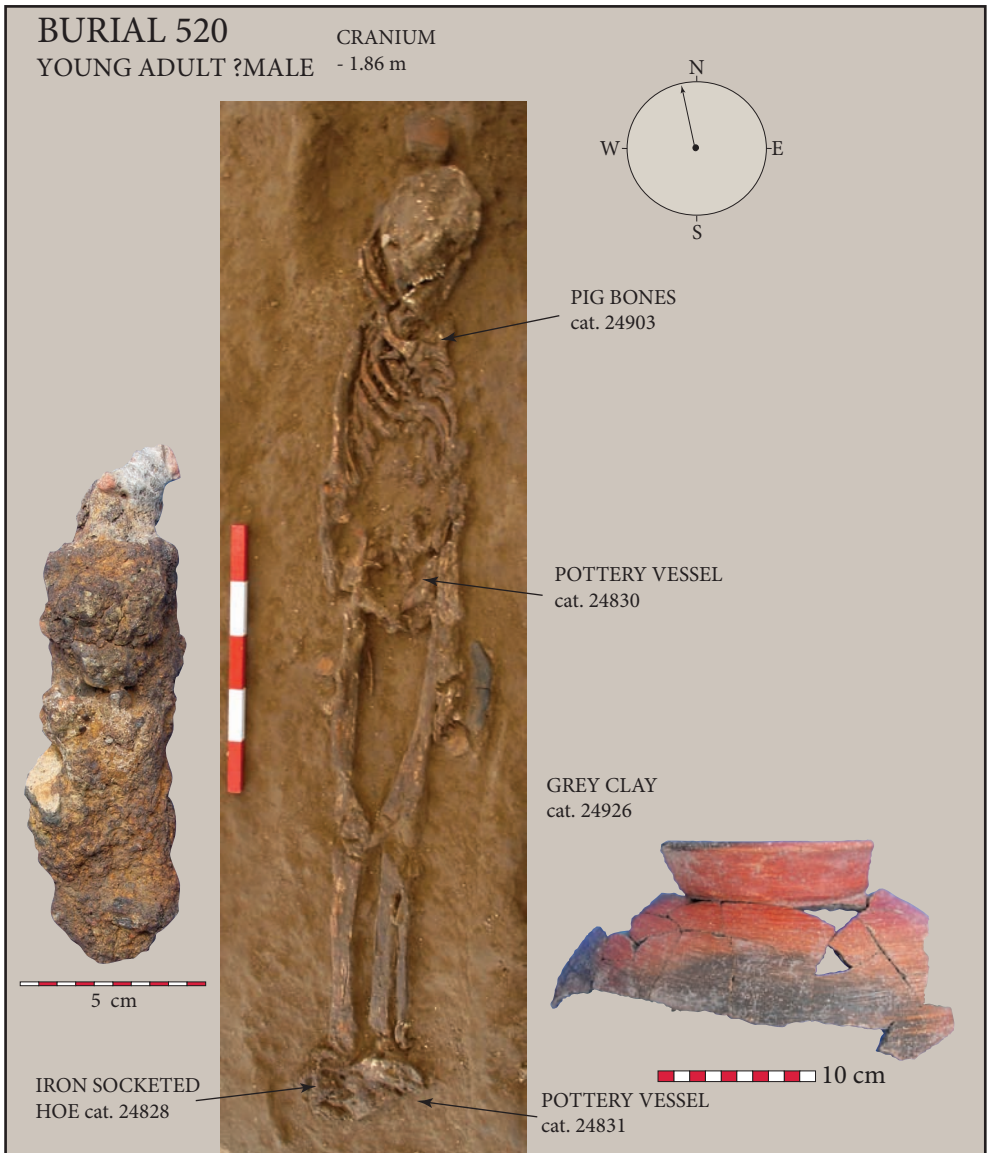


FIG. 9:31 Burial 520

Burial 520 contained the skeleton of a young adult ?male and was found at a depth of 1.86 m below datum, the grave orientated with the head 355° from north. Two pottery vessels are associated, one over the feet, the other over the abdomen. The only one that could be reconstructed is of form 45. A socketed iron implement in the form of a hoe was found over the ankles. Other mortuary offerings comprises grey clay and the right fore limb bones of a pig. A complete skeleton of the fish *Channa striata*, cat. 24913,



FIG. 9:32 Burial 520, showing close up of the cranium. Scale 5cm



FIG. 9:33 Burial 278

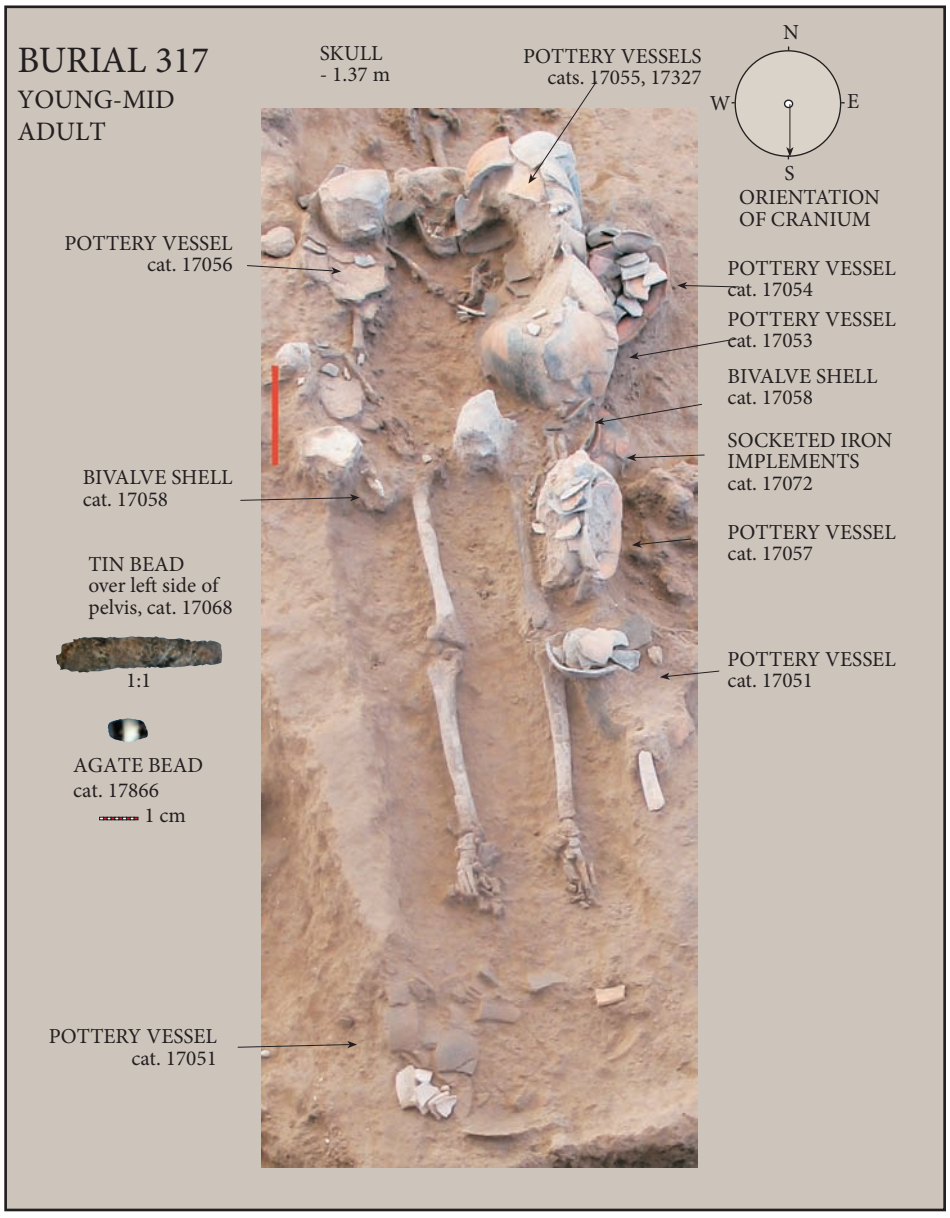


FIG. 9:33 Burial 317

Burial 278 was found at a depth of 1.96 m below datum, orientated with the head directed 355° from north. At least seven pots were found broken over the skeleton. Three are of form 51, two of form 48 and one form 55. Fish bones were found in the form 55 vessel cat. 17123 as follows: *Hemibagrus nemurus* 2 whole fish, *Channa micropeltes* 1 whole fish, *Channa striata* 2 whole fish and contents of pot cat. 17124, *Channa striata* 1 whole fish. There was also some red ochre and the distal epiphysis of a bovid radius, but the area beyond the head was disturbed and there may well have been more mortuary offerings.

Burial 317 was found at a depth of 1.37 m below datum, with the body of a young to mid adult was orientated with the head to the south. There are six pottery vessels in association, found beside the head, beyond the feet and down the left hand side of the body. Three are of form 51, and another three of form 45. One bivalve shell was found by the right hand, and there was another over the pelvis. A bead made of tin was also found in the pelvic area while at least four socketed iron implements were present by the left hand. A small agate bead was found in the upper area of the body.



FIG. 9:34 Mortuary offerings from burial 317

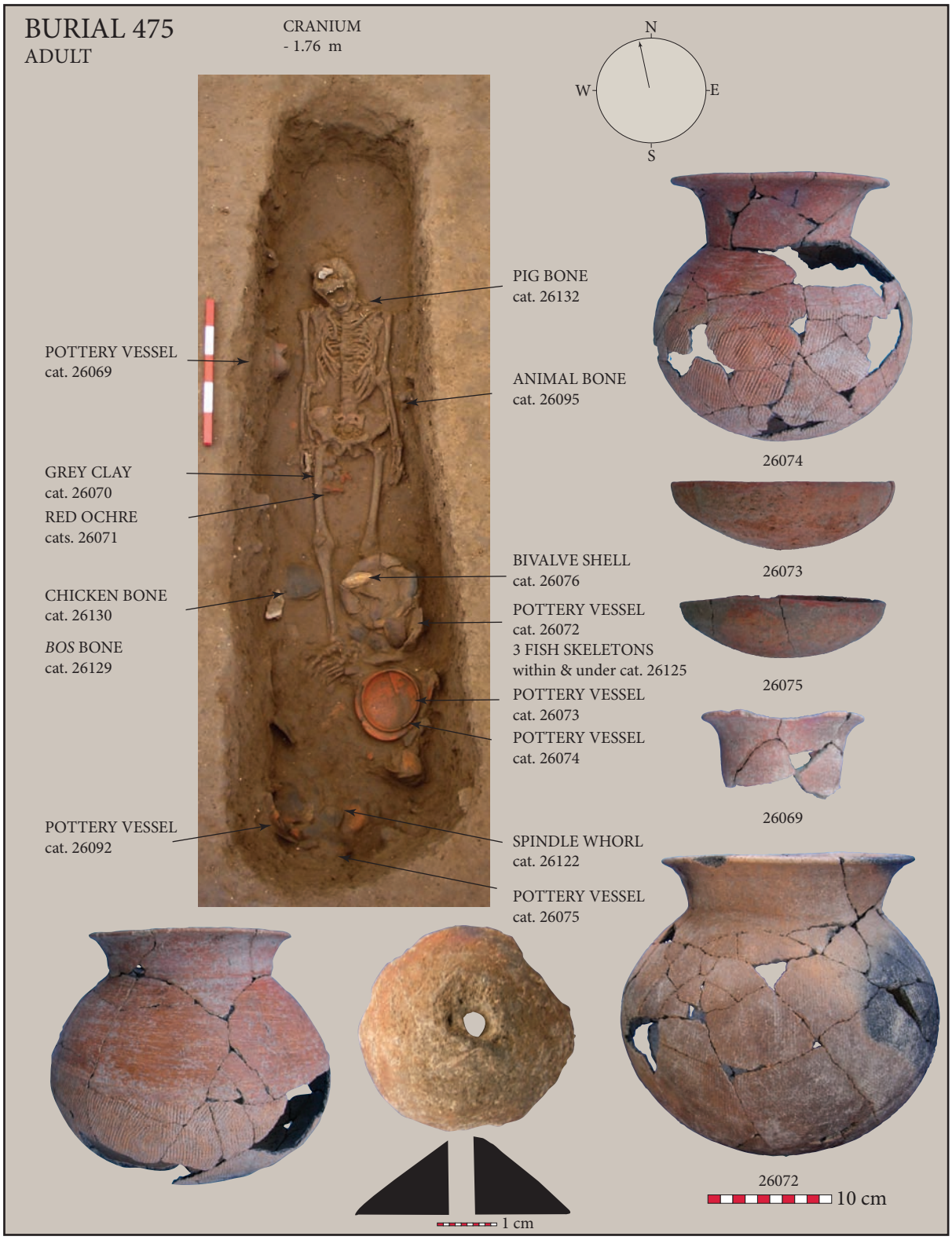


FIG. 9:35 Burial 475

Burlal 475 was found intact. The adult individual was interred with the head orienated 355° from north at a depth of 1.76 below datum. Six pottery vessels were found over the lower limbs, two of form 45, two of form 51 and a single example of forms 48 and 55. Grey clay and four pellets of red ochre lay by the inner right thigh. Pig bones had been placed by the head, *Bos* bone and chicken bone by the right knee. A bivalve shell was found over one of the pottery vessels and a spindle whorl was present beyond the feet.

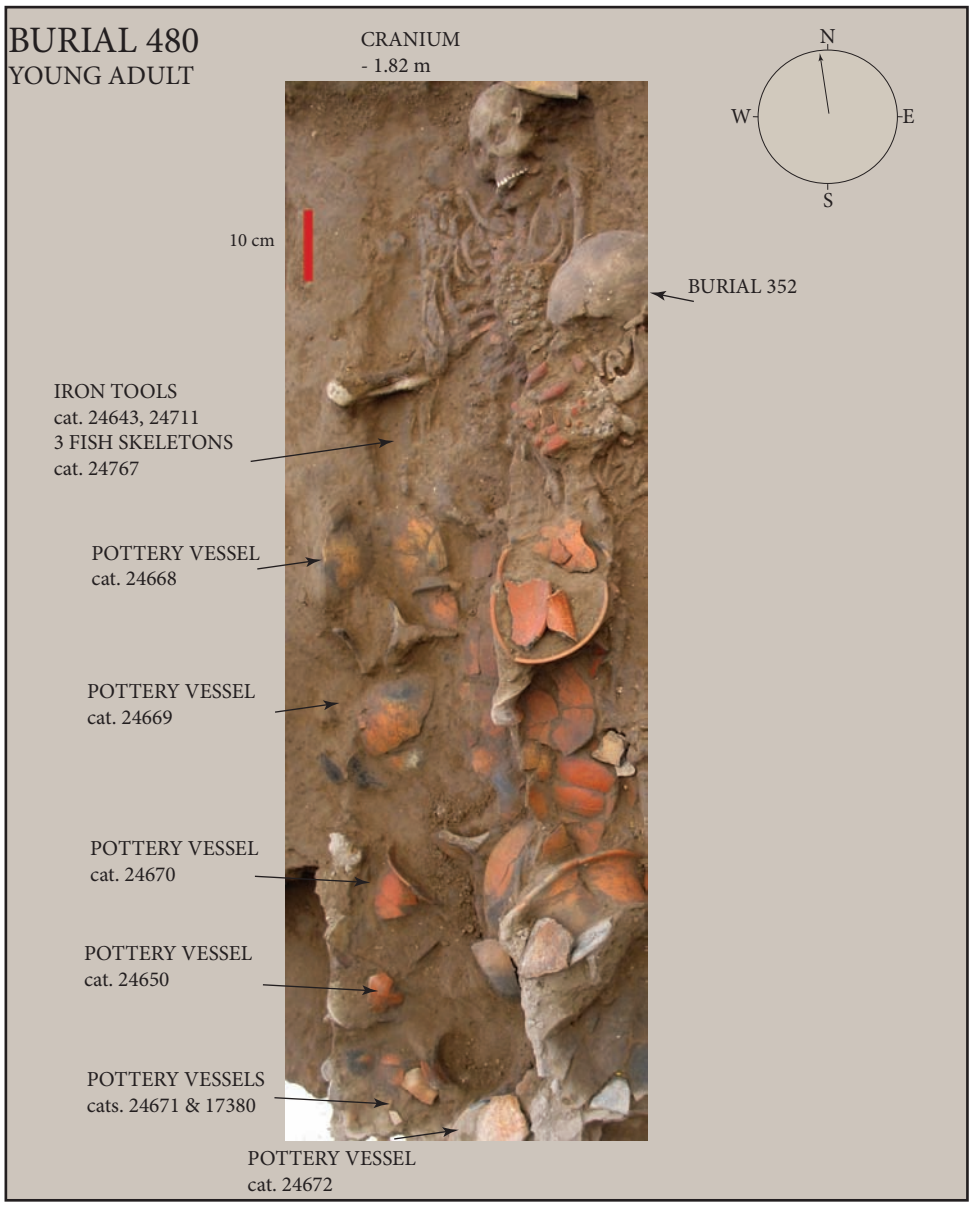


FIG . 9:36 Burial 480

Burial 480 was found at a depth of 1.78 m below datum with the head orientated 355° from north. It was partially covered by burial 352. Seven pots of were found over the lower part of the body, three of form 51, three of form 55 and one of form 45. At least five iron artefacts lay by the right elbow, and their form suggests that they might have been tanged chisels or knives. Three skeletons of the fish *Channa striata* were found in the pelvic area (cat. 24767).



FIG . 9:37 Burial 480 showing the way in which burial 352 lies over the grave of 480. Scale 5 cm



FIG. 9:38 Mortuary offerings from burial 480

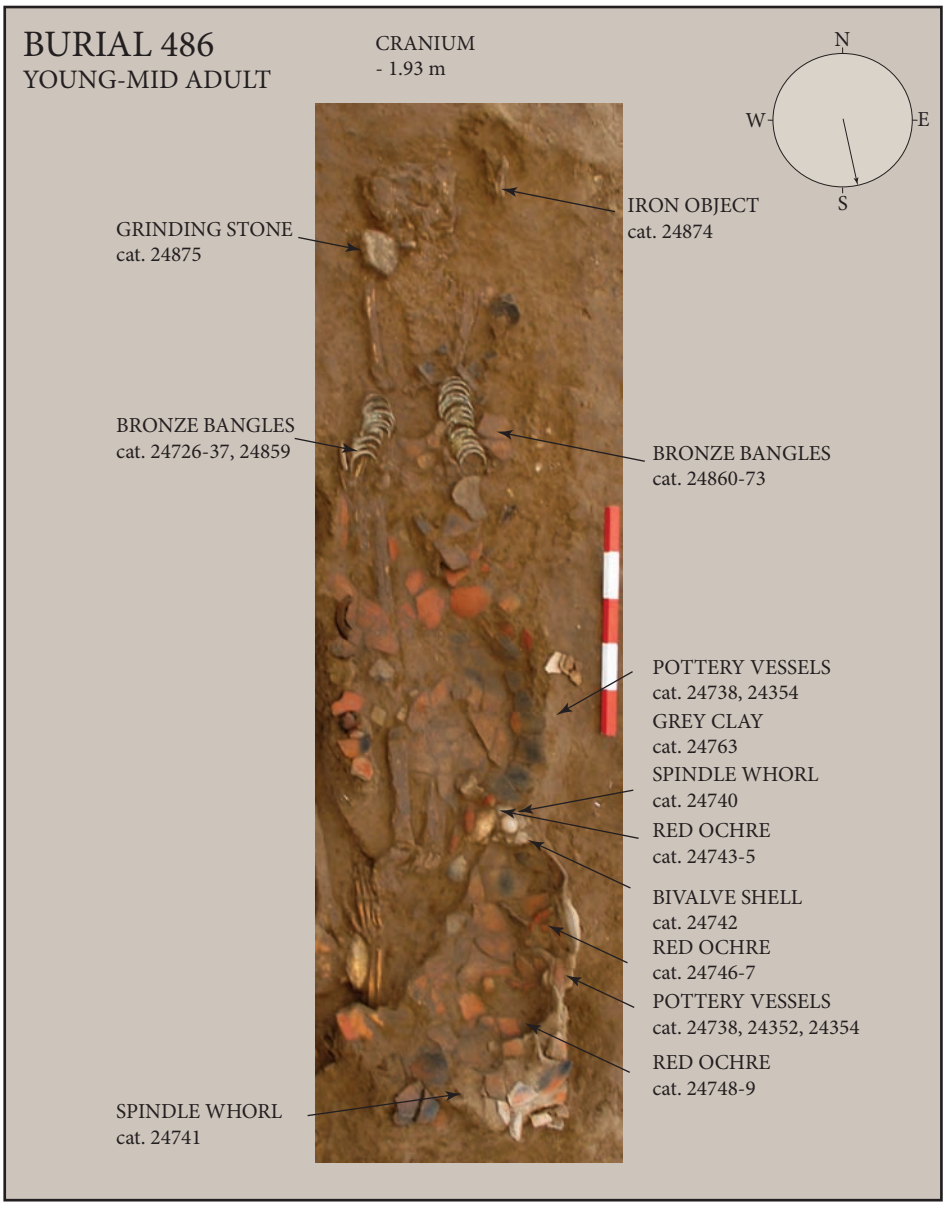


FIG. 9:39 Burial 486

Burial 486, that of a young-mid adult, was found at a depth of 1.93 m below datum, the grave orientated with the head 170° from north. It is unusual to find such an orientation in this group of burials. Four ceramic vessels were associated, three of form 55 and one of form 51. This person wore 27 plain bronze bangles 14 on the left arm and the rest on the other. There were also two spindle whorls, placed beyond the feet and by the left ankle. This same area had three pellets of red ochre. A bivalve shell was found by the left ankle, together with a deposit of grey clay. An iron artefact lay beside the skull. and a whetstone was found over the right shoulder. The following fish bones were found: cat. 24924 next to L arm, one whole *Channa striata*

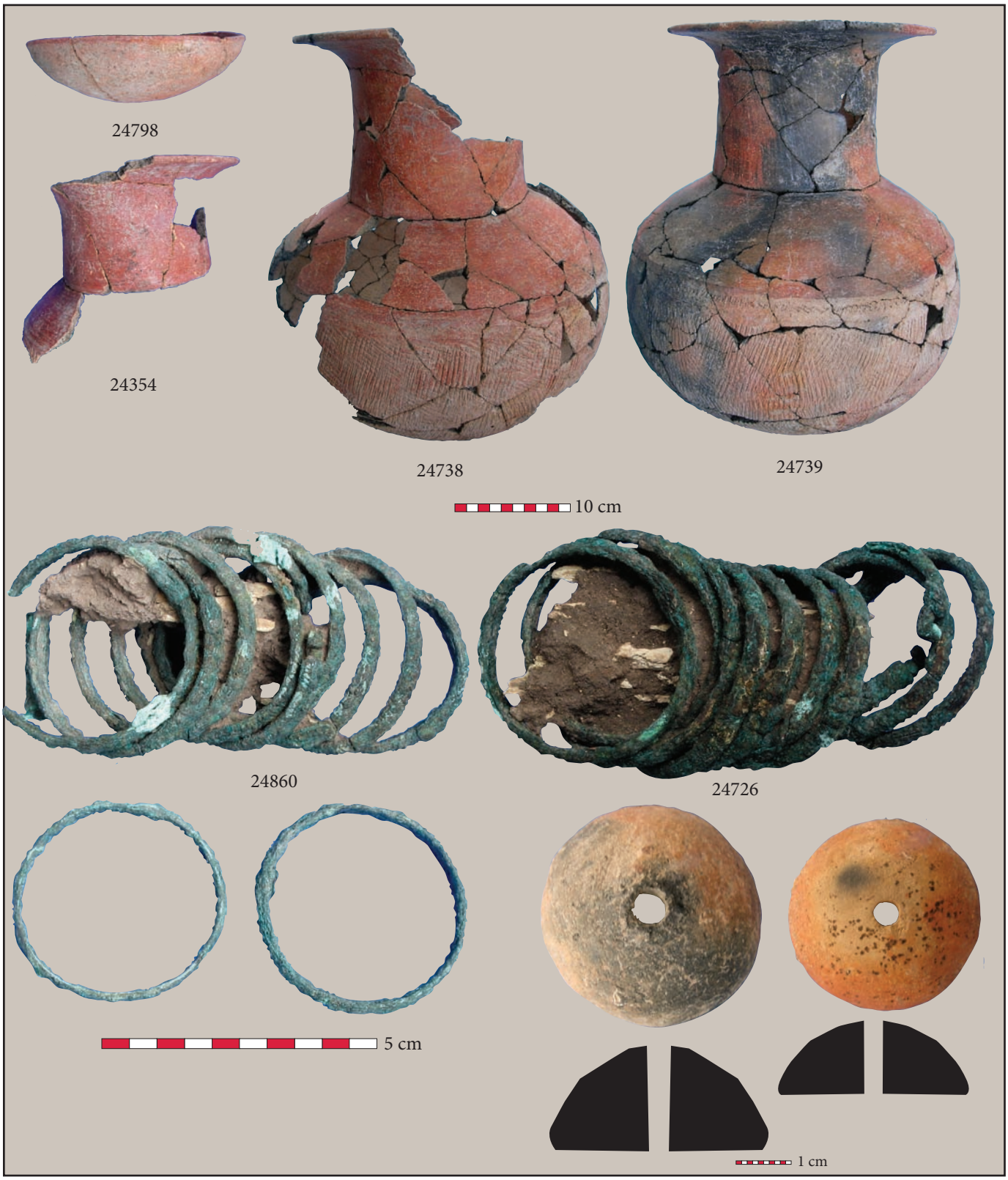


FIG. 9:40 Ceramic vessels from burial 486

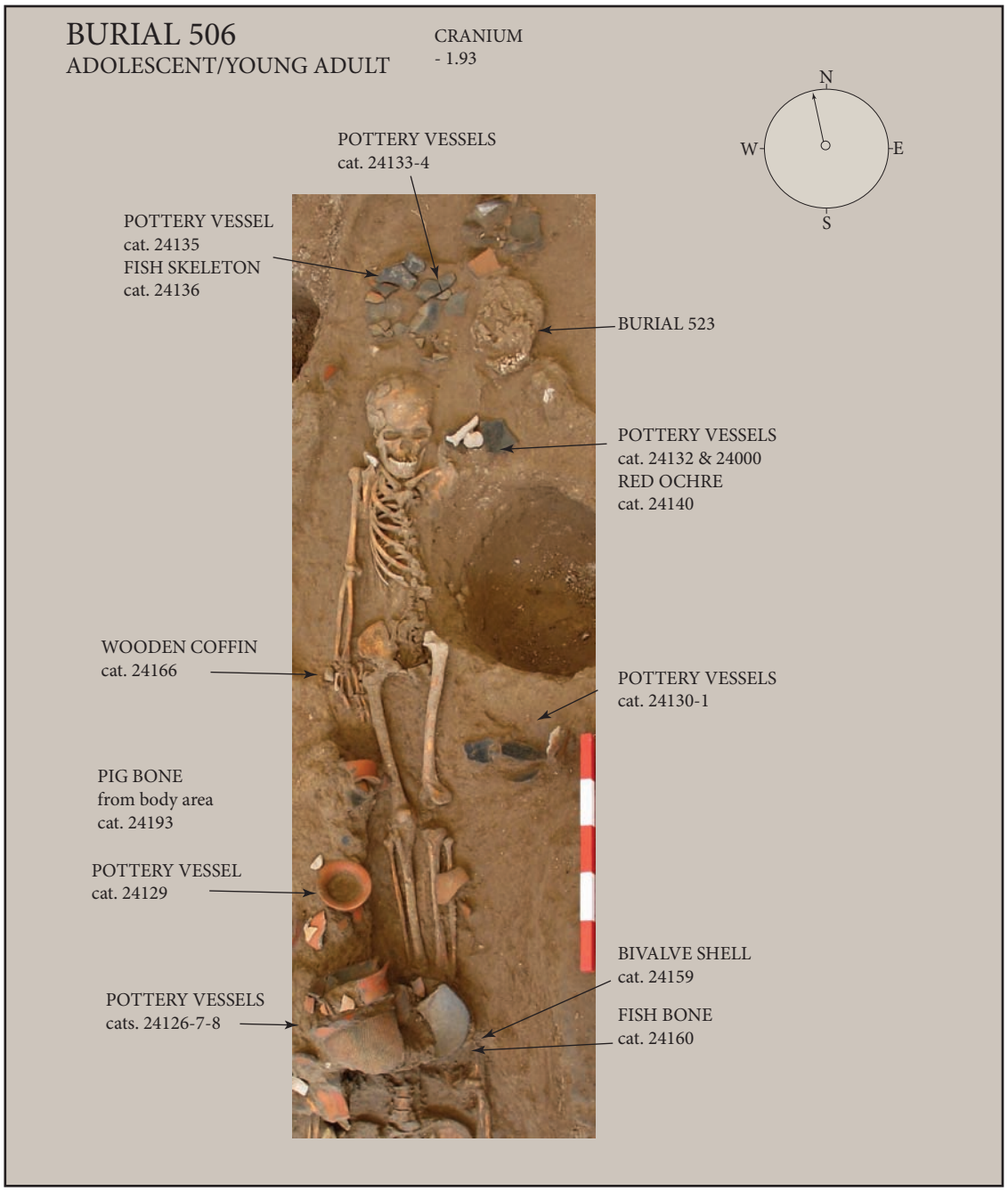


FIG. 9:41 Burial 506

Burial 506 was found at a depth of 2.06 m below datum, with the grave orientated with the head 350° from north. A pit dug through the left abdomen disturbed the burial in antiquity. Eleven ceramic vessels were found with this person, beyond the head and beside and beyond the legs. There is one of form 62, two of forms 45 and 48, and three respectively of forms 51 and 55. The following fish bones were found: one Chana striata in pot cat. 24135, 2 whole Channa striata skeletons in pot cat. 24126, 4 fish vertebrae and *Clarias* sp. 1L, 1R pectoral fin spine; Hemibagrus/Mystus 1L pectoral fin spine in pot cat. 24130. The second phalanx and metapodial of a pig were recovered while lifting the skeleton. A bivalve shell was present beyond the feet and red ochre inside pot cat. 24132. The remains of mineralised wood under the skeleton probably come from the coffin.



FIG. 9:42 A row of Iron Age burials in the eastern part of the northern group. From top to bottom, burial 474, 475, 477 ansd 476. Burial 474 is a young adult female, 475 is an adult, 477 is a mid adult male and 476 is an adolescent ?male.

X THE ADULT FEMALE BURIALS OF IRON AGE PERIOD 1, NORTHERN GROUP

The Iron Age 1 cemetery has a singular distribution. The Iron Age graves follow in an easterly direction from the late Bronze Age burials. However, the cemetery divides into two groups based on the orientation of head. Those in the northern half had the head pointing in a northerly direction, and those in the southern half had the head orientated to the south (Fig. 10:1). Each group contains the graves of men, women, children and infants, and there are no stratigraphic grounds for considering them to be anything but contemporary. Graves on the western side were interred cheek by jowl, and were often very disturberd as a consequence, meaning that identifying the sex of the dead person is not possible. As one progresses to the east, however, the burials were spaced and well preserved.

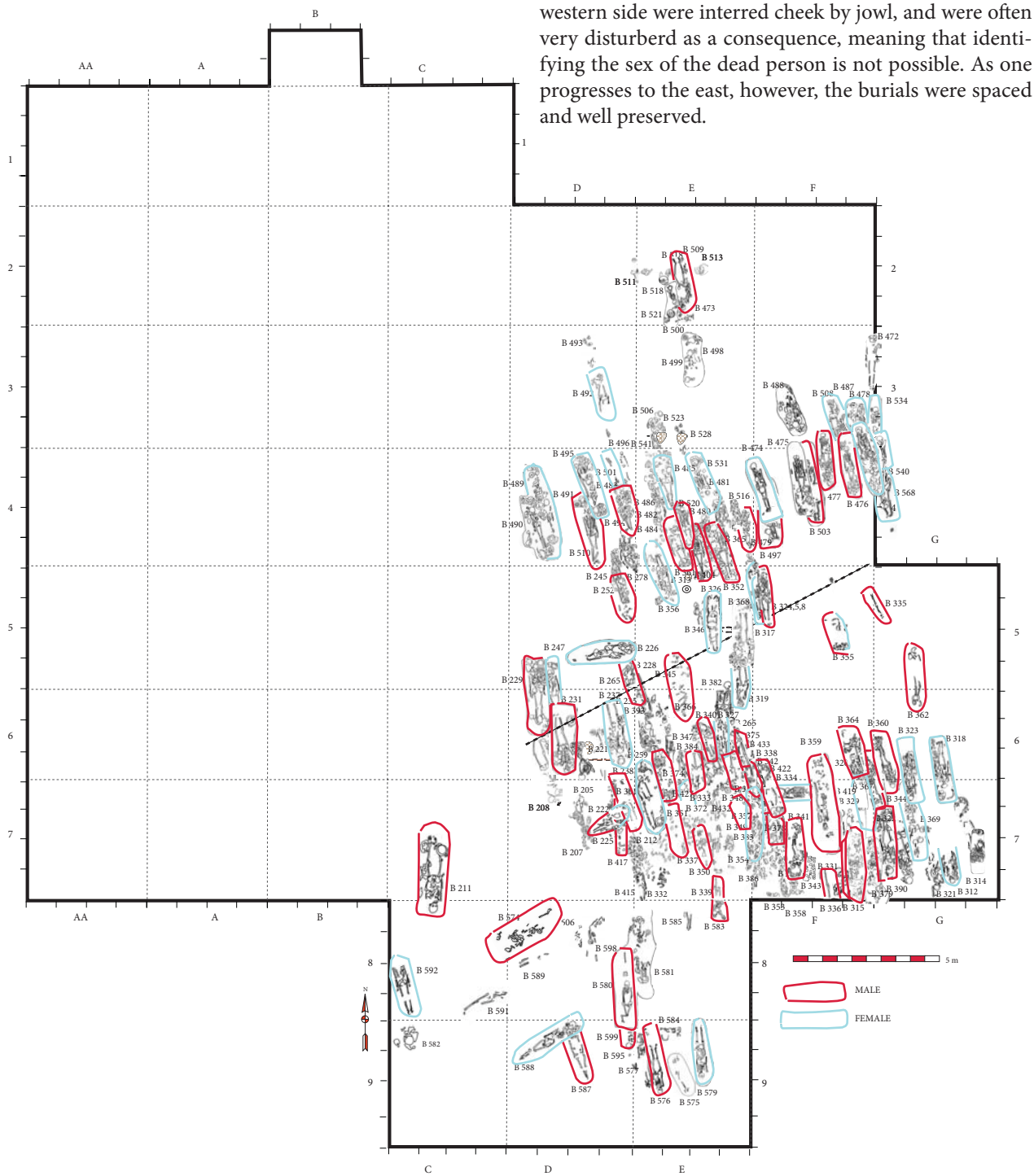


FIG. 10:1 The distribution of Iron Age 1 graves

TABLE 10:1 *The mortuary offerings for Iron Age 1 female burials, northern group*

burial no.	226	247	324	326	328	356	474	478	485	487	489	492	495	501	508	531	534	568
age	OA	MA	M-O A	OA	Y-MA	OA	YA	MO	YA	YA	OA	YMA	OA	A	YA	VYA	YA	YA
orientation	80º	340º	355º	352º	355º	160º	355º	350º	355º	340º	340º	160º	340º	350º	340º	355º	N	N
Sex	?F	?F	F	F	F	F	F	?F	F	?F	?F	F	F	?F	F	F	F	?F
depth (metres)	1.48	1.87	1.53	1.58	1.56	1.88	1.63	1.96	2.04	1.91	1.88	2.06	1.77	2.05	1.85	2.00	1.79	1.93
n pots	7	1	2	3	0	6	2	15	1	5	4	1	4	2	2	4	5	10
pot form 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
pot form 41	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 45	0	0	0	1	0	1	0	5	0	1	1	0	0	0	0	0	1	2
pot form 48	0	1	0	0	0	0	0	1	0	0	1	0	2	0	0	1	0	0
pot form 51	2	0	2	1	0	2	1	4	0	2	2	1	2	0	0	1	2	3
pot form 52	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
pot form 55	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	2	2
pot form 56	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
pot form 58	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bivalve shell	1	0	0	0	0	0	1	2	1	0	1	0	1	0	1	0	2	1
pig bones	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1
red ochre	1	0	1	0	0	5	0	1	7	2	4	0	3	0	2	0	0	2
spindle whorl	0	0	0	0	0	3	0	2	1	1	1	0	1	0	1	0	1	1
fish skeleton	0	0	0	0	0	2	0	9	0	1	3	0	1	1	0	0	2	2
chicken bone	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
grey clay	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	6	1	1
bronze ring	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
iron bangle	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
iron blade	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
iron point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pellet bow pellet	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
stone adze	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
agate bead	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
carnelian bead	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
glass bead	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
shell earring	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
shell bangle	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
stone adze	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0

YA: young adult, MO: mid-old adult, OA: old adult, YMA: young-mid adult



FIG. 10:2 Burial 226

Burial 226 was found at a depth of 1.48 m below datum, with the head orientated in an easterly direction. Seven pottery vessels were found with the body, distributed over much of the skeleton. Of these, two respectively were of forms 41 and 51, and there was a single example of forms 56 and 58. An iron knife, possibly a sickle, was present between the ankles, and red ochre had been placed beyond the feet.

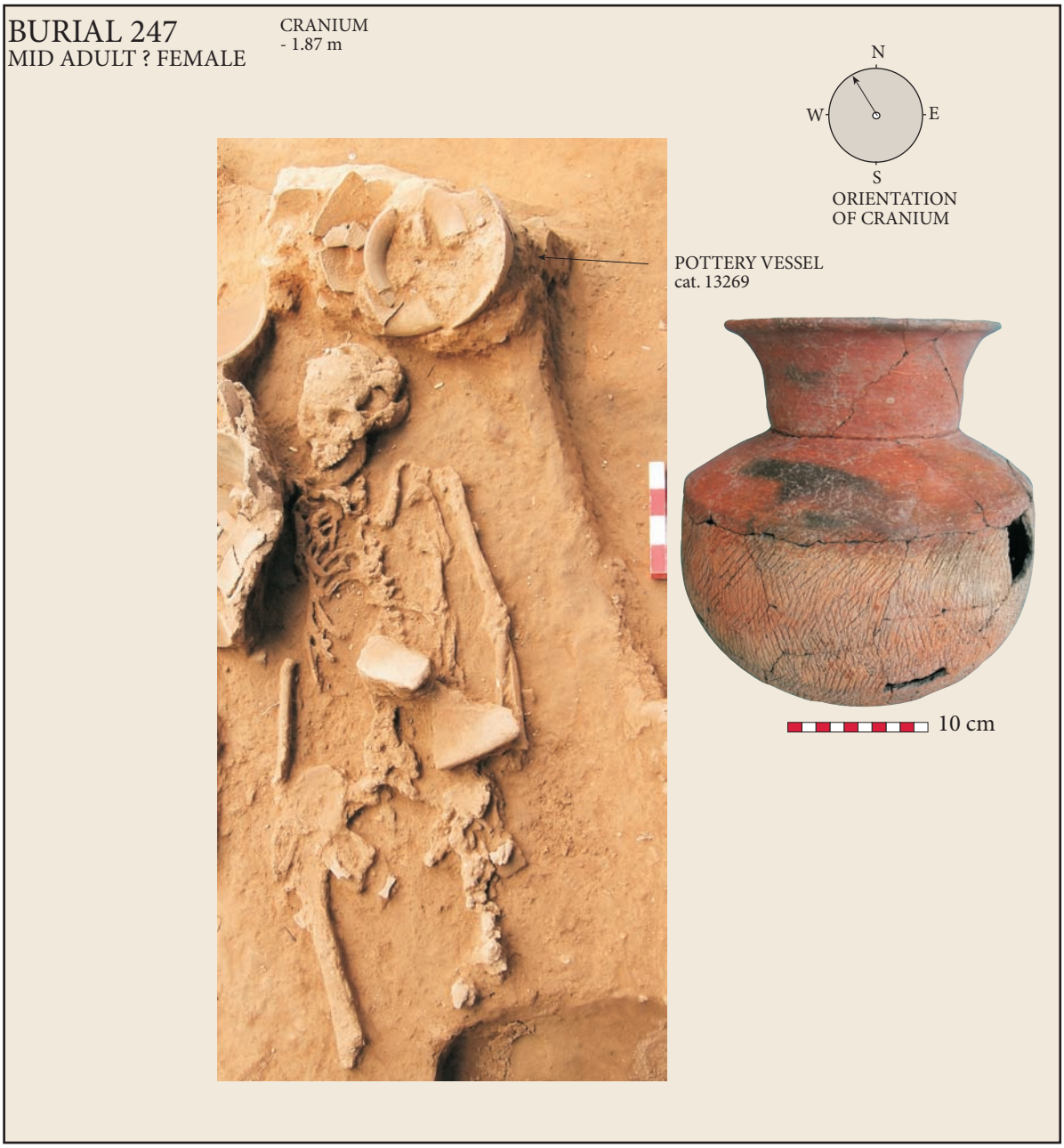


FIG. 10:3 Burial 247

Burial 247 was found at a depth of 1.82 m below datum, oriented with the head directed 340° from north. It had been cut at the knees by burial 231. Only one pot of form 48 was found in association.

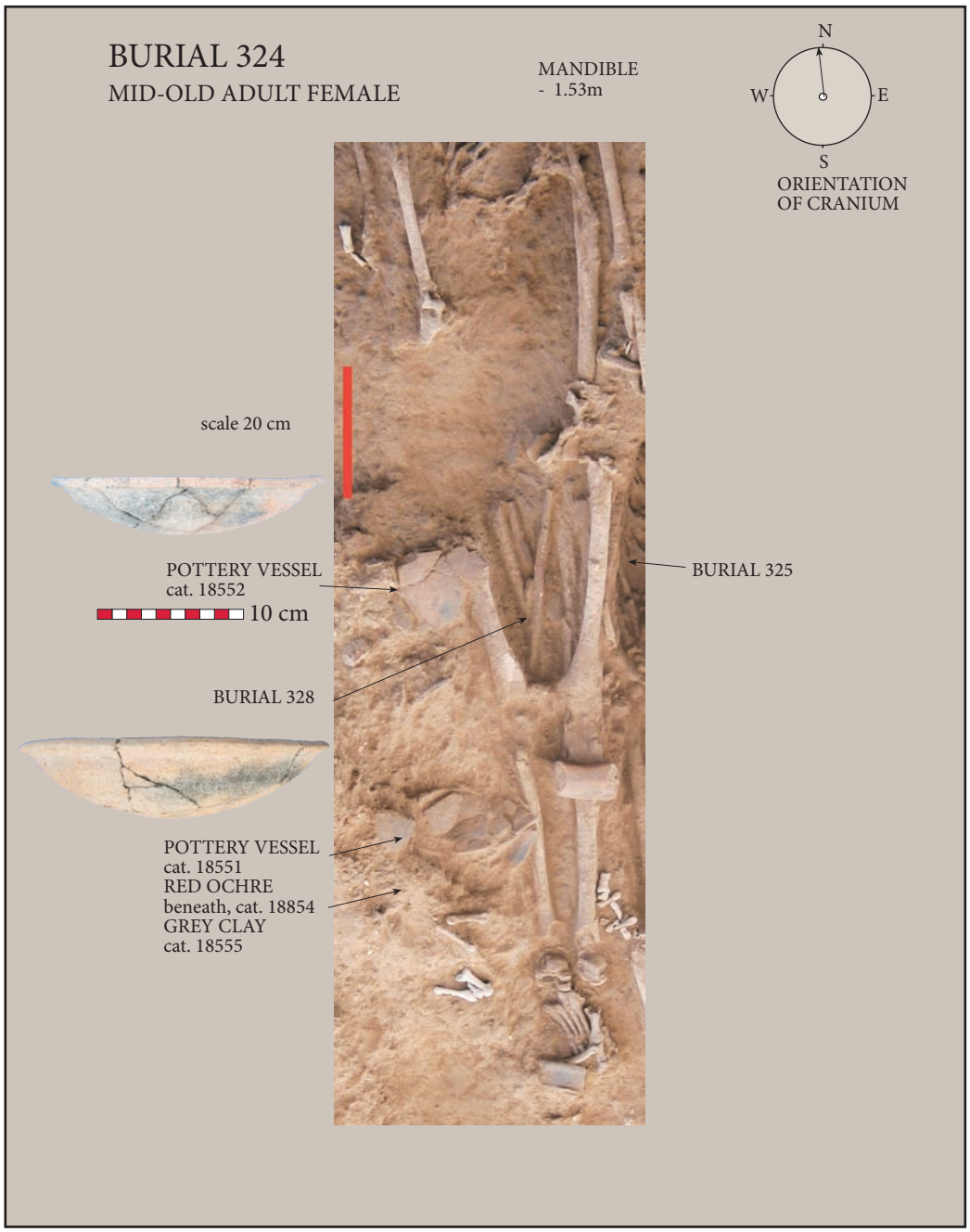


FIG. 10:4 Burial 324

Burial 324 was found at a depth of 1.53 m below datum, with the body orientated with the head 355° from the north. The grave contained the skeleton of a mid to old adult woman. It is difficult to assign grave goods to this person, because burials 325 and 328 shared the same grave. Two form 51 vessels probably belong to it, together with some red ochre and grey clay.

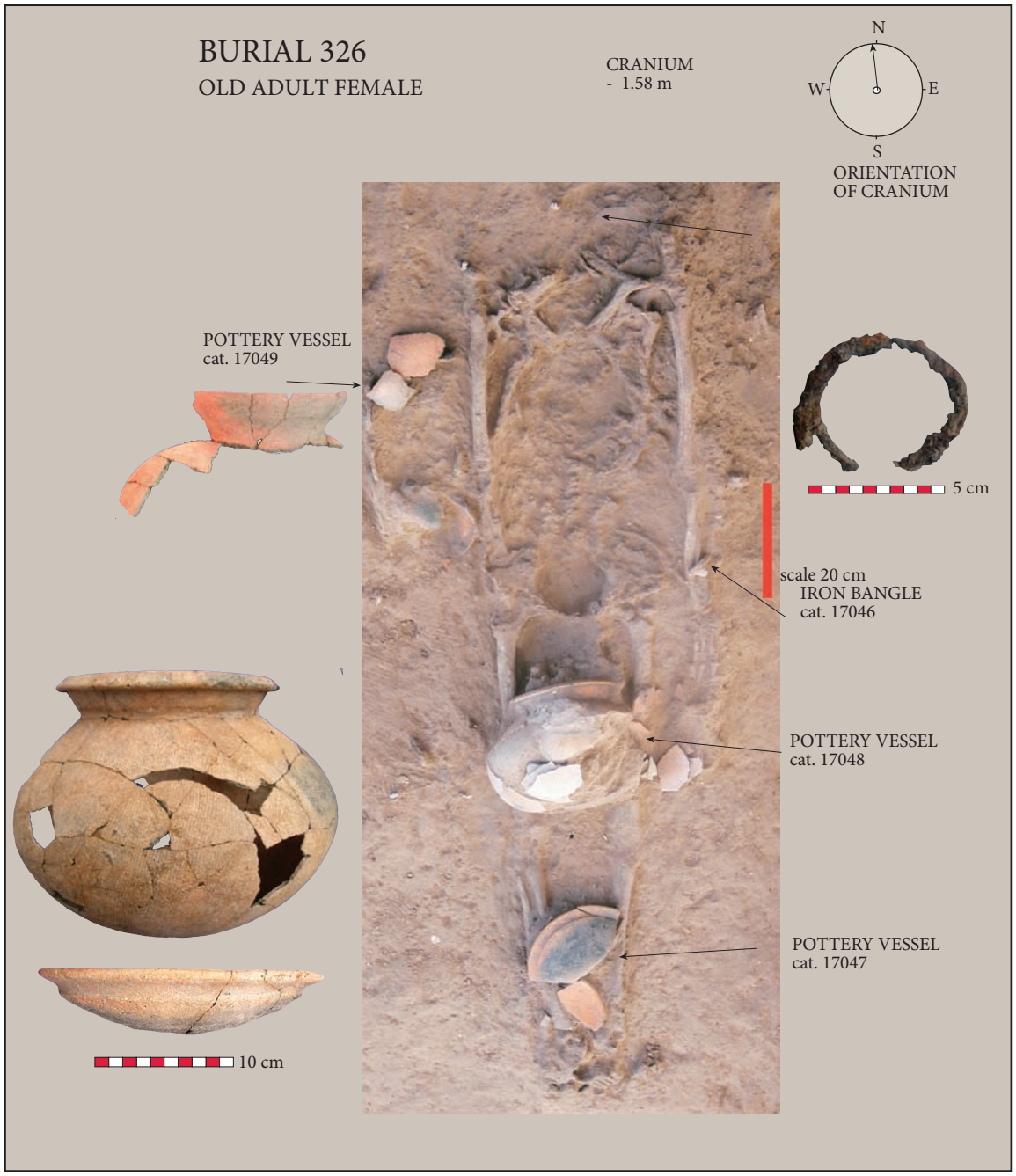


FIG. 10:5 Burial 326

Burial 326 was complete except for the area beyond the shoulders. It involved an old female. The grave was found at a depth of 1.58 m below datum, orientated with the head directed 355° from north. A form 51 pot lay over the ankles, and there was a form 45 vessel over the thighs. A third, partial pot of indeterminate form was found beside the right shoulder. This person wore an iron bangle on the left wrist.

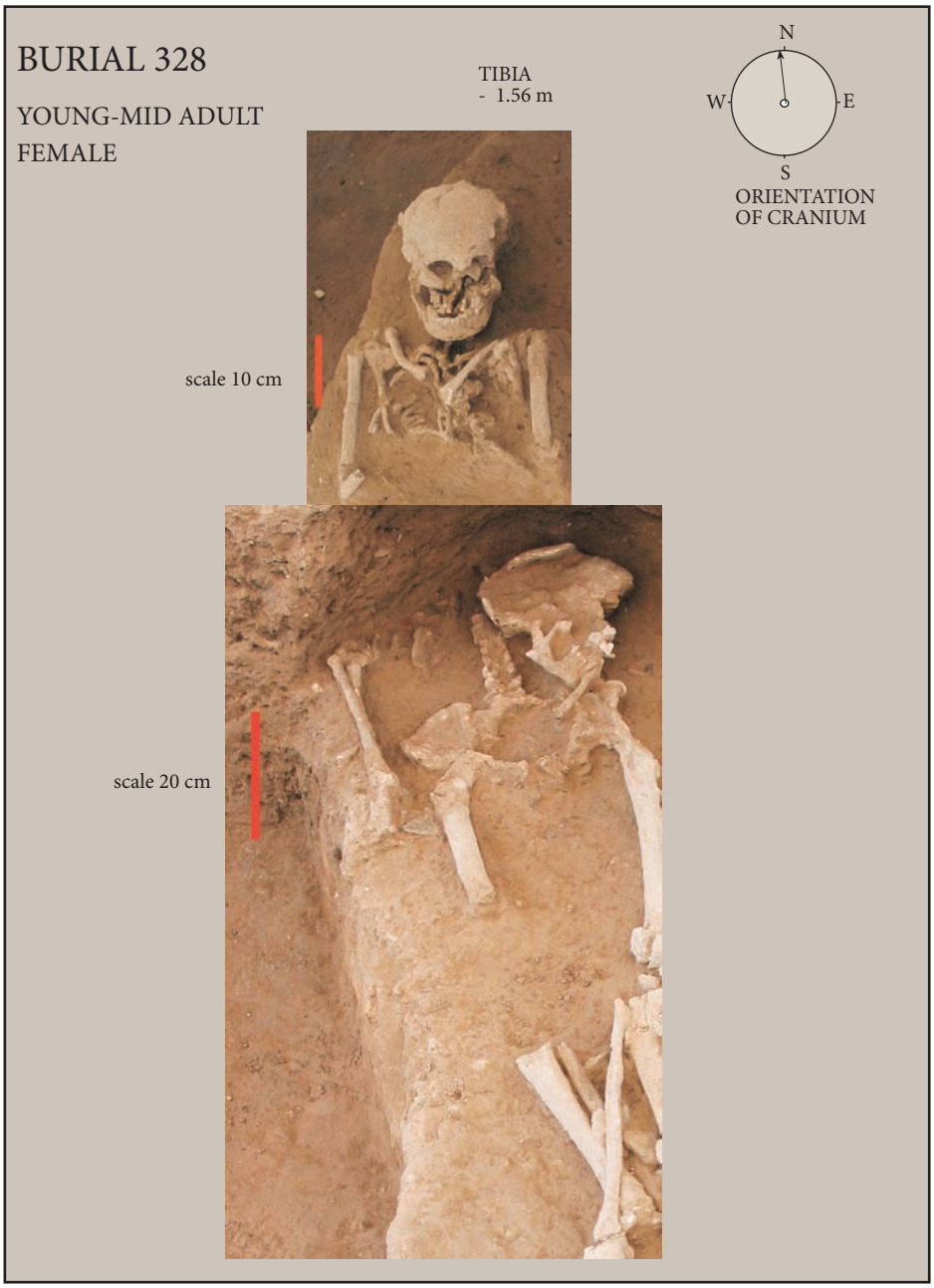


FIG. 10:6 Burial 328

Burial 328 was found at a depth of 1.56 m below datum, with the body orientated with the head 355° from the north. The grave contained the skeleton of a young to mid adult woman. No mortuary offerings were found with this individual.



FIG. 10:7 Burial 356



FIG. 10:8 Mortuary offerings from burial 356

Burial 356 was found at a depth of 1.88 m below datum, with the body of an old woman orientated with the head 160° from north. Three of the six pots could be assigned a form, two being of form 51 with one 45. For jewellery, this person wore a shell bangle on the right wrist, and two iron bangles on the left wrist. At the neck, there was an agate, a carnelian and one glass bead. An iron knife or blade was present over the right tibia. Remarkably, two stone adzes were found in positions over the left hand and beside the left arm, which suggest that they were deliberate offerings. Two spindle whorls were found beside the ankles and a third in the head area. Pellets of red ochre were recovered from beyond and beside the ankles.

The following fish bones were found: Pot cat. 17115, *Clarias* sp. 2 fragments of neurocranium; *Anabas testudineus* 1 fragment of skull.

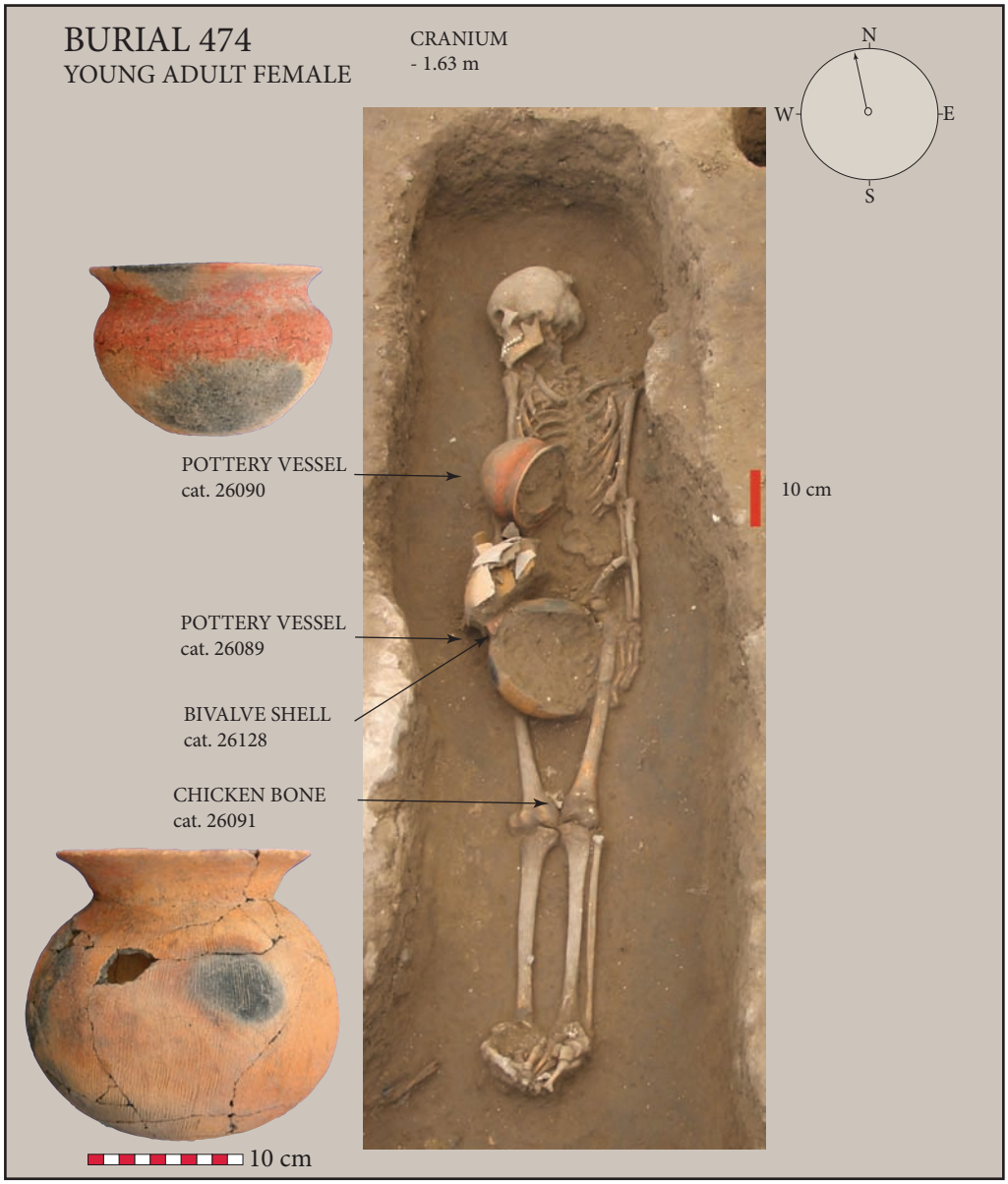


FIG. 10:9 Burial 474

Burial 474 contained the complete skeleton of a young adult female orientated with the head 355° from north. The body lay 1.63 m below datum. One ceramic vessel lay over the chest, the other covered the abdomen. They are of forms 51 and 56. A bivalve shell was found by the right hand and a chicken bone between the knees



FIG. 10:10 Burial 474, showing a close up view of the cranium. Scale 20cm

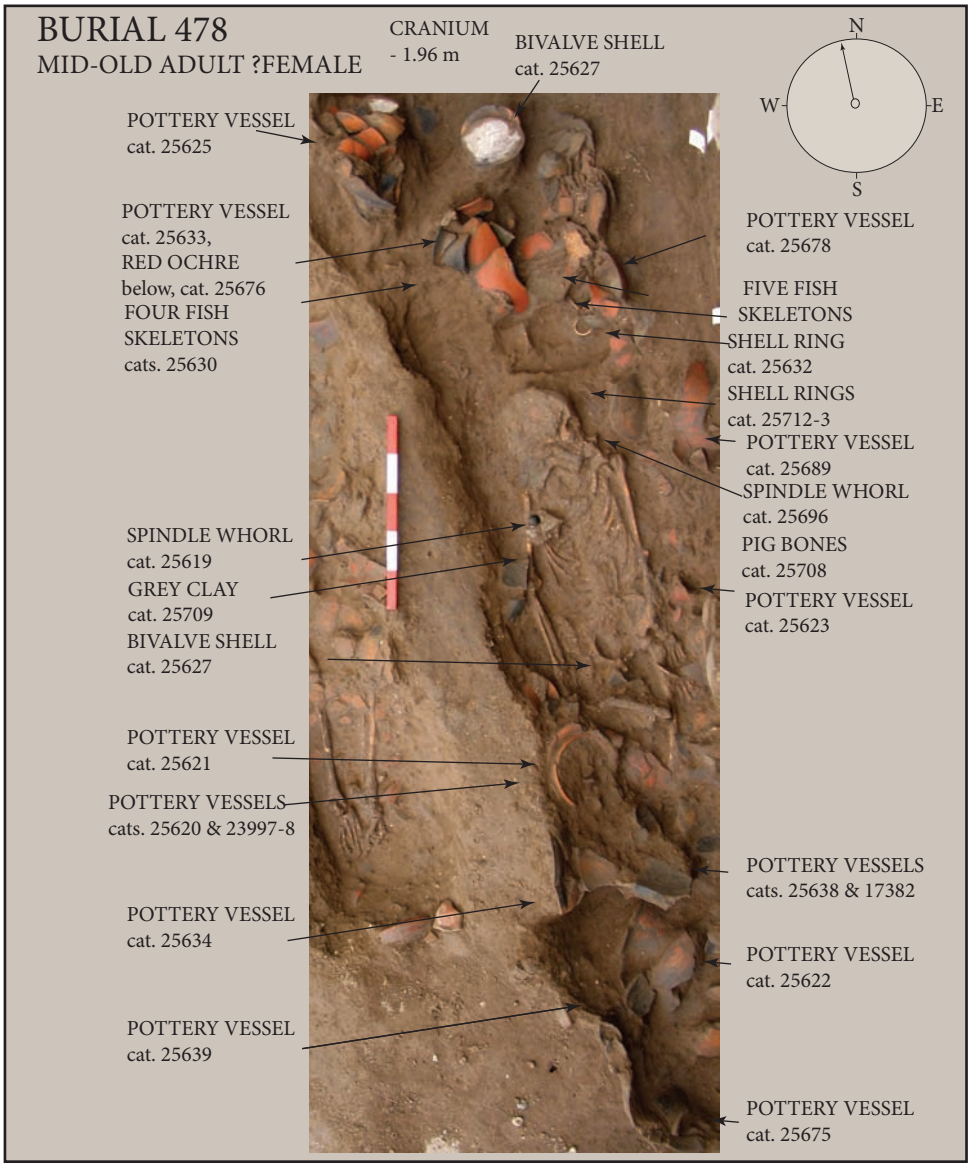


FIG. 10:11 Burial 478

Burial 478 was found at a depth of 1.96 m below datum, with the body orientated with the head 340° from north. At least 15 ceamic vessels were associated from beyond the head, by the hands, to the right of the pelves, by the knees and ankles, and beyond the feet. Those that could be reconstructed belong to forms 51 (4), 45 (5), 55 (3) and one 48. This person wore five shell earrings. Two bivalve shells were identified, beyond the head and under the backbone. Two spindle whorls, beside the head and by the right arm. The right fore limb bones of a pig were found over the face, and three fish skeletons of *Channa striata* together with the broken skull and left cleithrum of a *Clarias* sp. were found inside pot cat. 25633. One complete *Clarias* sp. and four *Channa striata* were located beside the head. Red ochre lay under the pots beyond the head. There was some grey clay over the right humerus.

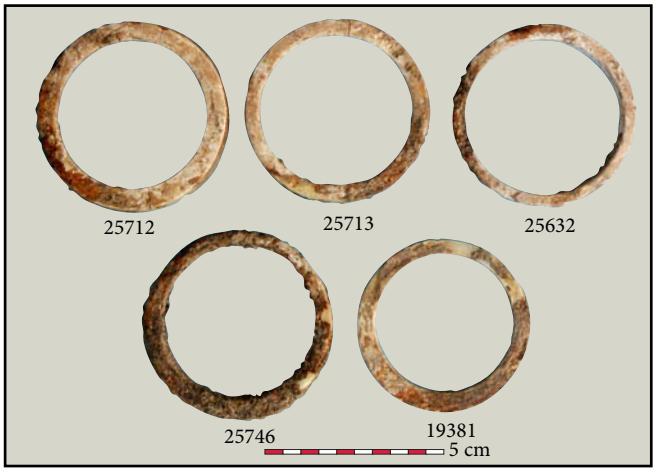


FIG. 10:12 Shell earrings from burial 478



FIG. 10:13 Pottery vessels and spindle whorls interred with burial 478

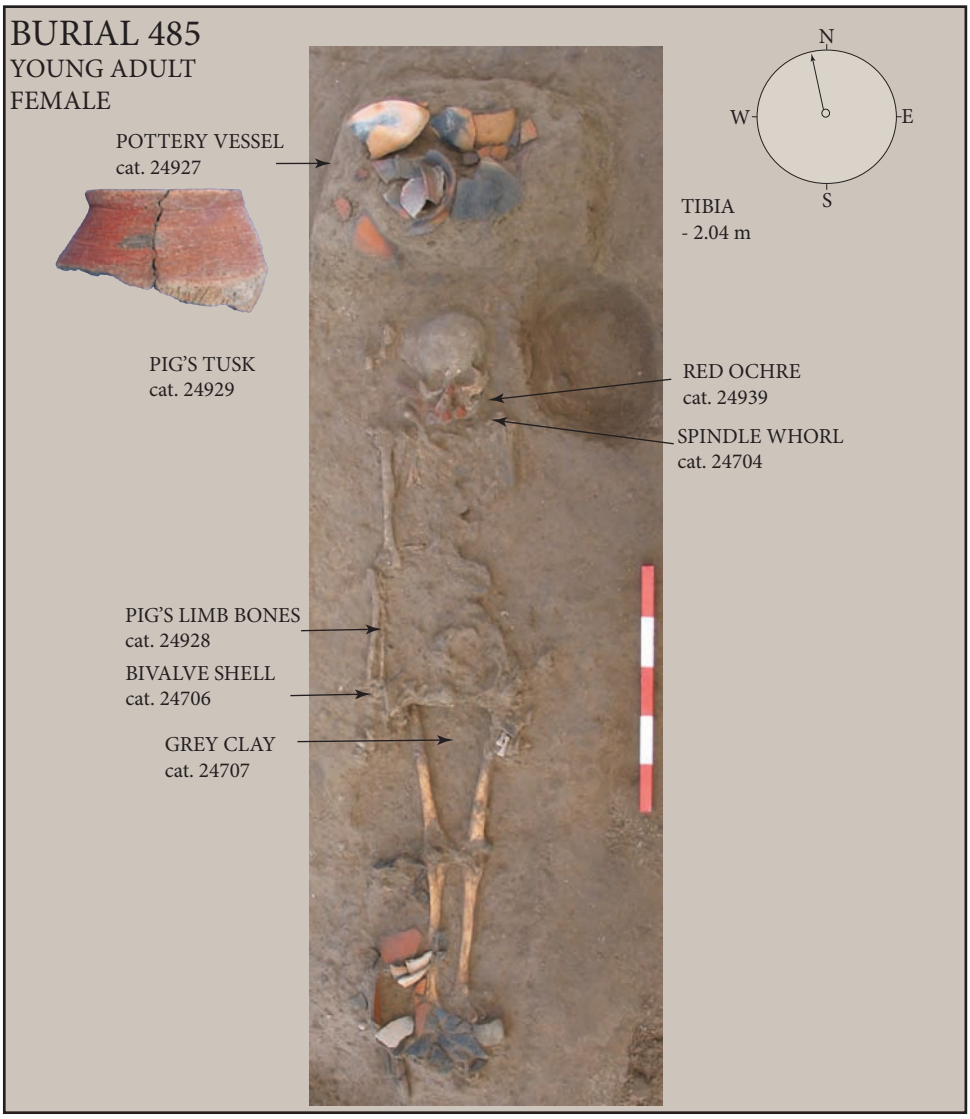


FIG. 10:14 Burial 485

Burial 485 was found at a depth of 2.04 m below datum, the grave orientated with the head 355° from north. A single pottery vessel of form 52 lay beyond the head. Other mortuary offerings included a spindle whorl over the face, and seven red ochre pellets beside the head. By central part of the body, there were the articulating right fore limb bones of a pig, a bivalve shell and a deposit of grey clay.



FIG. 10:15 Burial 485, showing a close up view of the cranium with pellets of red ochre and spindle whorl over the lower face and mandible. Scale 5 cm

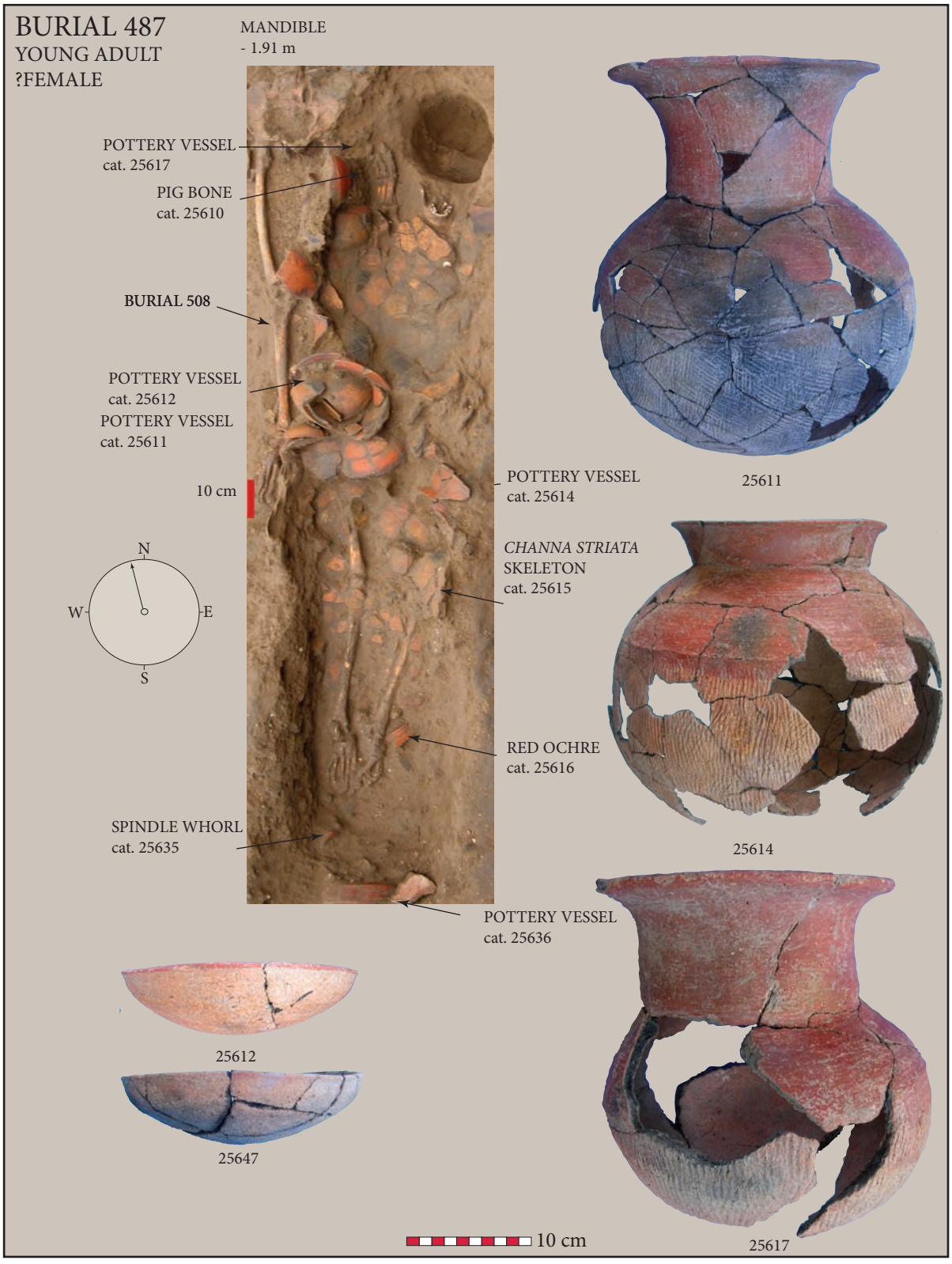


FIG. 10:16 Burial 487

Burial 487 was found at a depth of 1.91 m below datum, in a grave with the head orientated 340° from north. Five pottery vessels were found over the skeleton. Two are of form 51, two of form 55 and there is one form 45. The left fore limb bones of a pig were present to the right of the head, and and a fish skeleton of *Channa striata* was located in pot cat. 25614. There are also two deposits of red ochre, beyond the feet and to the left of the left tibia. A spindle whorl was also present, beyond the feet.



FIG. 10:17 Burial 489

Burial 489 was found at a depth of 1.88 m below datum, the grave orientated with the head 340° from north. Five ceramic vessels were recovered, two beyond the feet, two beyond the head and one to the left of the head. Four can be assigned a form: two are of form 51, one is form 45 and one form 48. A bivalve shell was found next to the head and red ochre pellets were present over the head. A bronze ring, probably a finger ring, lay below the pelvis and fish bones were located next to the right knee. A cow's metacarpal beside the left femur might also have been associated with this individual. The following fish bones were found: Cat. 23195 to the right of the knees, 5 fish vertebrae, *Clarias* sp. 1R pterotic; 1 fragment of skull, *Hemibagrus*/*Mystus* 1R pectoral fin spine, *Channa striata* 1L maxilla; 1R dentary; 1L, 1R upper pharyngeal bone.



FIG. 10:18 Burial 492

Burial 492, a young female, was found at a depth of 2.06 m below datum, with the body orientated with the head 160° from north. The skeleton suffered disturbance in antiquity and the only surviving mortuary offering is a form 51 pottery vessel.

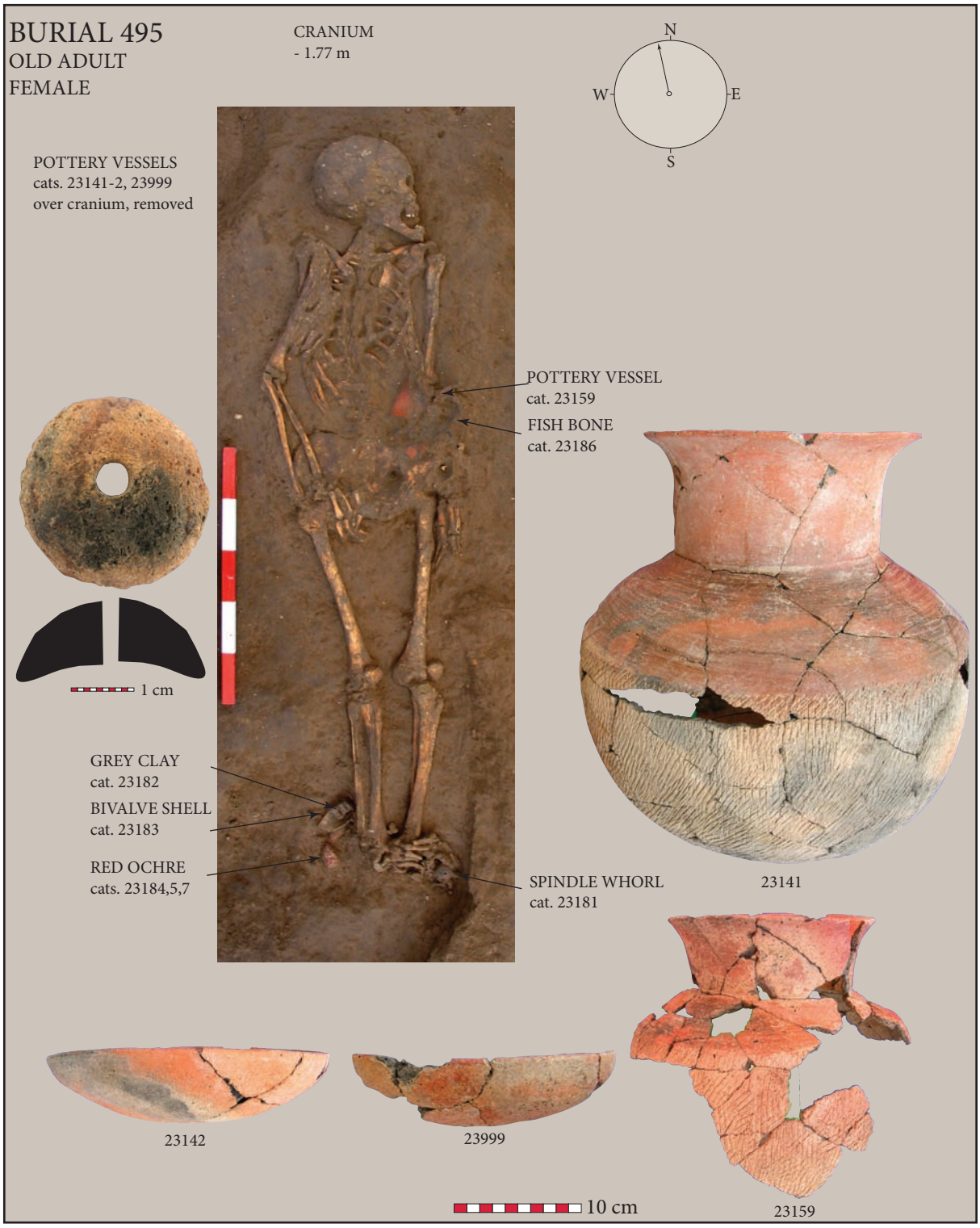


FIG. 10:19 Burial 495

Burial 495 was found at a depth of 1.77 m below datum, oriented with the head 340° from north. Three ceramic vessels lay over the head, and there was another over the left arm. Two are of form 48 and two of form 51. There were also three deposits of red ochre, to the right of the feet. A spindle whorl also lay beside the foot bones, together with a bivalve shell and grey clay. The skeleton of a fish, *Channa striata* cat. 23186, was found to the left of the pelvis.

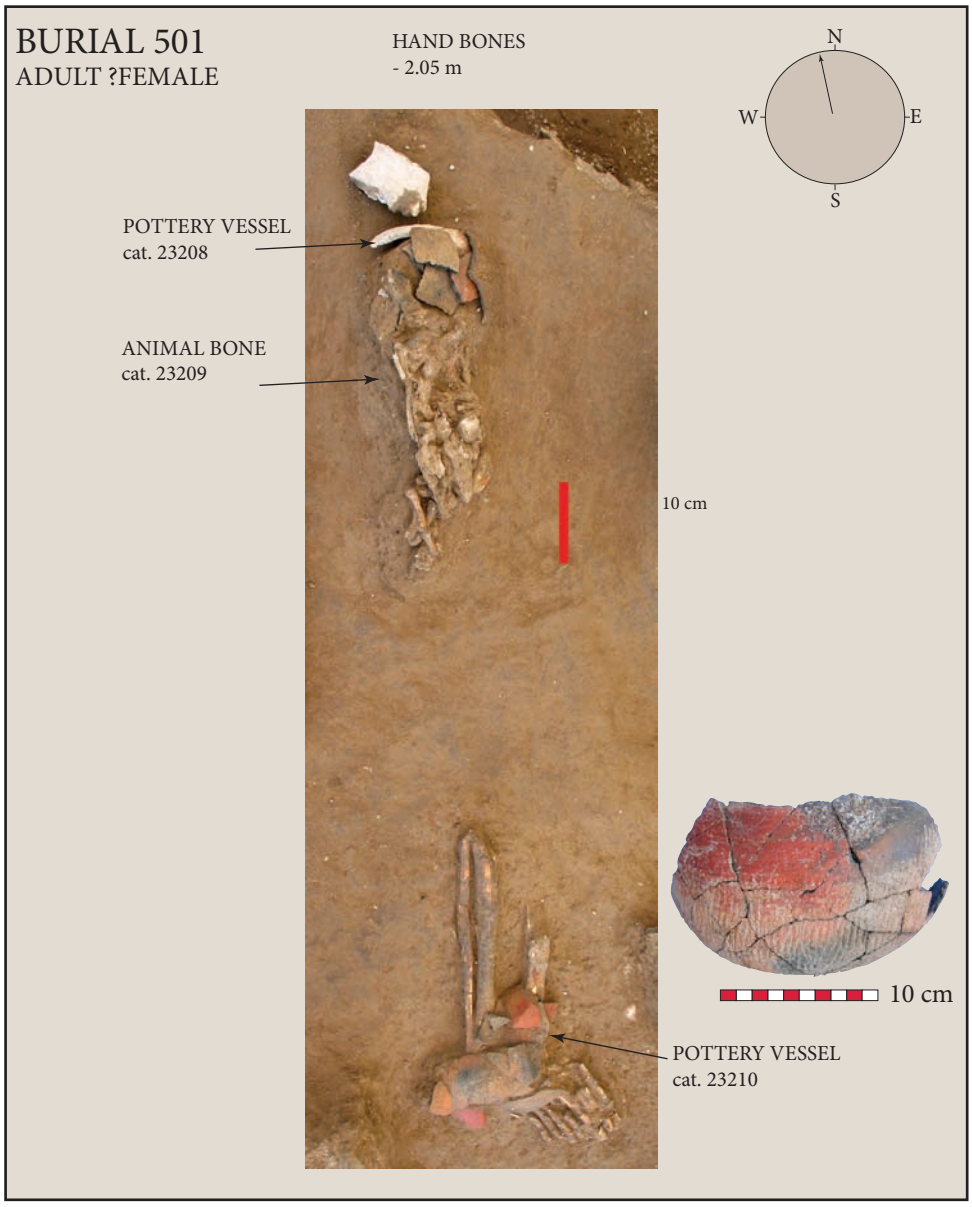


FIG. 10:20 Burial 501

Burial 501 was found in an exrremely fragmentary conditon, at a depth of 2.05 m below datum. The body of an adult ?female was orientated a few degrees from due north, and sealed under burial 494. Two fragmentary pottery vessels were found, one over the ankles and the other in the area of the right hand. Some unidentified fish bone was found with the latter.

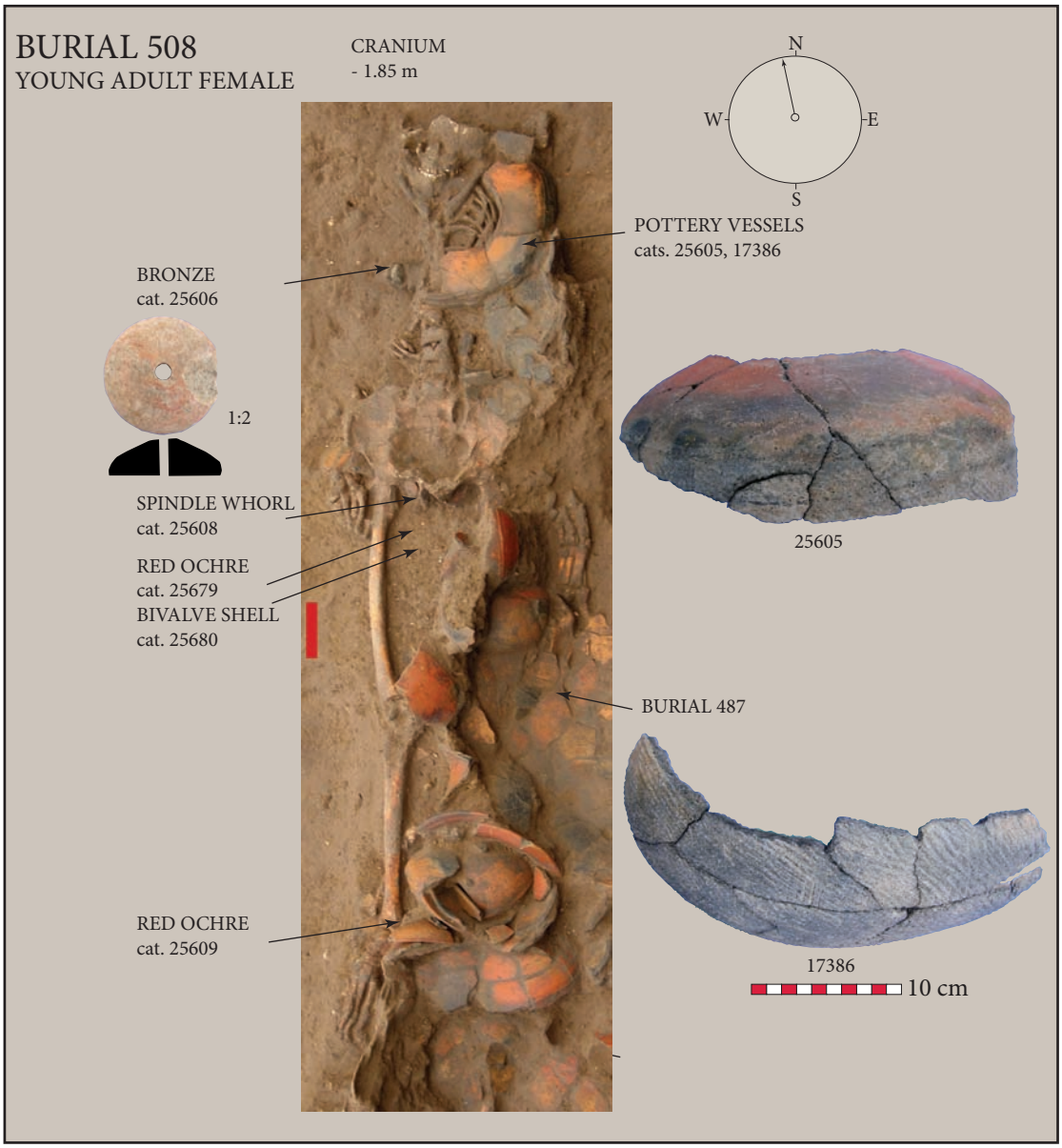


FIG. 10:21 Burial 508

Burial 508, a young female, was found at a depth of 1.85 m below datum, in a grave with the head orientated 340° from north. It was disturbed by burial 487. Two pots were found but both were fragmentary and lay over the upper body. Red ochre had been placed beyond the feet and between the thighs. A spindle whorl and bivalve shell were also recovered from the latter area.

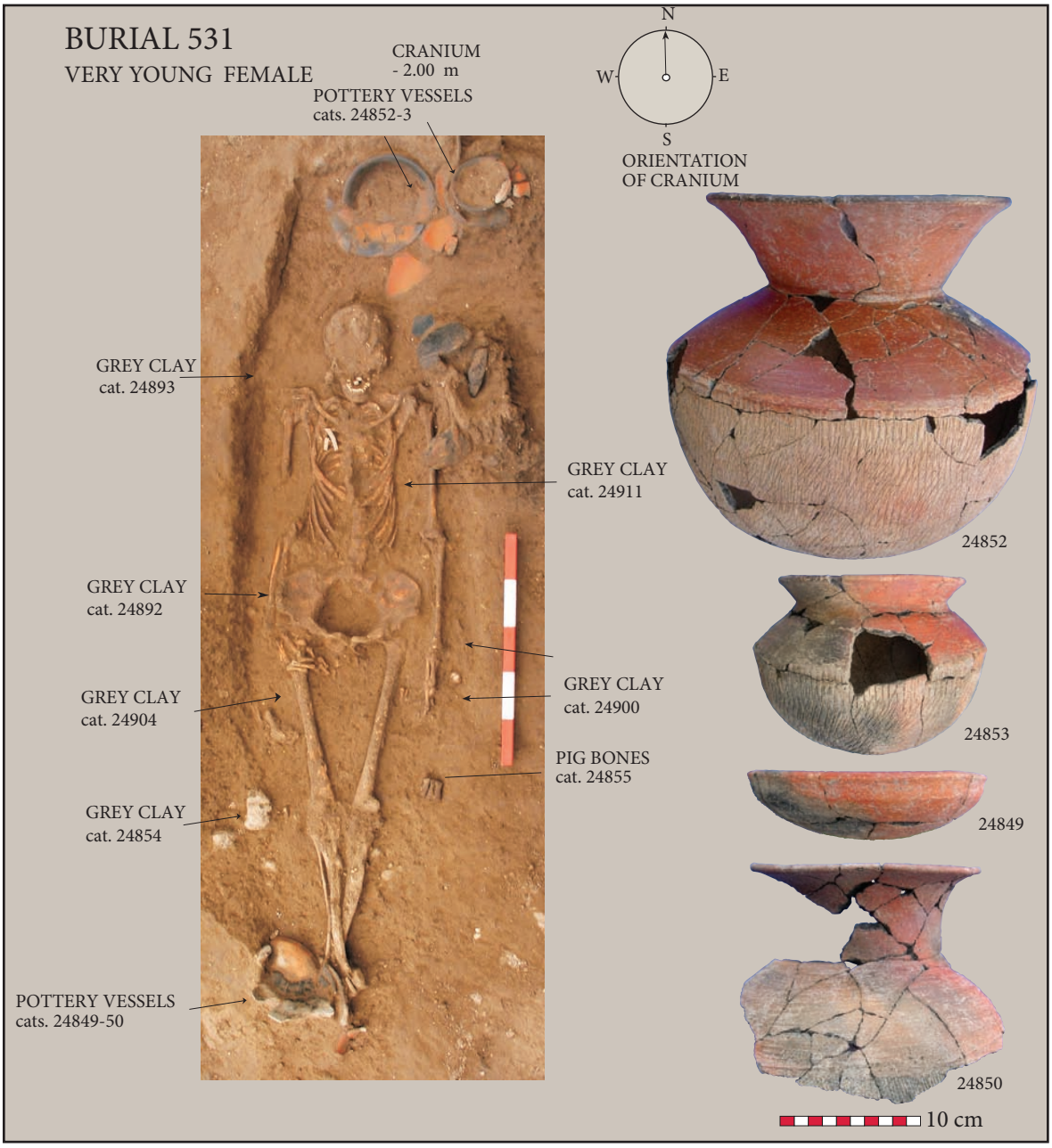


FIG. 10:22 Burial 531

Burial 531 was found at a depth of 2.00 m below datum, and orientated 355° from north. It contained the complete skeleton of a very young adult female. Four pots were found with this individual, two beyond the head and by the ankles. These are of forms 15, 48, 50 and 51. Pig bones were present by the left knee, and six different deposits of grey clay were placed unde the pelvis, by the skull, in the torso area, by the right knee and under both femora.

Burial 534 was found at a depth of 1.79 m below datum, with the body of a young woman orientated with the head 350° from north. Five pottery vessels were found in association, two of form 51, two of form 55 and one of form 45. The other offerings comprised pig bones beside the head, two bivalve shells over the abdomen and two skeletons of the fish *Channa striata* in the ceramic vessel cat. 25813. There was a cache of grey clay by the left arm, and a spindle whorl lay beside the left shoulder.

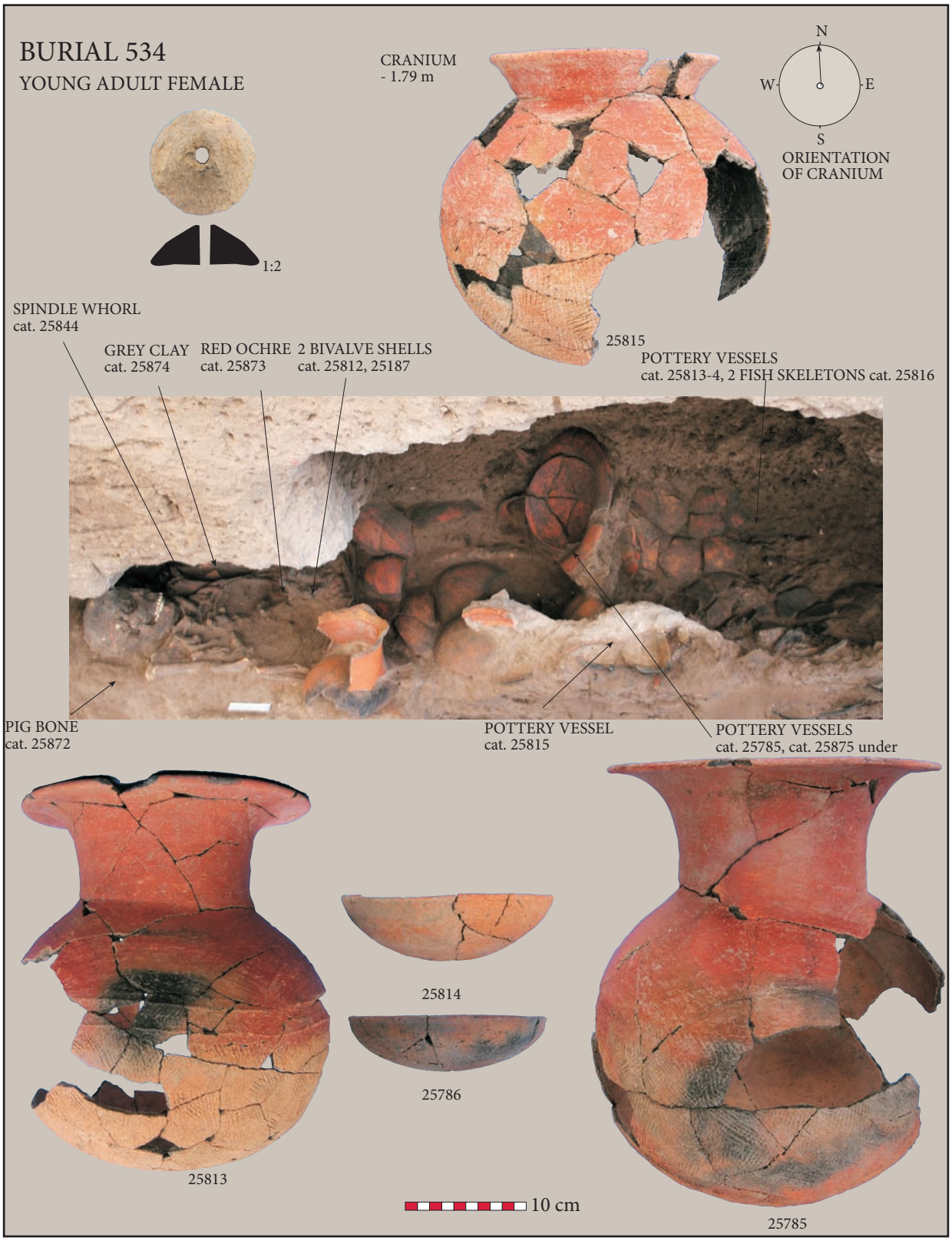


FIG. 10:23 Burial 534

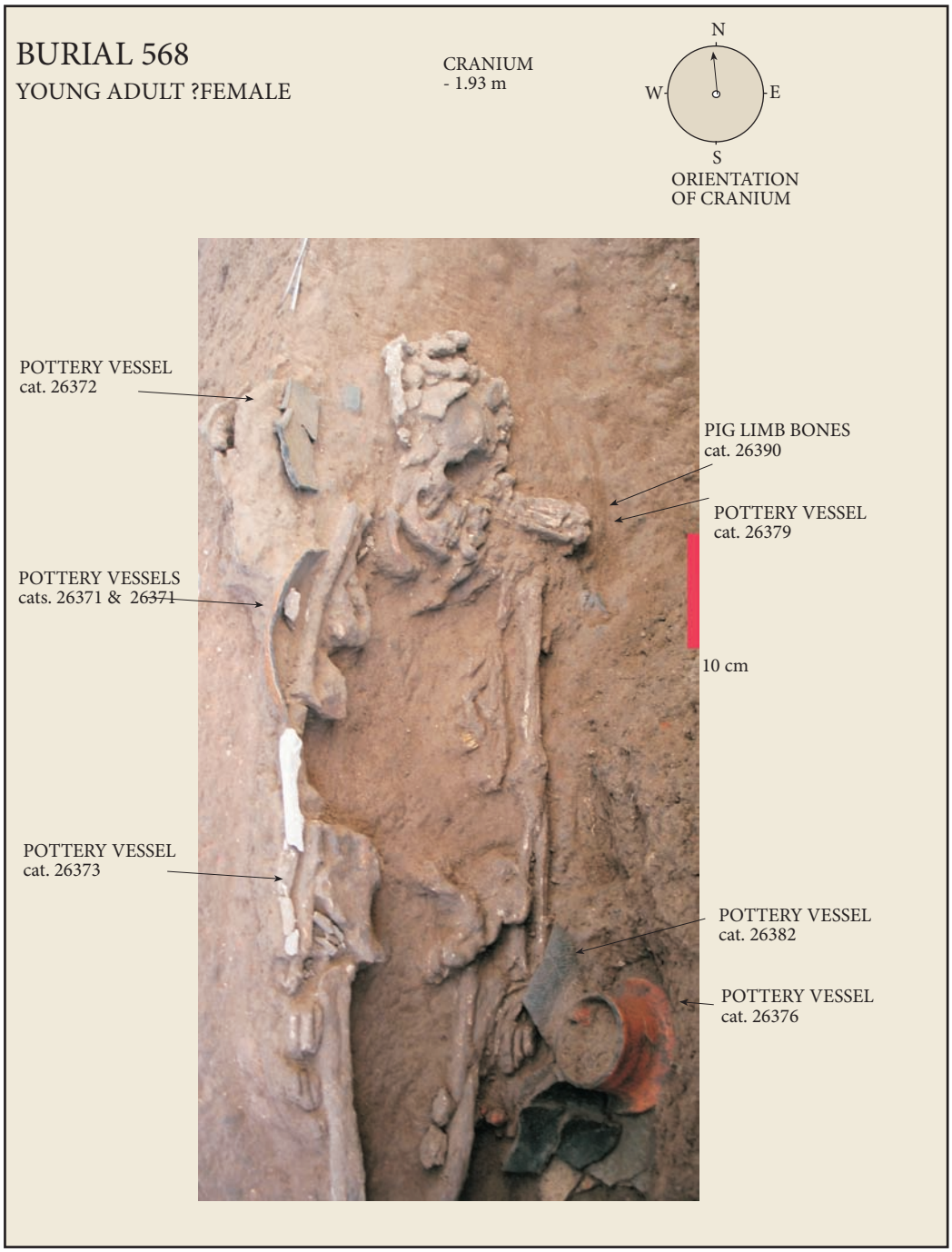


FIG. 10:24 The upper skeleton of burial 568



FIG. 10:25 The lower skeleton of burial 568

Burial 540, that of a young to mid adult female, was located just outside the eastern edge of the excavated area. She was associated with at least three pottery vessels, one of form 45 and another of form 61.

Burial 568 was located marginally within the excavated area. It was found at a depth of 1.93 m below datum, with the body of a young ?female orientated with the head to the north. As many as ten ceramic vessels were found in association, to the left of the left leg and round the area of the head. Of these, three belong to form 51 and there are two each of forms 45 and 55. The remainder are fragmentary. Pot cat. 26383 contained the skeleton of *Channa* sp. and pot cat. 26383 contained a *Channa striata.* The left fore limb bones of a pig was found by the left shoulder. This person was interred with a spindle whorl and a handful of grey clay placed by the left shin. A bivalve shell was found in the same part of the grave. A red ochre pellet lay beside the left femur.



FIG. 10:26 The ceramic vessels from burial 568

XI THE INFANT BURIALS OF IRON AGE PERIOD 1, NORTHERN GROUP

C.F.W. HIGHAM

There are at least 24 infants in the northern group of Iron Age 1 burials. They range in age from 32 weeks *in utero* to 15 years.The foetal or newly-born infants were interred in large, lidded jars of a form not matched at other Iron Age sites in the Upper Mun Valley or different phases at Ban Non Wat. The older infants and children were buried as were adults, with a range of mortuary offerings dominated by pottery vessels.

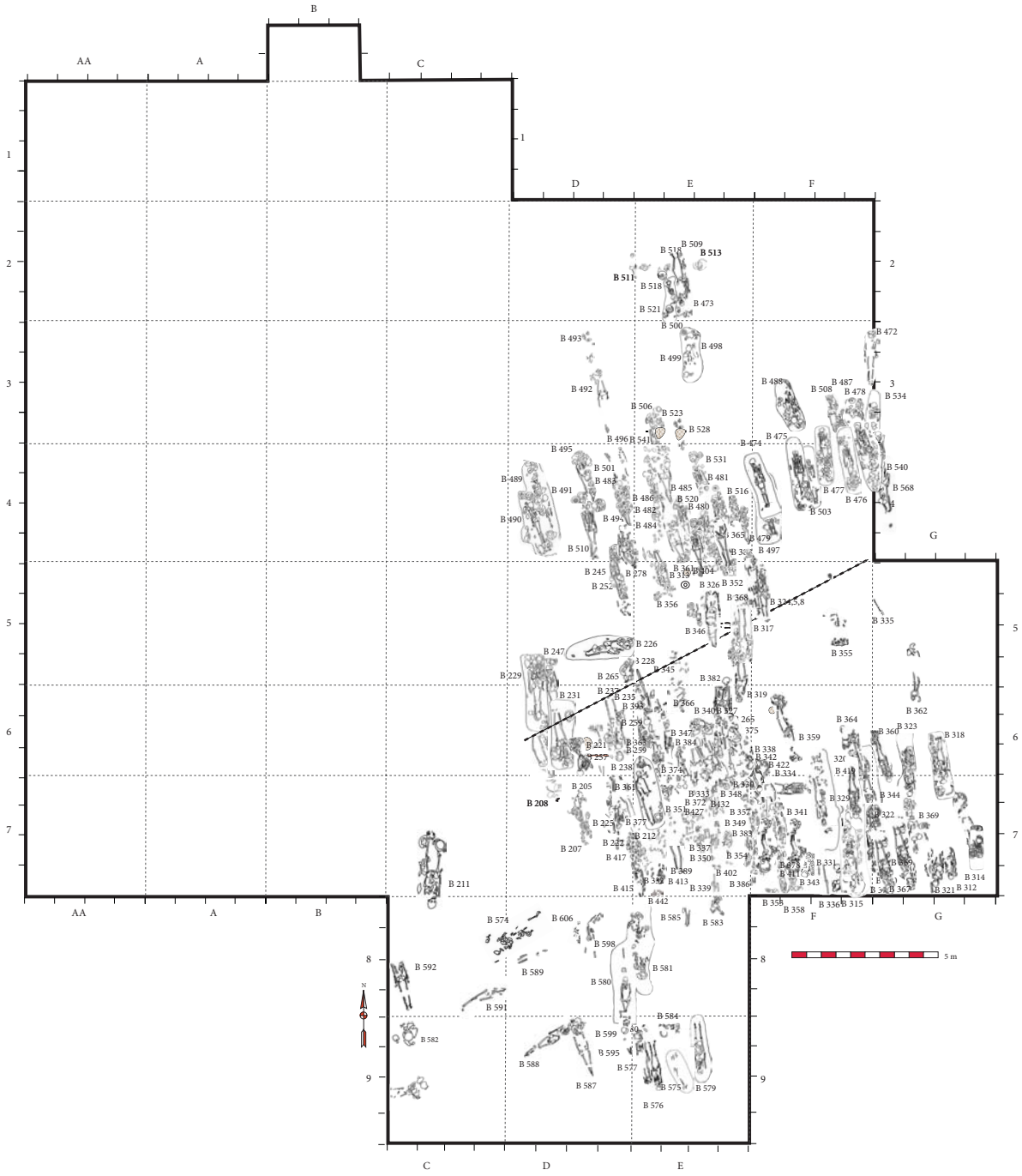


FIG. 11:1 The distribution of Iron Age 1 graves

TABLE 11:1 *The mortuary offerings for Iron Age 1 infant and child burials in the northern group*

burial no.	245	346	368	472	479	481	483	484	488	490	491	493	496	498	499	500	509	511	513	515	516	518	523	541
age	child	inf.	32w	15 y	2-4 y	7 y	2-4 y	5 y	2.5 y	15 y	4 y	2-4 y	2-4 y	0-4 m	0 m	35-7 w	0 m	5 y	0 m	6 m	5 y	0 m	4 y	7 y
orientation	355°	S		355°	355°	355°	355°	355°	340°	340°	340°	160°	340°	355°	355°	N	-	355°	-	175°	355°	335°	355°	355°
depth (metres)	2.03	1.59	1.82	1.17	1.87	1.82	1.82	1.82	1.86	1.85	1.81	1.93	2.07	1.97	2.06	1.88	1.49	1.77	1.83	1.91	1.85	1.92	1.97	2.02
n pots	7	5	3	2	1	9	6	6	4	7	5	4	1	1	3	1	0	1	2	1	6	2	2	1
pot form 23	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 41	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 45	1	0	0	0	1	1	1	2	2	1	2	0	0	0	1	0	0	1	0	0	1	0	0	0
pot form 48	0	1	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	2	0	0	0
pot form 51	2	2	1	1	0	3	2	1	1	2	1	0	0	0	0	0	0	0	1	0	2	0	0	0
pot form 52	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 54	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 55	3	0	0	1	0	4	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 56	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
pot form 59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
pot form 65	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
bivalve shell	0	0	0	2	0	1	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0
pig bones	1	0	1	0	0	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0
red ochre	0	1	0	0	0	0	0	1	6	2	1	0	1	0	0	1	0	0	0	0	0	0	0	1
spindle whorl	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fish skeleton	0	2	0	0	0	3	6	6	11	3	6	0	0	1	0	1	0	0	6	0	1	6	1	2
burnishing stone	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
turtle bone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
gastropod shells	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
grey clay	0	2	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
ivory bangles	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pellet bow pellet	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bronze bangle	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

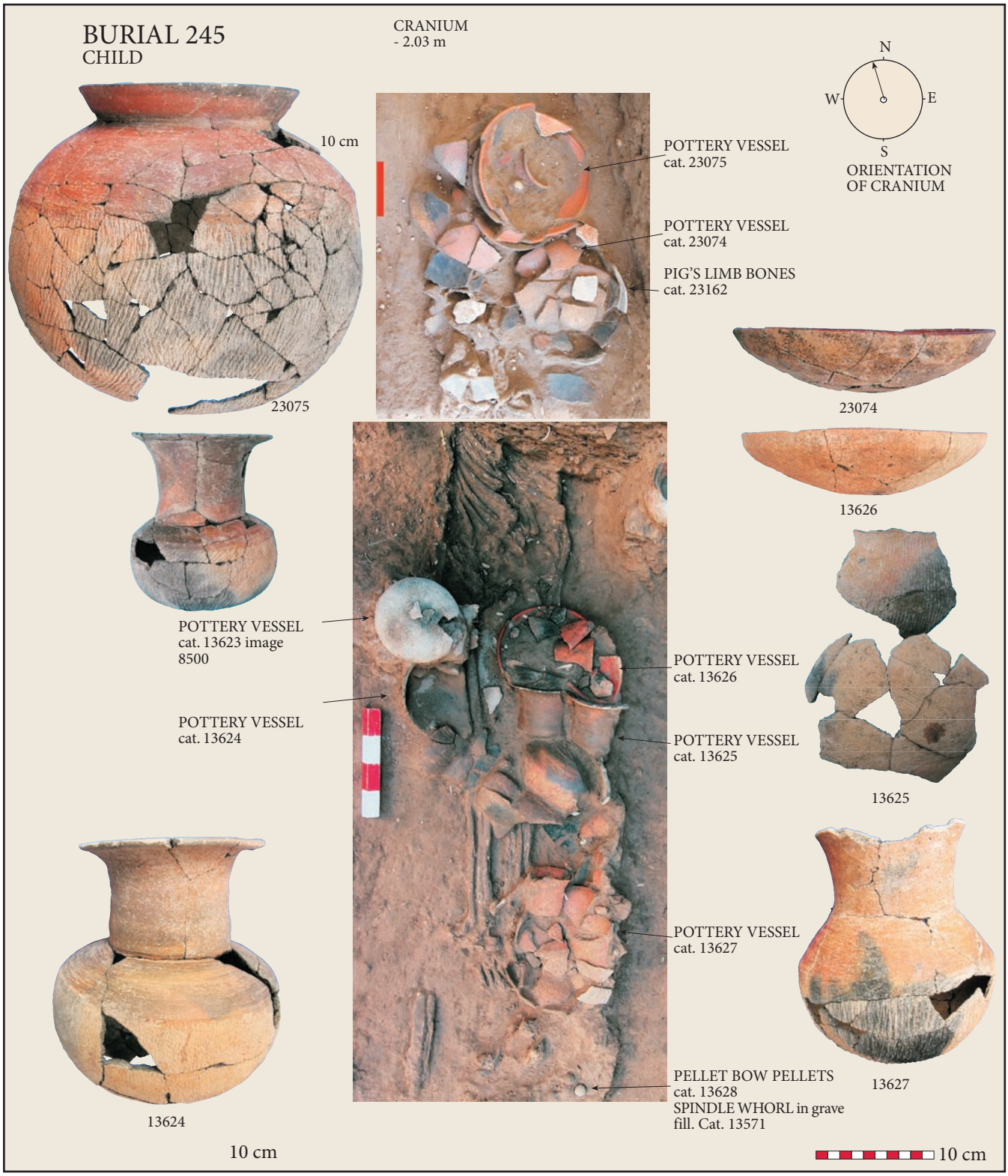


FIG. 11:2 Burial 245

Burial 245, that of a child, was found at a depth of 2.03 m below datum, with the head orientated to 355° from north. Seven ceramic vessels covered the lower body and the head area. Two are of form 51, three of form 55 and one is form 45. The right fore limb bones of a pig were found beyond the head and at least 10 pellet bow pellets beyond the ankles.

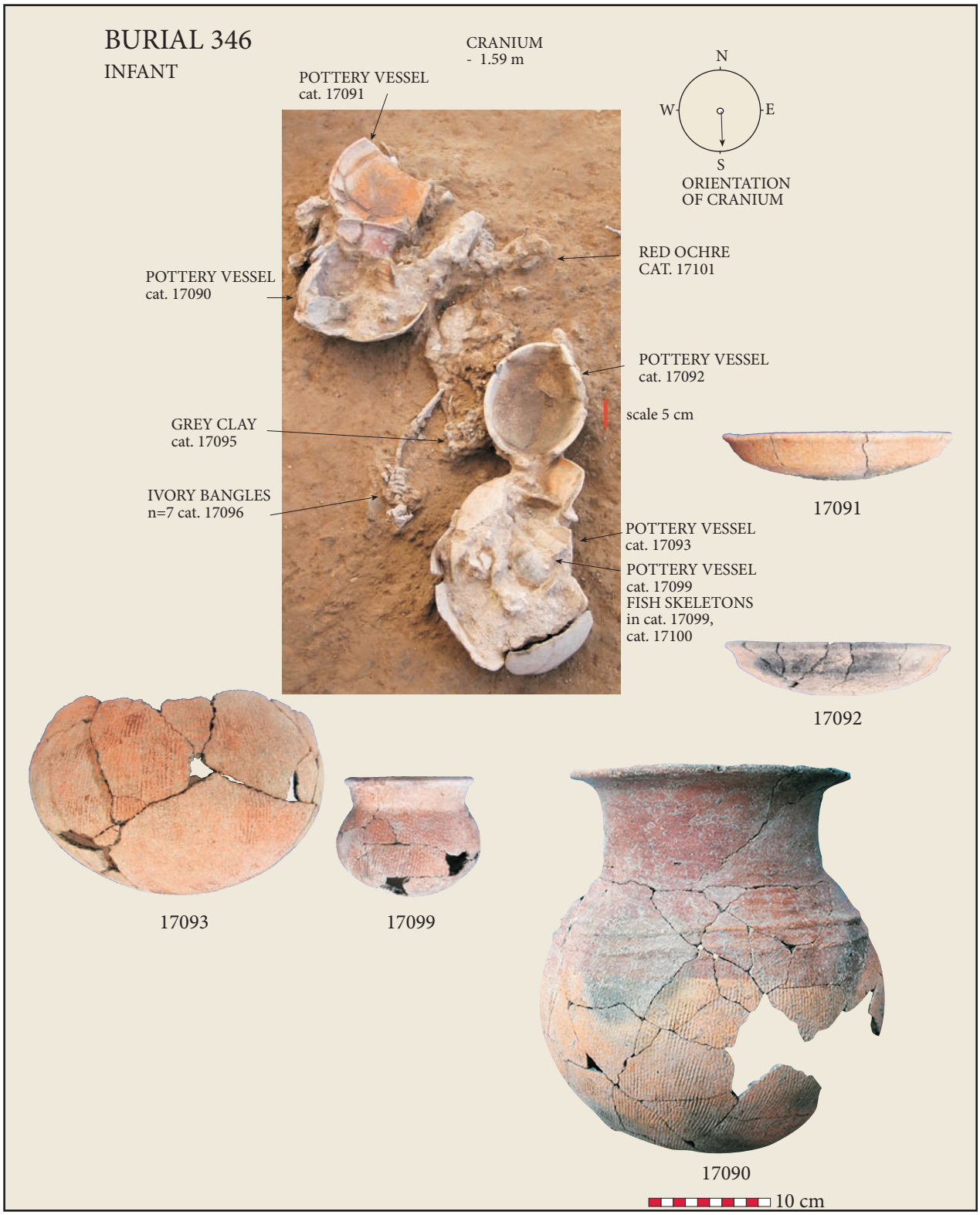


FIG. 11:3 Burial 346

Burial 346 involved an infant interred at a depth of 1.59 m below datum, orientated with the head to the south. Five pottery vessels lay beside the body and beyond the head. Two are of form 51 and there is one form respectively of form 41 and 48. Pot cat. 17099 contained 13 fish vertebrae, *Clarias* sp. 1 whole skull and *Clarias macrocephalus* one whole fish. The infant wore eight ivory bangles. Grey clay was found over the chest area and beyond the head. Red ochre was also present in the latter.

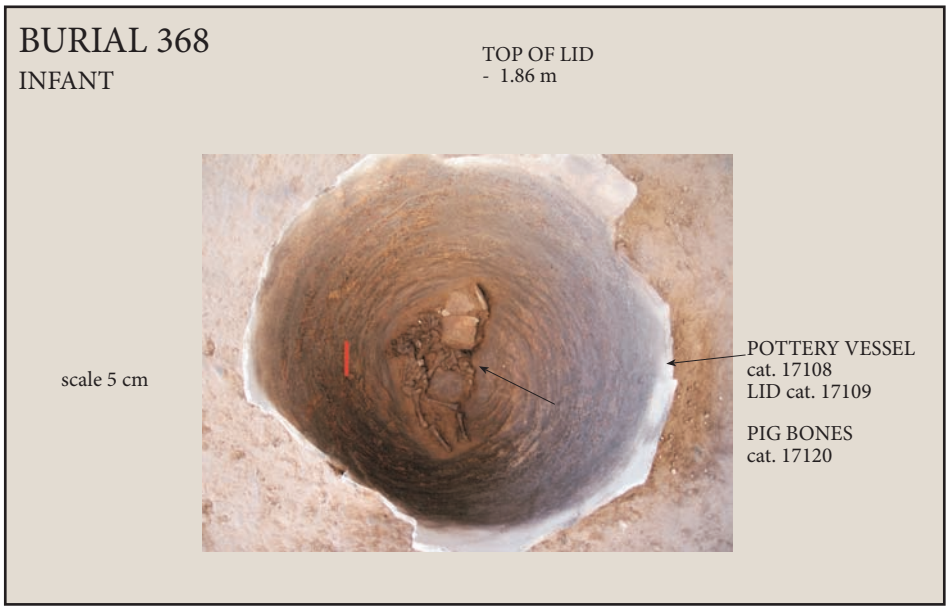
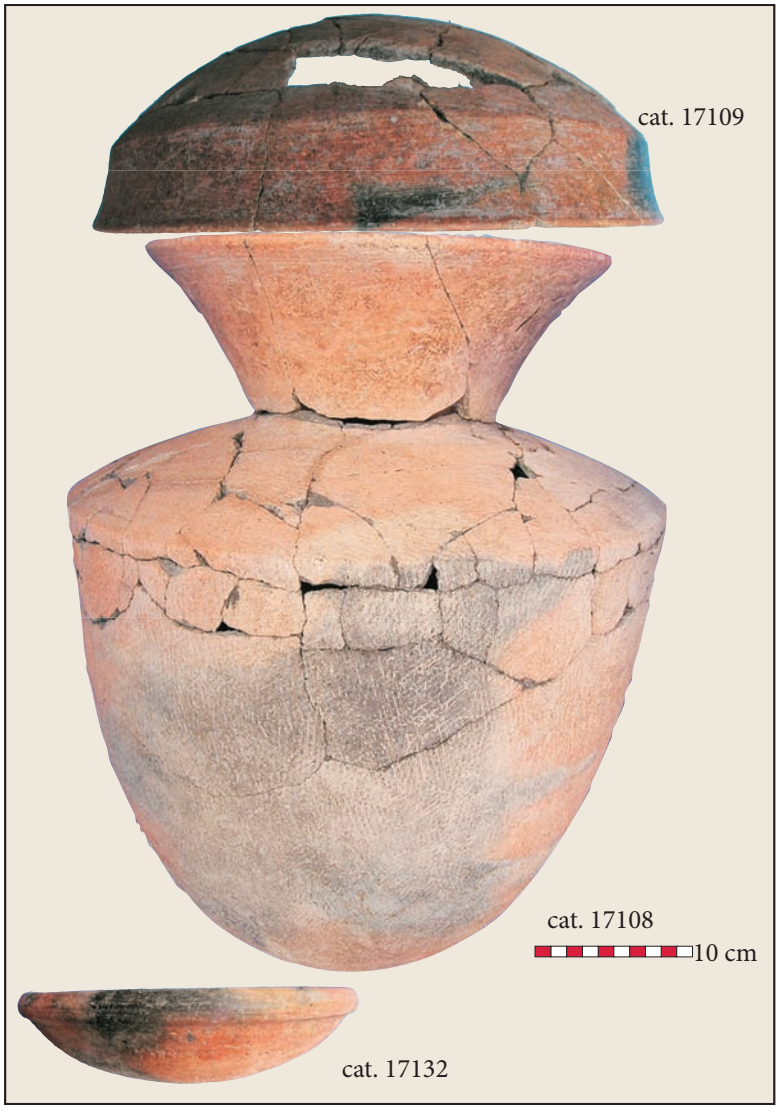


FIG. 11:4 Burial 368



Burial 368 is a lidded jar containing the remains of a foetus aged about 32 weeks from conception. The mortuary vessel is of form 65, and the lid resembles form 23. The vessel also contained the following fish bones: *Clarias* sp., the stem of a pectoral fin spine, *Ompok/ Wallago* 1R pectoral fin spine and *Channa* sp. 1L dentary; 1R cleithrum (ventral). The left and right fore limbs of a very young pig were also found within this pot. The vessel lying adjacent to the mortuary jar, which is of form 51, also contained fish bones as follows: three fish vertebrae, *Anabas testudineus* one small fragment of opercular and *Channa striata* one right premaxilla and a fragment of right cleithrum (dorsal).

FIG. 11:5 The ceramic vessels with burial 368

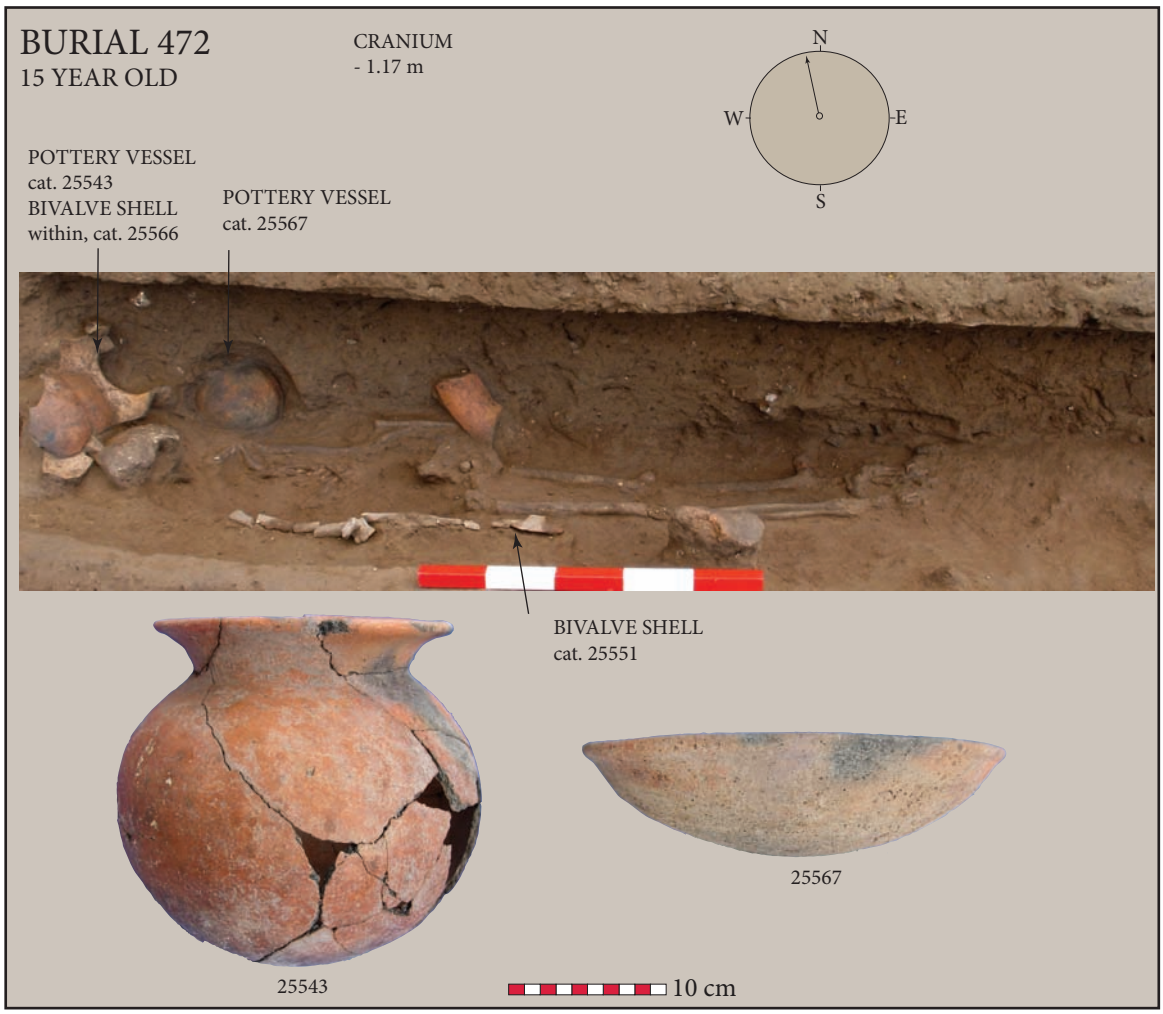


FIG. 11:6 Burial 472

Burial 472 contained the skeleton of a 15-year old. This person was interred with the head orientated 355° from due north, at a depth of 1.17 m below datum. Two pottery vessels were associated both beyond and beside the head. One is of form 51, the other form 55. The latter contained a bivalve shell, while a second bivalve shell was found beside the right hand.

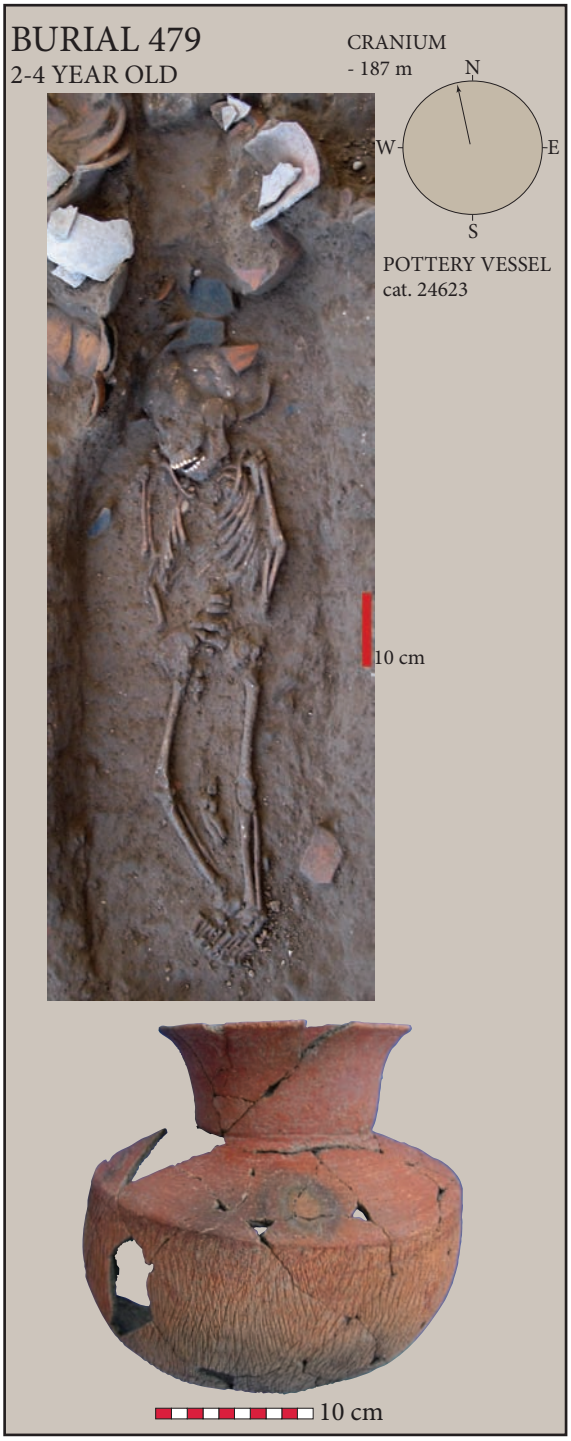


FIG. 11:7 Burial 479

Burial 479 contains the complete skeleton of a child who died when between 2 and 4 years of age. The grave was orientated with the head 355° from north. A pottery vessel of form 48 lay beyond the head,

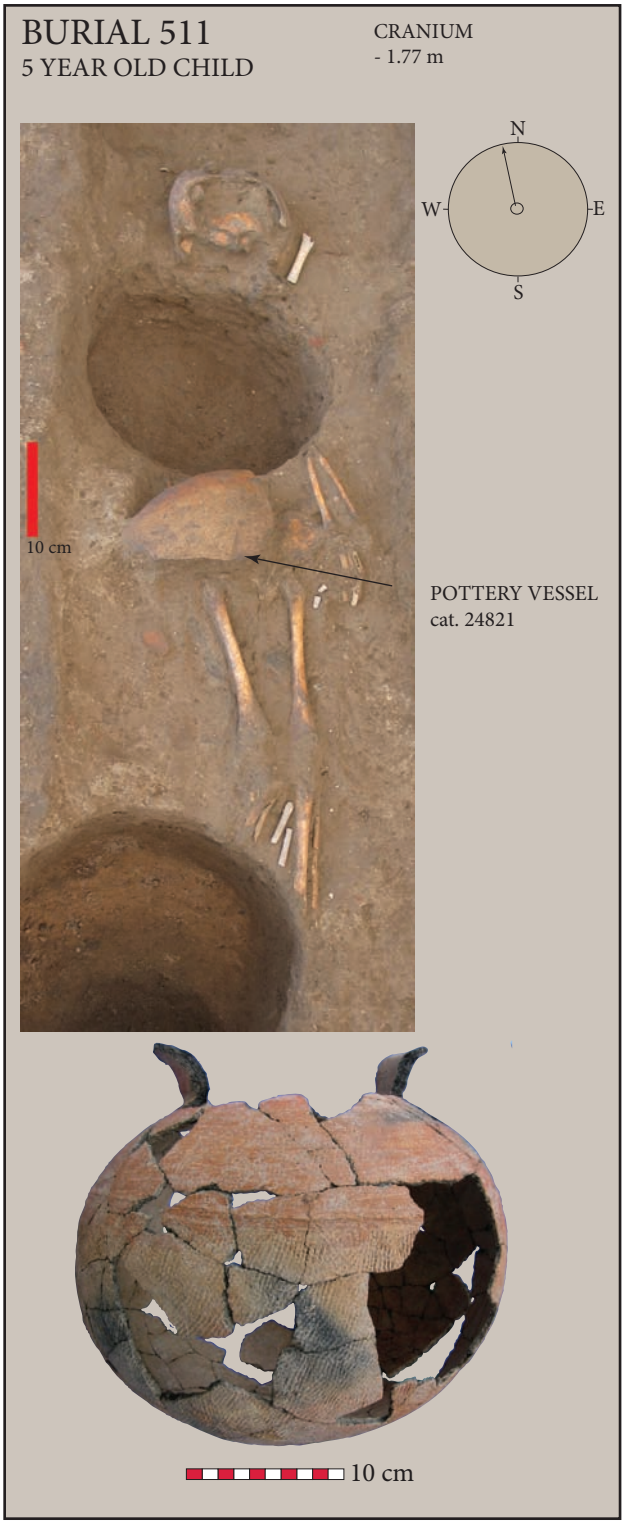


FIG. 11:8 Burial 511

Burial 511 contained the skeleton of a five-year old, orientated with the head 355° from north. It was found at a depth of 1.77 m. A large post hole had destroyed the upper part of the body, and another the foot area. A ceramic vessel of form 45 could be reconstructed from sherds found over the body.

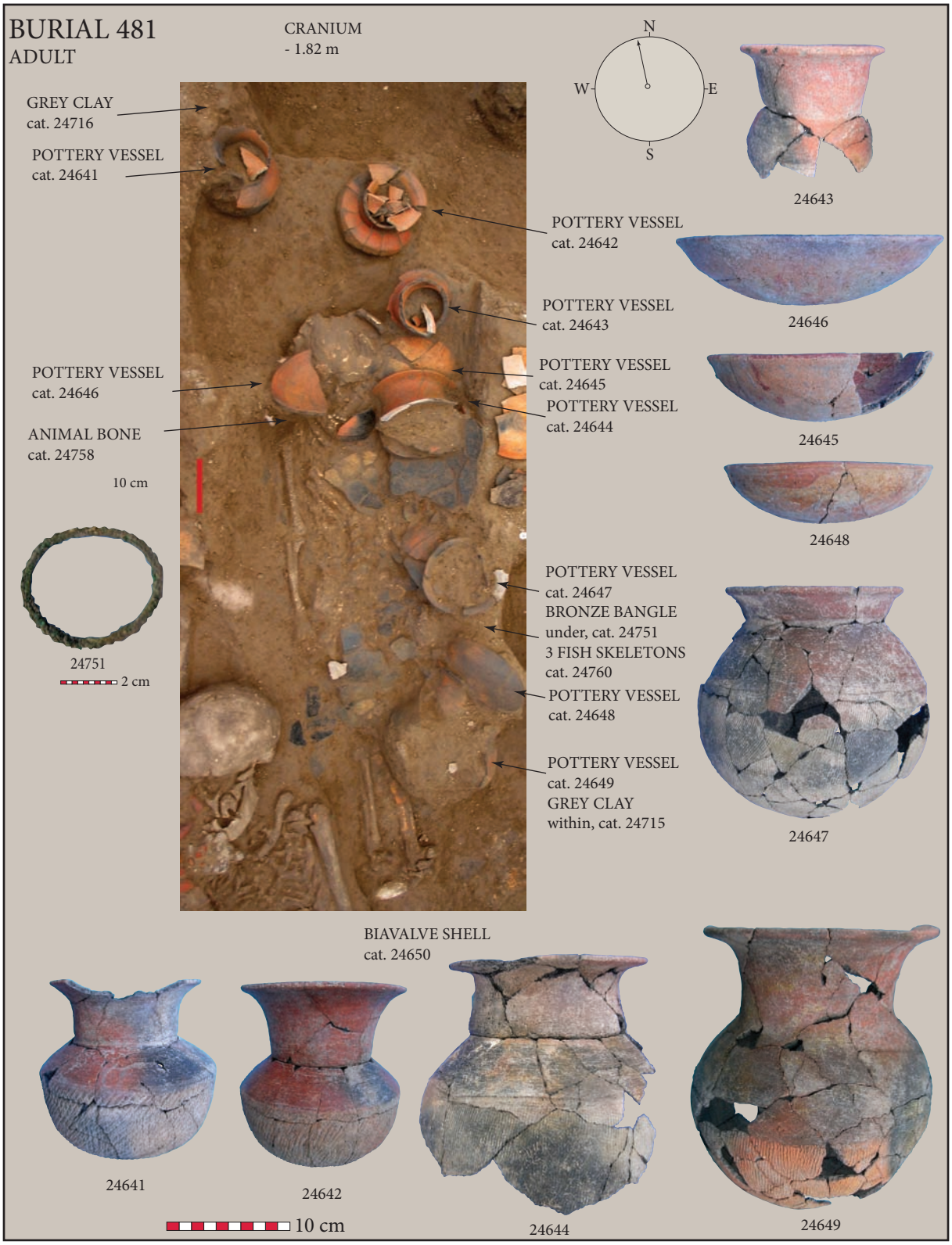


FIG. 11:9 Burial 481

Burial 481 was found at a depth of 1.82 m below datum, the grave orientated with the head 355° from north. A row of ceramic vessels lay along and to the left of the body with two beyond the head and one to the right of the head. Three are of form 51, there are four of form 55 and one each of forms 45 and 48. This person wore a bronze bangle on the left arm. There was a bivalve shell over the knees. Two deposits of grey clay had been placed with the body, one beside the lower legs and the other beyond the head. Three complete fish skeletons of *Channa striata*, cat. 24760, were found next to left hand.

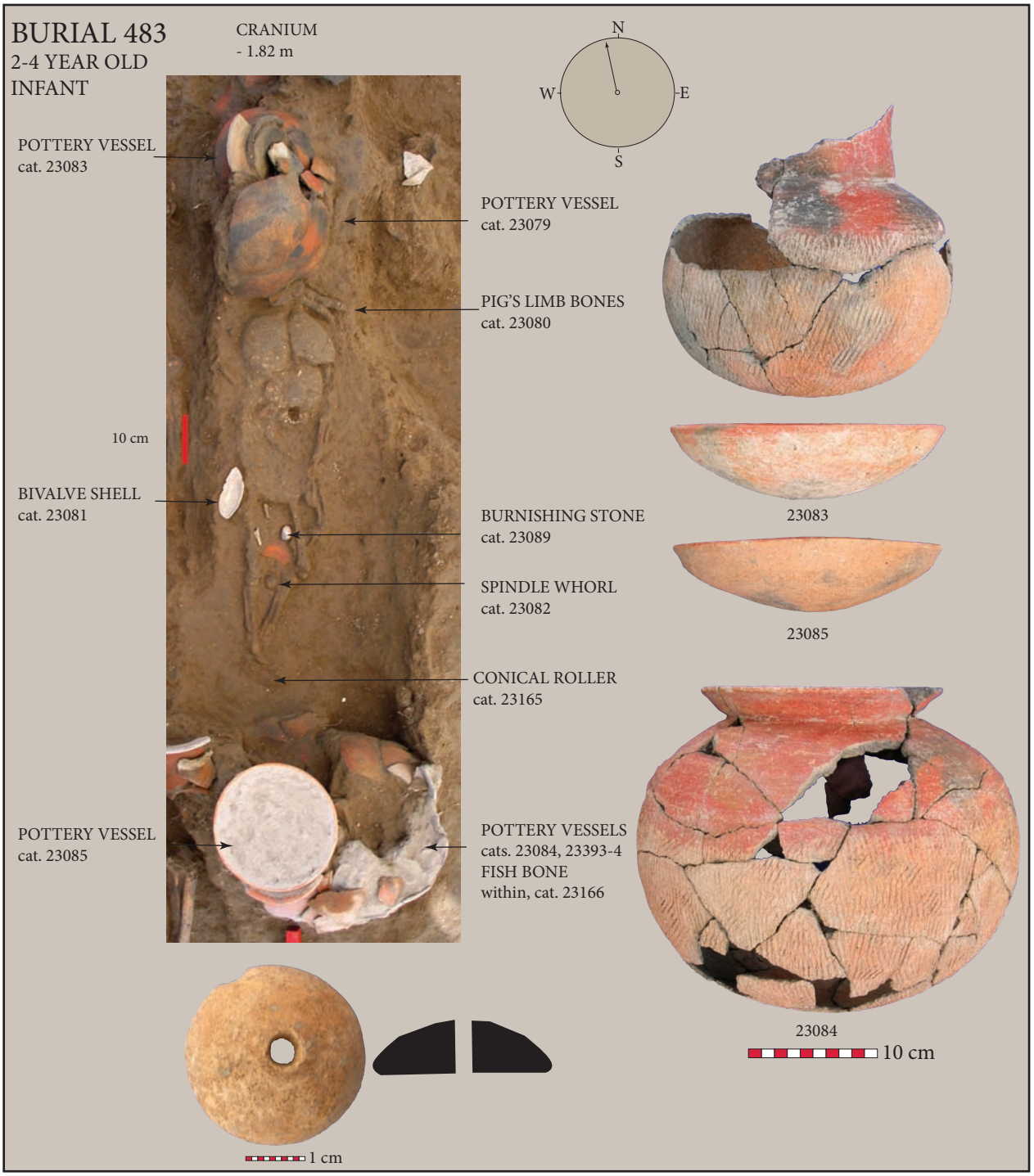


FIG. 11:10 Burial 483

Burial 483 contained the skeleton of an infant who died when aged between 2-4 years. The infant was buried on an orientation 355° from north, at a depth of 1.82 m below datum. There were six ceramic vessels associated, four beyond the feet and two beyond the head. Four could be reconstructed, and comprise two of form 51, one of form 45 and another of form 55. The form 45 vessel contained fish bones as follows: *Clarias* sp. 1 supraoccipital; 1L, 1R post-temporal; 1L, 1R pterotic; 1L jugal; 1R cleithrum; 1L pectoral fin spine; *Anabas testudineus* 1L dentary; four whole *Channa striata*. The left fore limb bones of a pig lay just beyond the head, and there as a bivalve shell by the right elbow. A spindle whorl was found between the infant's knees, and a conical roller beyond the ankles.

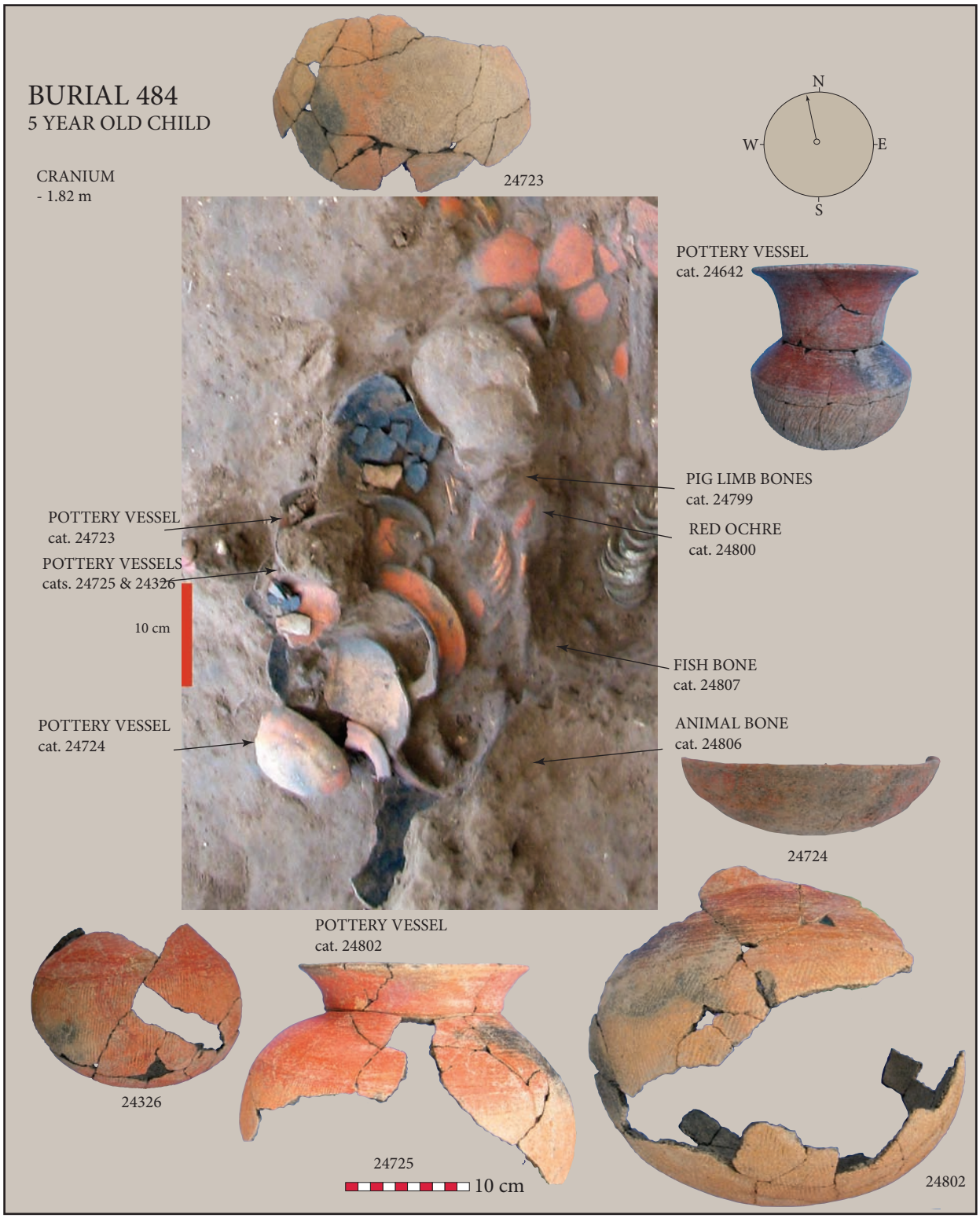


FIG. 11:11 Burial 484

Burial 484 contained the skeleton of a five-year old, orientated with the head 355° from north. It was found at a depth of 1.82 m. Six pots were associated, one beyond the head and the others partially over and to the right of the body. Forms 51, 52 and 54 are represented by one vessel, and there are two of form 45. The left fore limb bones of a pig and red ochre were found adjacent to the skull. The fish are as follows: cat. 24807 over left ribs/pelvis/arm area, one whole *Clarias macrocephalus* and four whole *Channa striata*. Cat. 24967 under lower vertebrae and ribs, six fish vertebrae

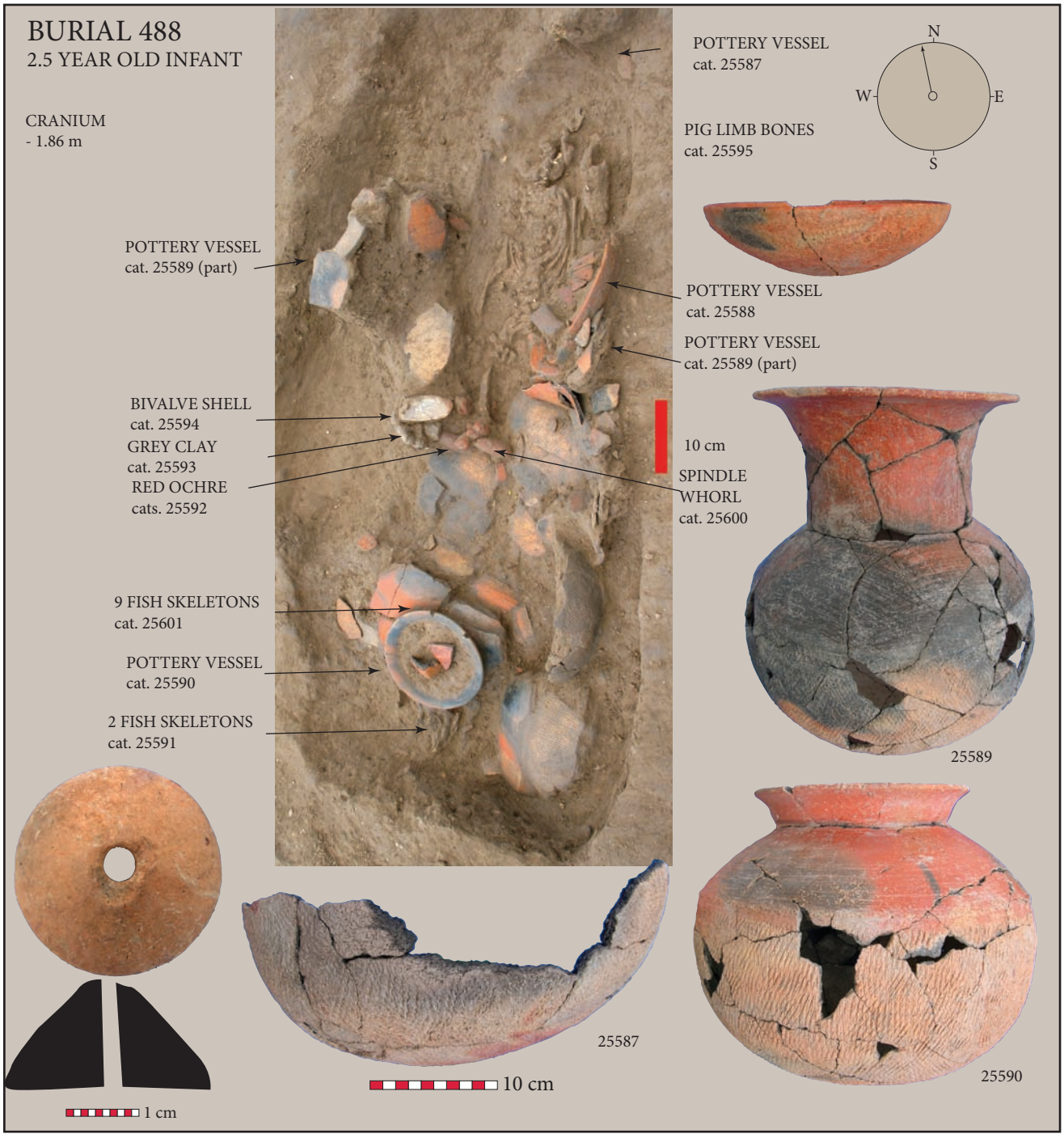


FIG. 11:12 Burial 488

Burial 488 contained the skeleton of an infant who died when about 2.5 years old. The body was orientated with the head 340° from north, and was found at a depth of 1.86 m below datum. Four pottery vessels were disposed over and beside the lower body. One is of form 48, one of form 51 and two are of form 45. Pig's rear limb bones had been placed to the left of the head. Six red ochre pellets, a bivalve shell and grey clay were found over the right knee, and a spindle whorl was present, to the right of the right femur. The following fish remains were found: cat. 25591, *Clarias* sp. 1 fragment of skull; 1L articular; one whole *Channa striata*. Cat. 25601 in pot cat. 25590, 1 whole *Clarias* sp.; *Monopterus albus* 1 hyoid bone; seven whole *Channa striata.* Six red ochre pellets, a bivalve shell and grey clay were found over the right knee, and a spindle whorl was present, to the right of the right femur. The following fish remains were found: cat. 25591, *Clarias* sp. 1 fragment of skull; 1L articular; one whole *Channa striata*. Cat. 25601 in pot cat. 25590, 1 whole *Clarias* sp.; *Monopterus albus* 1 hyoid bone; seven whole *Channa striata.*

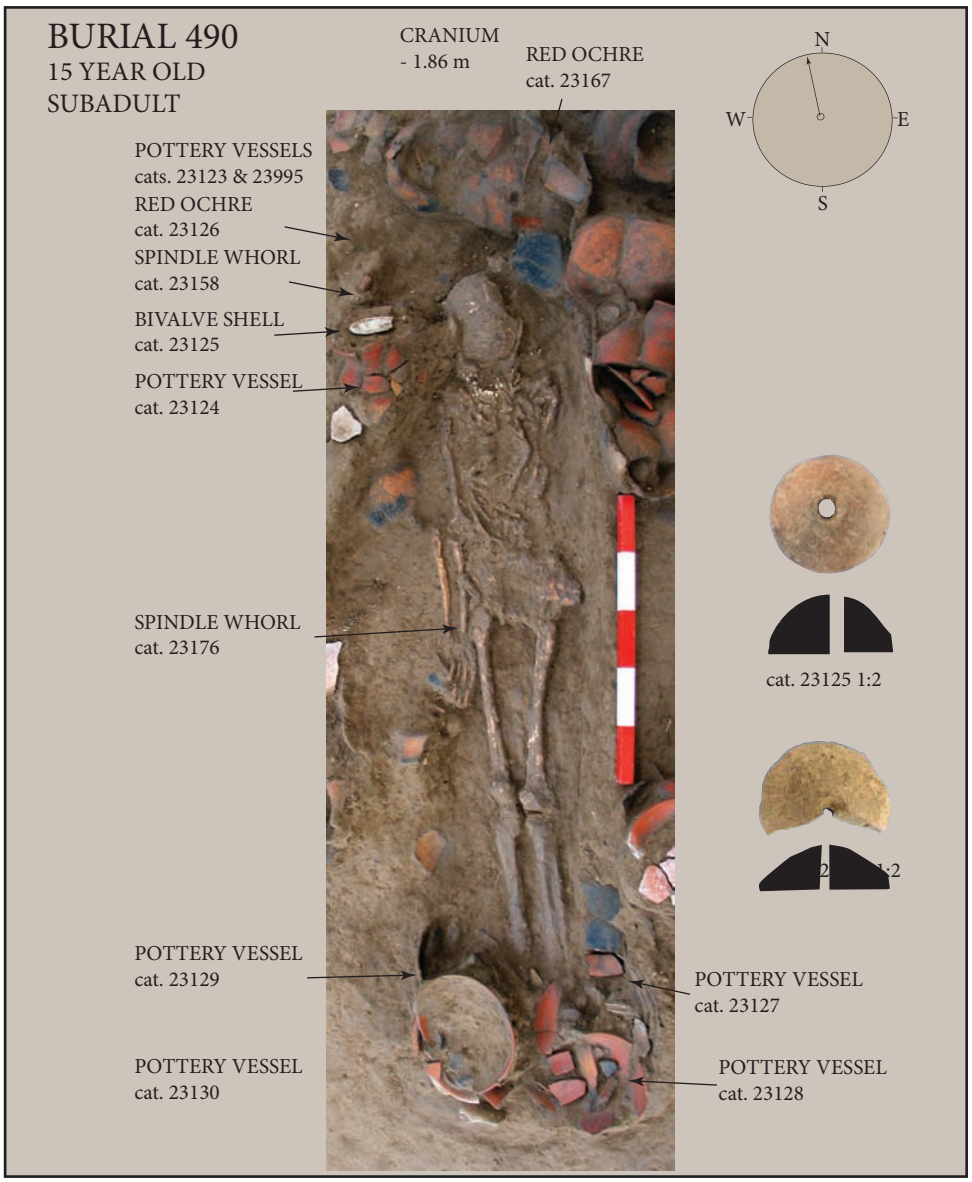


FIG. 11:13 Burial 490

Burial 490 contains the skeleton of a 15-year old, interred with the head orientated 340° from north. The body lay at a depth of 1.85 m below datum. Seven ceramic vessels were found in association beyond and beside the head and beyond the feet. Two are of form 51, and there is one each of forms 45, 48, 54, 55, and 56. A bivalve shell was found in the neck of the pot located beside the head. Red ochre had been placed beyond and beside the head, and two spindle whorls were found, one on the pelvis and the other to the right of the head. Pot cat. 23131 contained *Clarias* sp. one right articular; *Hemibagrus*/*Mystus* one pectoral fin spine and *Channa striata*, a right epihyal.



FIG. 11:14 Burial 490, showing the head area. The curvature of the broken pots to the right of the image indicated that they belong to burial 491, and were probably positioned within a tree trunk coffin. Scale 10 cm

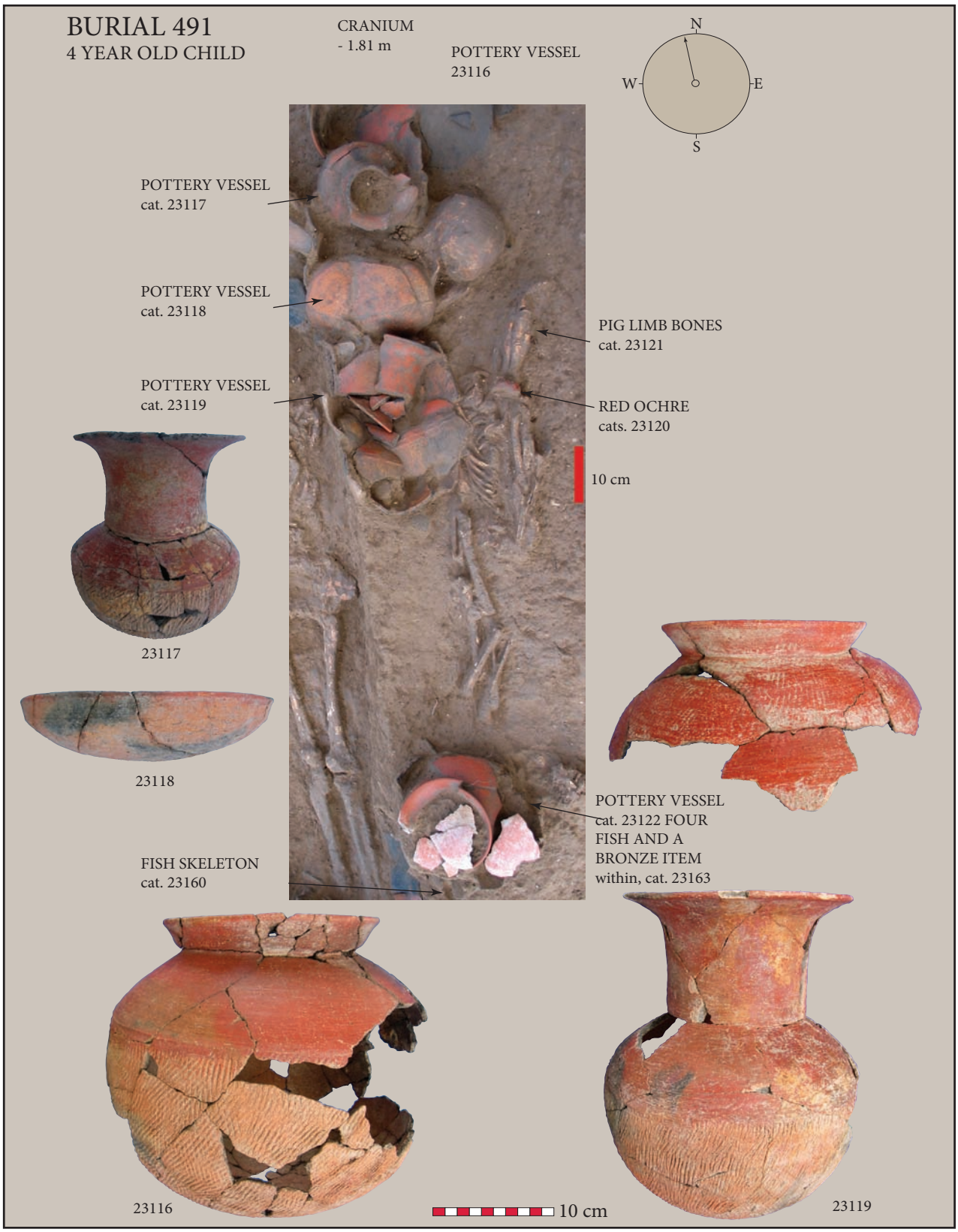


FIG. 11:15 Burial 491

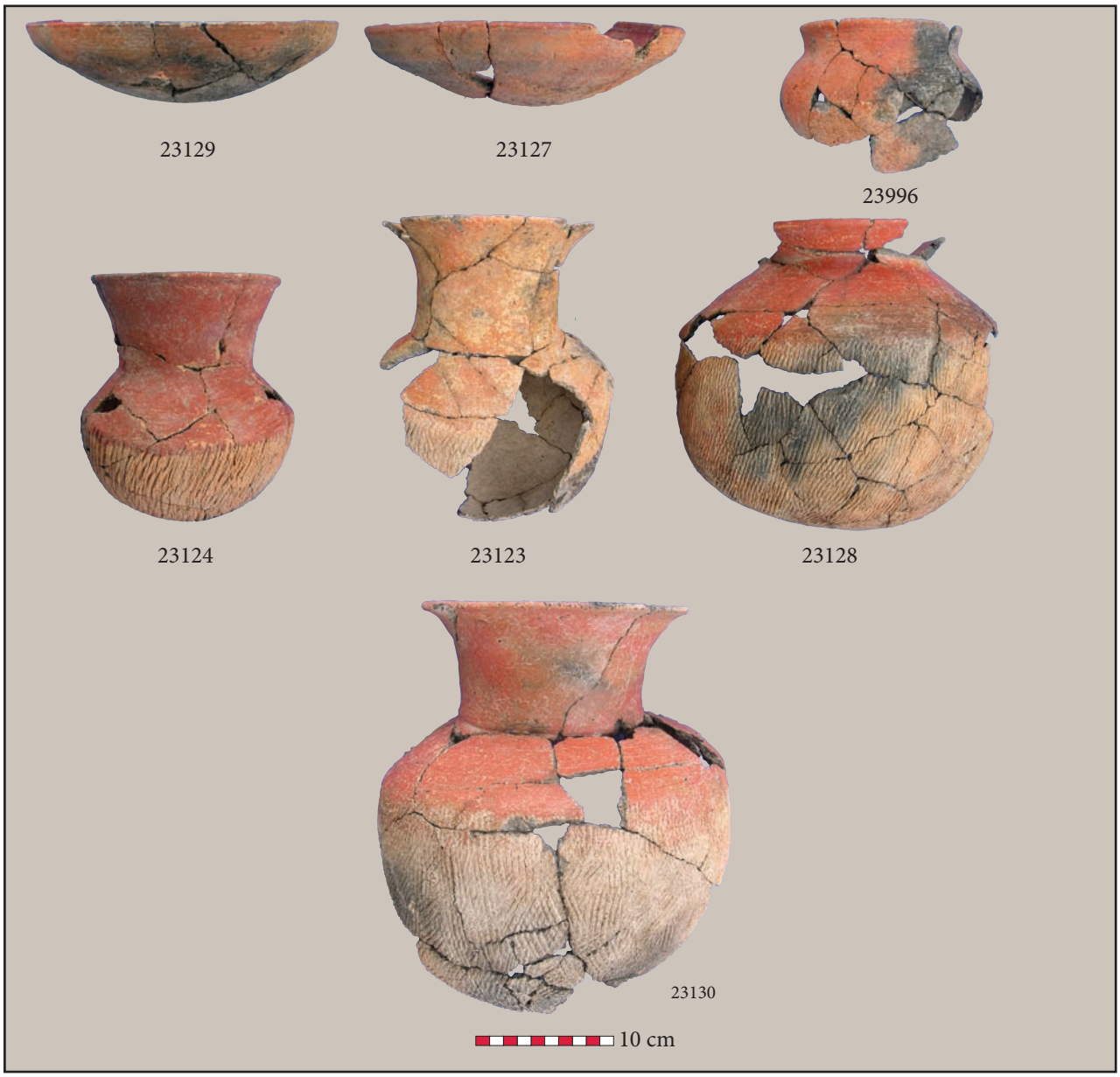


FIG. 11:16 The ceramic vessels from burial 490

Burial 491 contains the remains of a four-year-old child, orientated 340° from north, and at a depth of 1.81 m below datum. The form of the pottery vessels to the right of the skeleton suggests that the child was interred within a tree coffin. There are five vessels, four beside the upper body and one beyond the feet. They are of forms 45 (2), 51 and 55 (2). The right fore limb bones of pig and pellets of red ochre were found by the left shoulder. The following fish were found: Pot cat. 23117 contained 3 fish vertebrae, a small fragment of skull and a fragment of cleithrum from *Clarias* sp. Pot cat. 23122 contained a whole *Notopterus notopterus* and four whole *Channa striata*.



FIG. 11:17 Burial 491, showing the pig's limb bones and red ochre beside the skull and the pots that were associated. Scale 10 cm

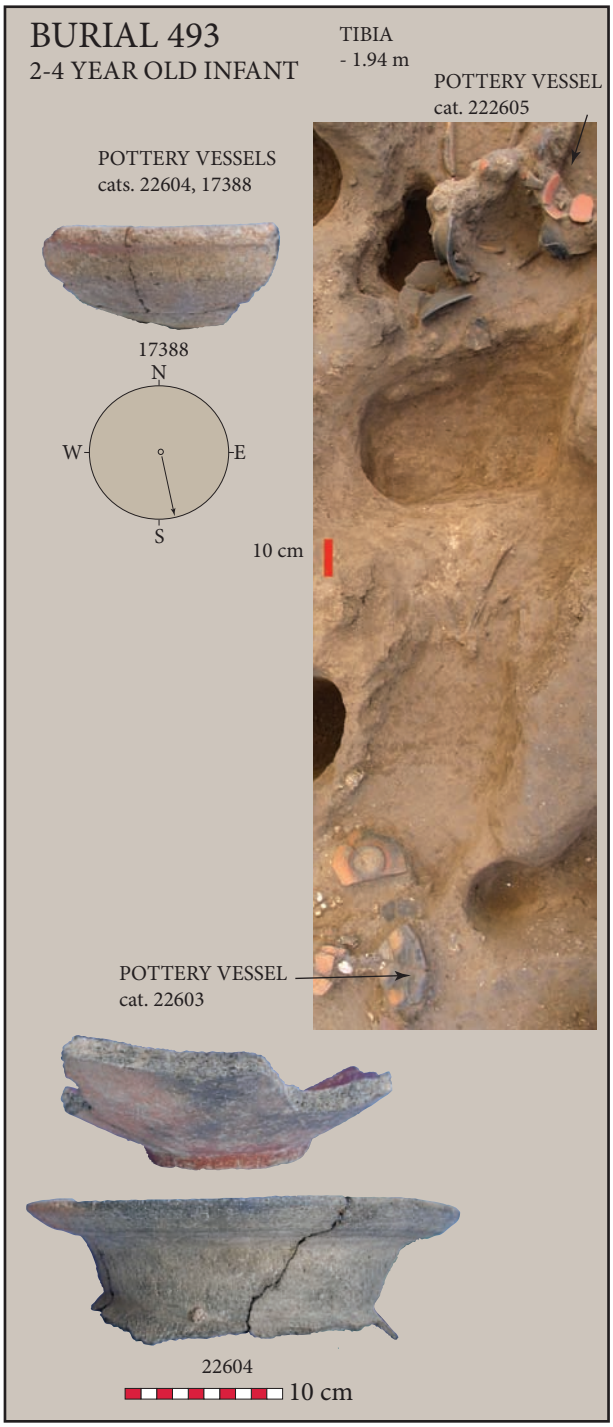


FIG. 11:18 Burial 493

Burial 493, that of a 2-4 year old, was badly disturbed in prehistory, and only four fragmentary ceramic vessels can be associated with it. The burial was found at a depth of 1.93 m below datum on the unusual angle with the head orientated 160° from north.



FIG. 11:19 Burial 498

Burial 498 involved an infant who died within the first four months of its life. A single, unreconstructed pottery vessel lay over the cranium. The skeleton was found at a depth of 1.97 m below datum, orientated 355° from north. The pot contained seven fish vertebrae, one stem of a pectoral fin spine and a small fragment of neurocranium from *Clarias* sp.

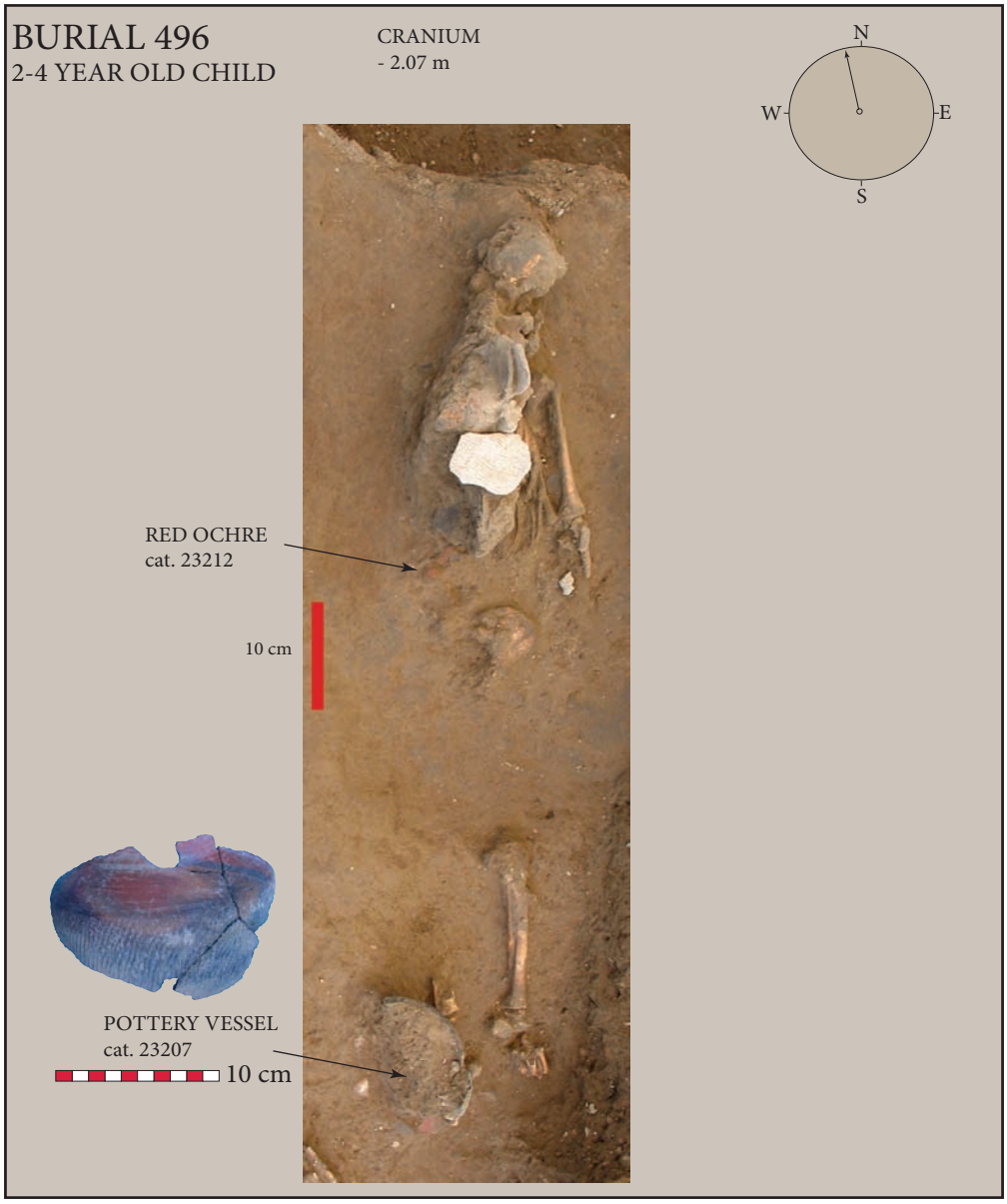


FIG. 11:20 Burial 496

Burial 496 contains the skeleton of a child who died when aged between 2-4 years. The grave lay 2.07 m below datum, and was orientated with the head at an angle of 350° from north. A fragmentary pottery vessel had been placed beside the ankles and some red ochre pellets were found by the right elbow. Most of the skeleton between the tibia and hands was missing and more grave offerings might have been present before this disturbance.



FIG. 11:21 Burial 496, showing the upper part of the body. Scale 10 cm

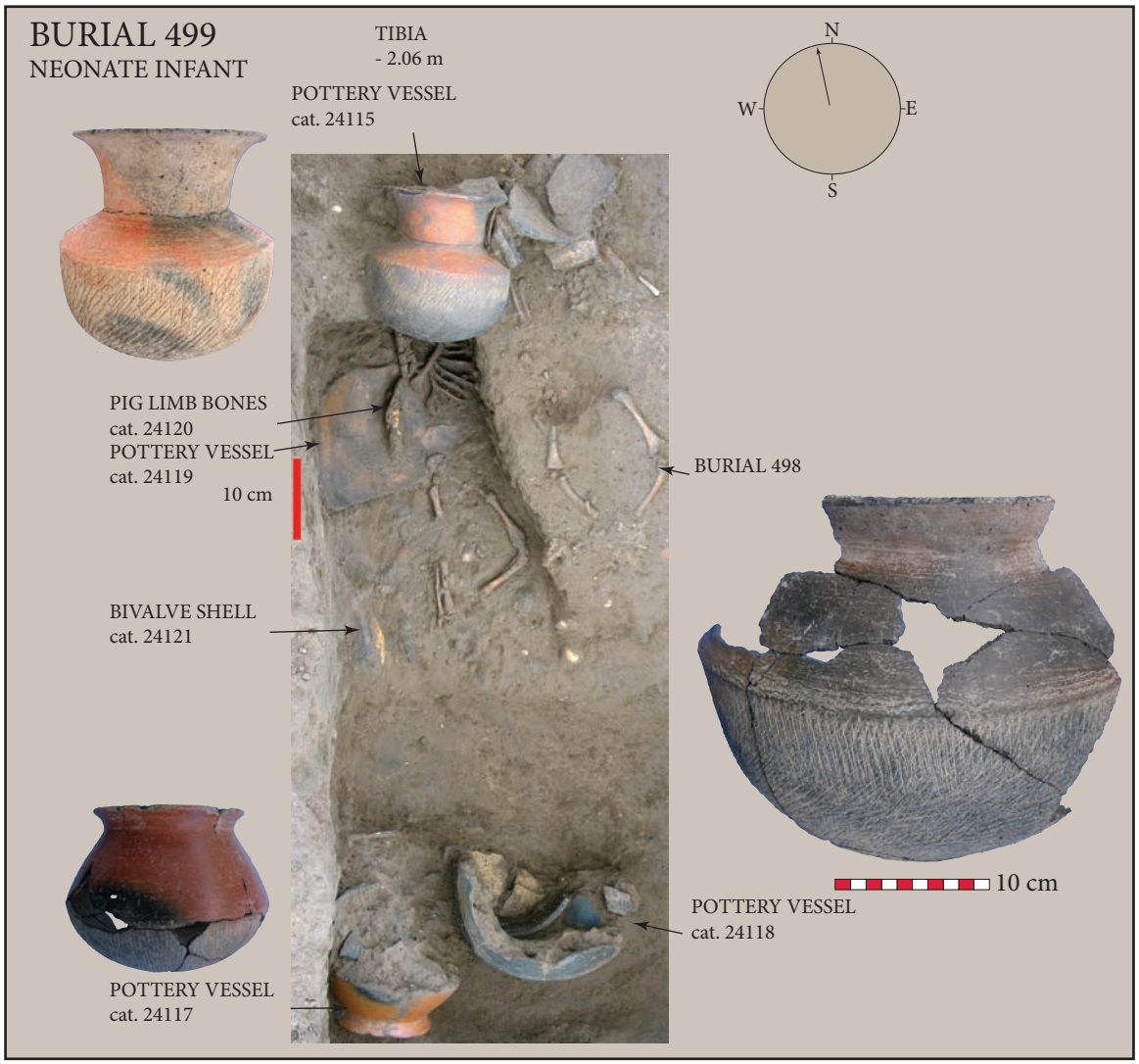


FIG. 11:22 Burial 499

Burial 499 was found adjacent to burial 498 in an area in which infant burials concentrated. This particular grave contained the skeleton of a neonate, interred at a depth of 2.06 m below datum, and orientated 355° from north. Three pots of forms 45, 48 and 59 were associated, two beyond the feet and one over the head. A bivalve shell lay beside the right ankle, and the right fore limb of a pig were found by the right arm.



FIG. 11:23 Burial 499, after the removal of the ceramic vessel over the head. Scale 10 cm

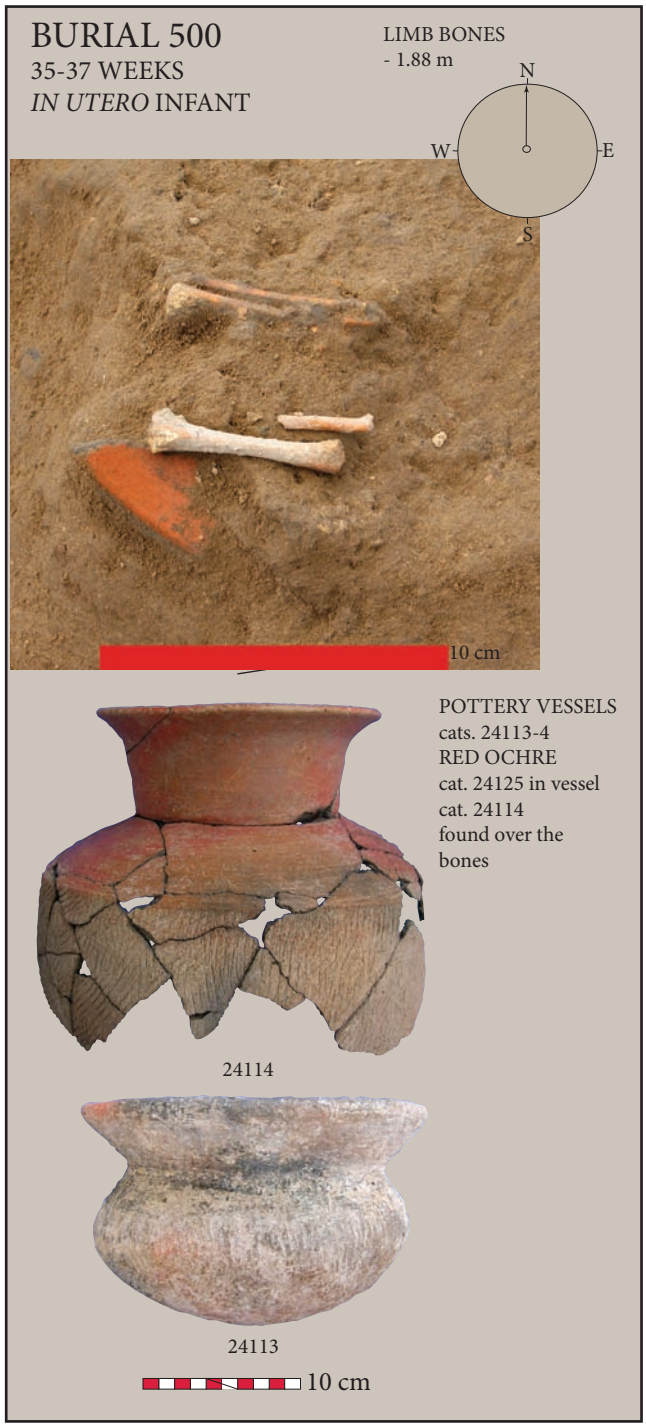


FIG. 11:24 Burial 500

Burial 500 involved an pre-term infant who died when about 35-37 weeks *in utero*. Only the tibiae and fibulae survive. Two pottery vessels of forms 48 and 56 were probably interred in this infant's grave. Red ochre was present in the form 48 vessel as well as 5 fish vertebrae and a few fish bones.



FIG. 11:25 Burial 509

Burial 509 contains an infant within a mortuary jar. There were no other offerings. The infant died before reaching full term..

Burial 518 (page 202) is the jar burial of a newly-born infant. The ceramic vessel and its lid are the only items associated. A third pot in the vicinity of the jar burial is unlikely to be associated with it. The burial was found at a depth of 1.92m below datum. The burial jar contained the remains of six fish as follows: 1 fish vertebra; *Clarias* sp. 1 small fragment of neurocranium; *Hemibagrus*/*Mystus* 1R pectoral fin spine; *Monopterus albus* 1 basihyal; *Anabas testudineus* 1R lacrymal; *Channa striata* 1L dentary; 1R ceratohyal; 1R quadrate.

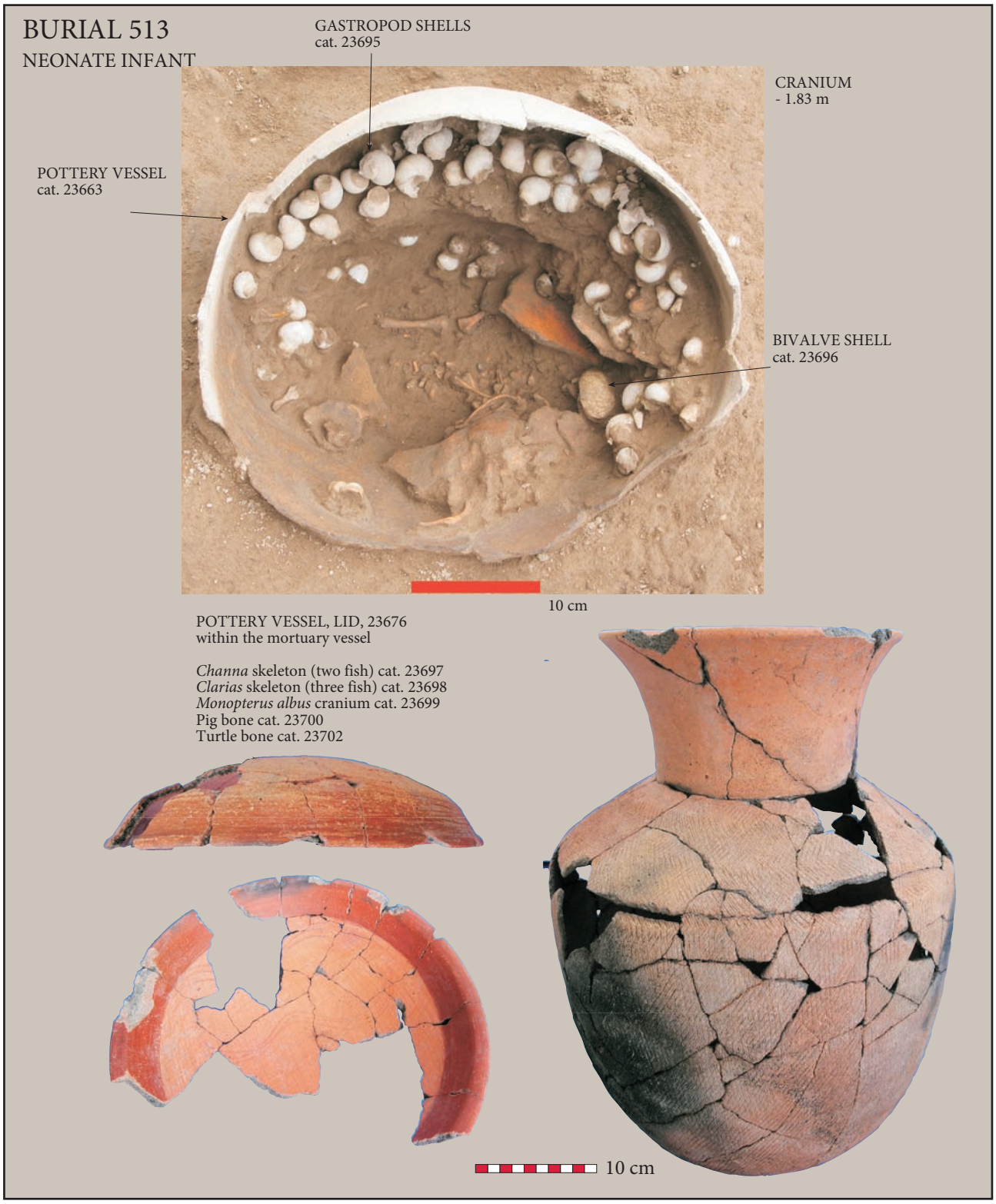


FIG. 11:26 Burial 513

Burial 513 is a lidded jar burial containing a newly born infant skeleton. It was found at a depth of 1.83 m. The mortuary jar is of form 65 and the lid is form 51. The contents include a layer of gastropod shells, the remains of several fish, a turtle bone and a bivalve shell. The fish are as follows: Cat. 23697 *Channa striata* 1L, 2R cleithrum; 1L dentary; 1L articular; 1L lower pharyngeal; 2L opercular; 1L, 1R epihyal; 2L, 1R ceratohyal; cat. 23698 *Clarias* sp. 3R pectoral fin spine; 1L, 1R cleithrum; cat. 23699 *Monopterus albus* 1 neurocranium; 1 basihyal.

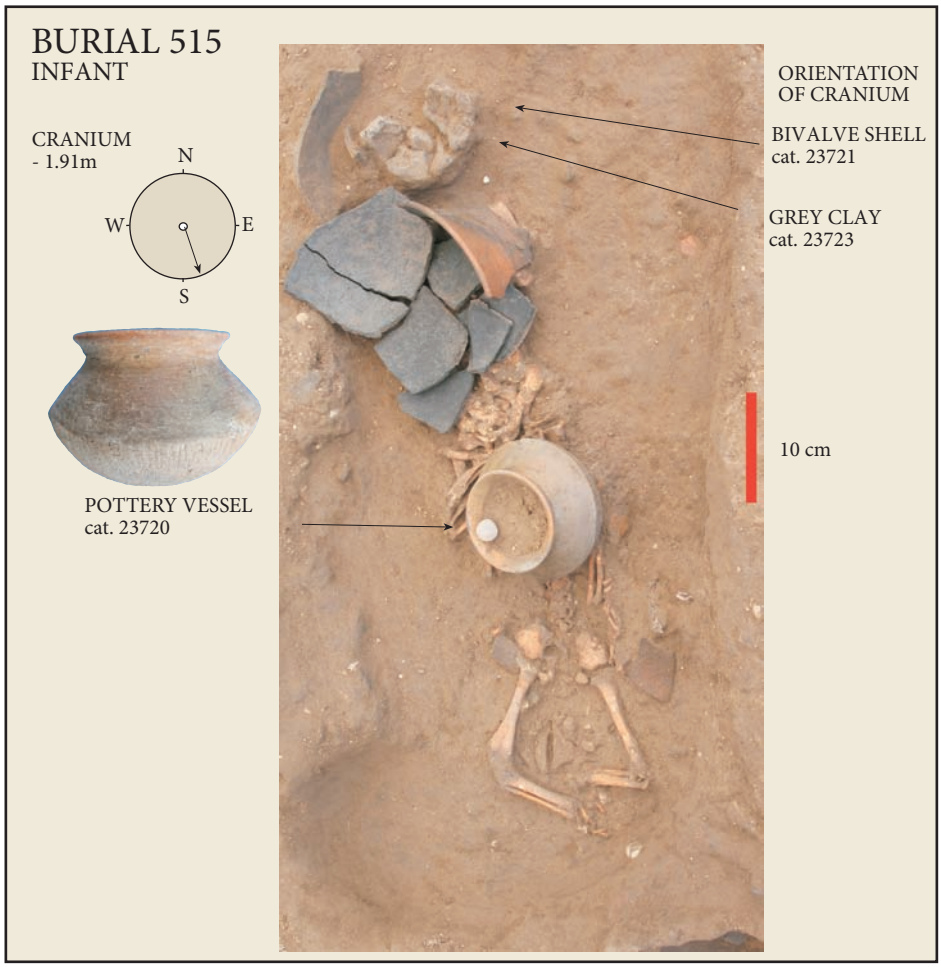


FIG. 11:27 Burial 515

Burial 515 involves an infant aged between 3-9 months at death. The body was laid out with the head orientated a few degrees from due south, at a depth of 1.91 m below datum. Three infant jar burials were located beyond the head and the feet. A single complete ceramic vessel of form 56 lay over the chest. Beyond the head, there was a deposit of grey clay and one bivalve shell.



FIG. 11:28 Burial 515, with jar burials 513, 518 and 521

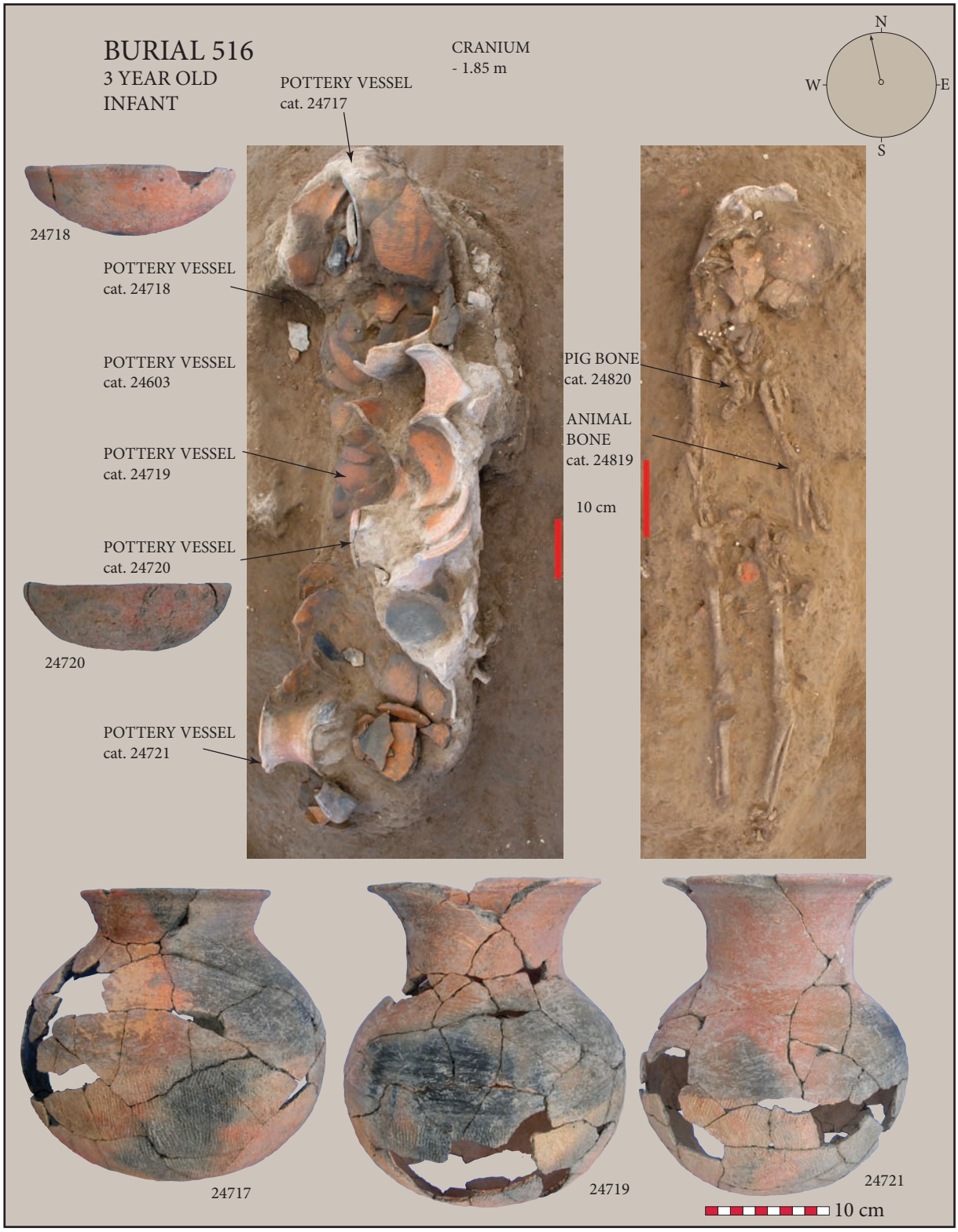


FIG. 11:29 Burial 516

Burial 511 contained the skeleton of a five-year old, orientated with the head 355° from north. The grave lay 1.85 m below datum. Six ceramic vessels were associated, all placed over the skeleton. Five could be reconstructed. There are two respectively of forms 48 and 51, and one of form 45. Pig's rear limb bones were found over the chest area and six fish vertebrae (articulated) were found in and around pot cat. 24717.

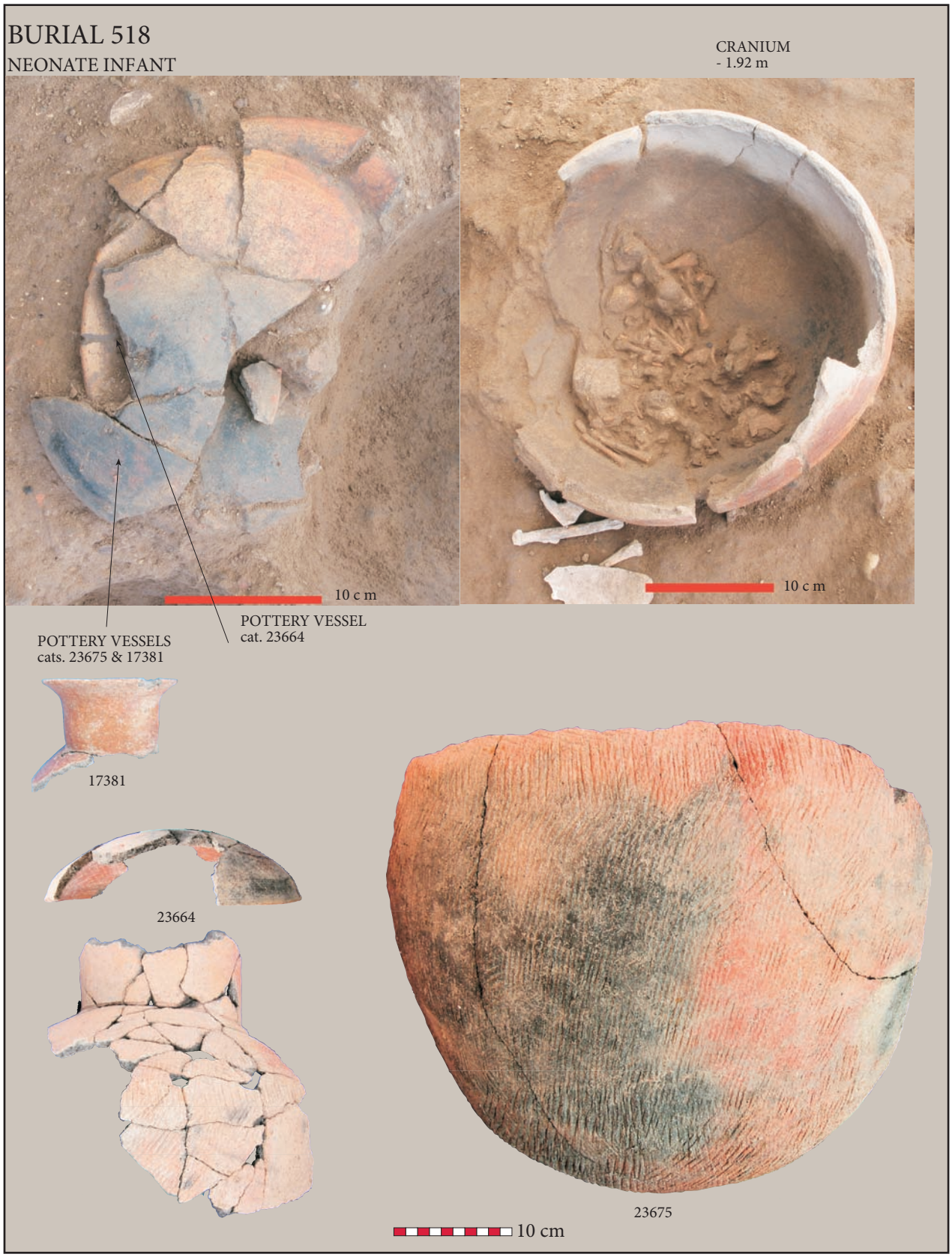


FIG. 11:30 Burial 518

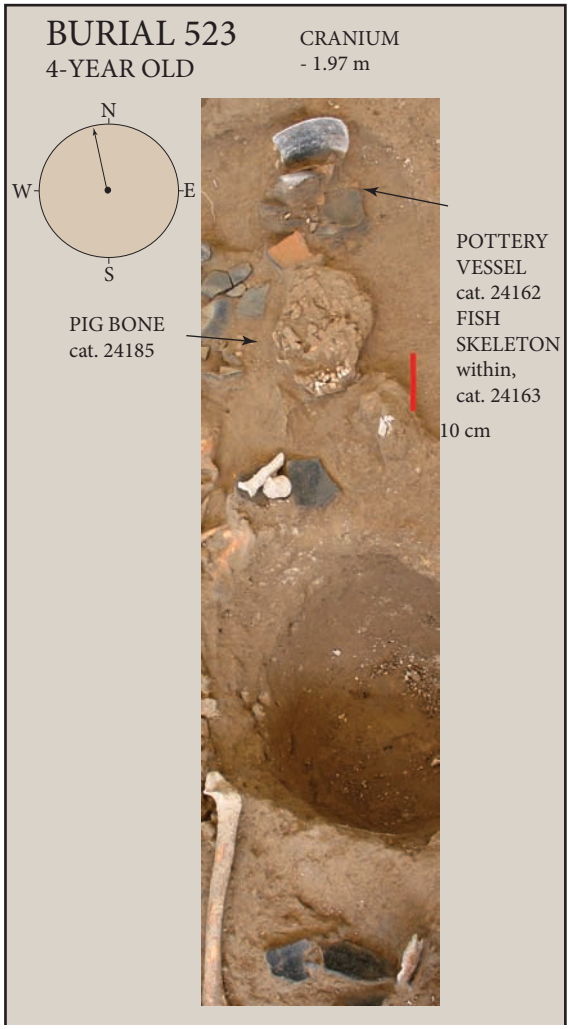


FIG. 11:31 Burial 523

Burial 523 contained the remains of a four-year-old infant, found at a depth of 1.97 m below datum. The body was orientated with the head just to the west of due north. A large pit had been dug in prehistory through the central part of the grave. Two very fragmentary pots were probably associated with this child, one of which contained the complete skeleton of the fish *Channa striata*. Some pig bones were found on the cranium.

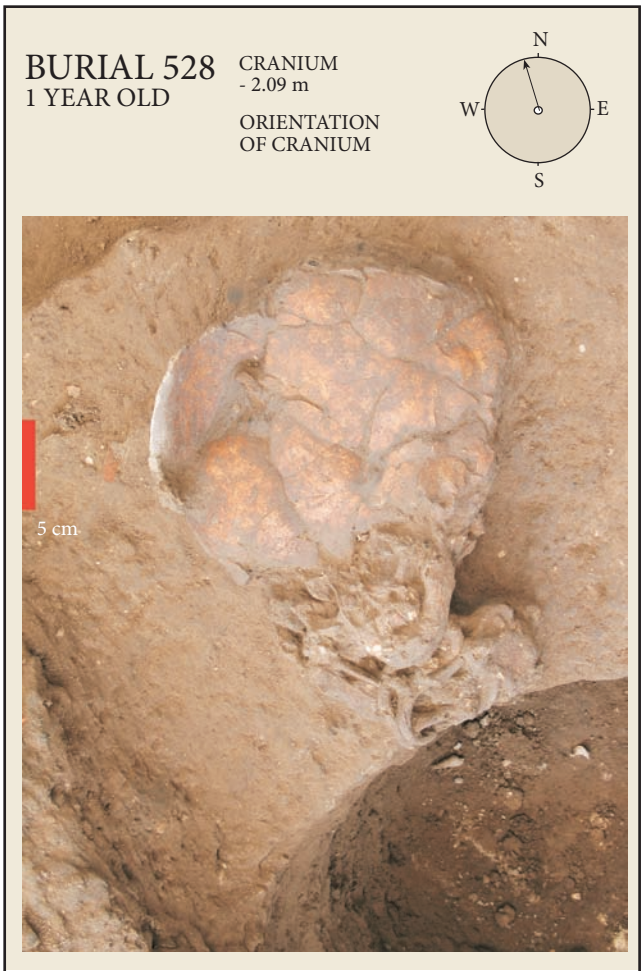


FIG. 11:32 Burial 528

Burial 528 was found at a depth of 2.09. It contained the cranium and upper vertebrae of an infant who died when about a year of age. The lower part of the grave was destroyed when a pit was dug through it in antiquity.

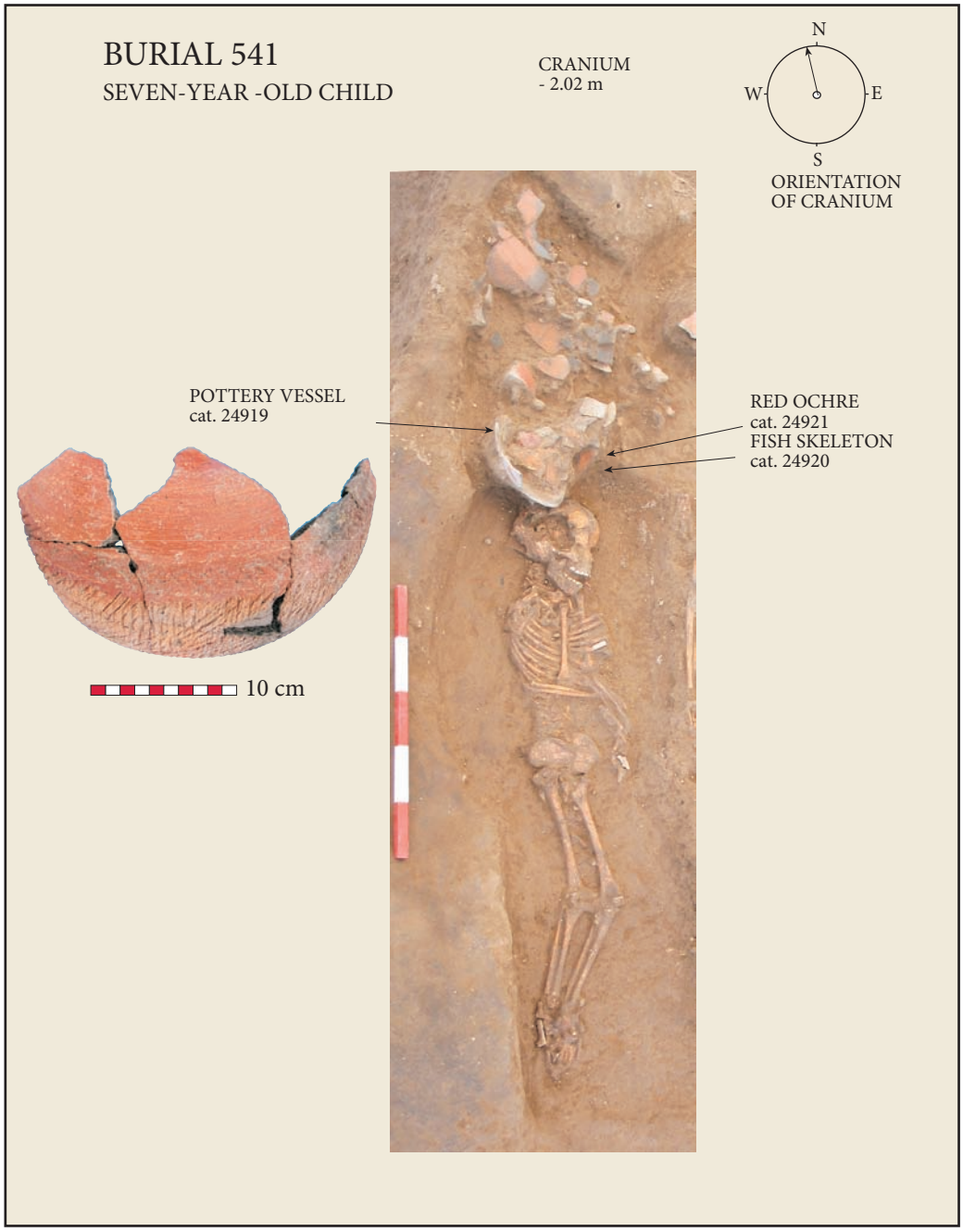


FIG. 11:33 Burial 541

Burial 541 was found at a depth of 2.02 m below datum, and on an orientation of 355° from north. A single poorly-preserved ceramic vessel lay beyond the head, together with some red ochre and the complete skeletons of two *Channa striata* (1 large and 1 small).

XII THE FEMALE BURIALS OF IRON AGE PERIOD 1: SOUTHERN GROUP

C.F.W. HIGHAM

The southern group of burials is distinguished from the Bronze Age 5 graves only by the presence of iron artefacts in some of interments. The western burials are very concentrated and intercut each other but as one progresses to the west, the graves are usually intact and undisturbed. There is a series of burials to the southwest of the main concentration, which are described below as part of the southern group.

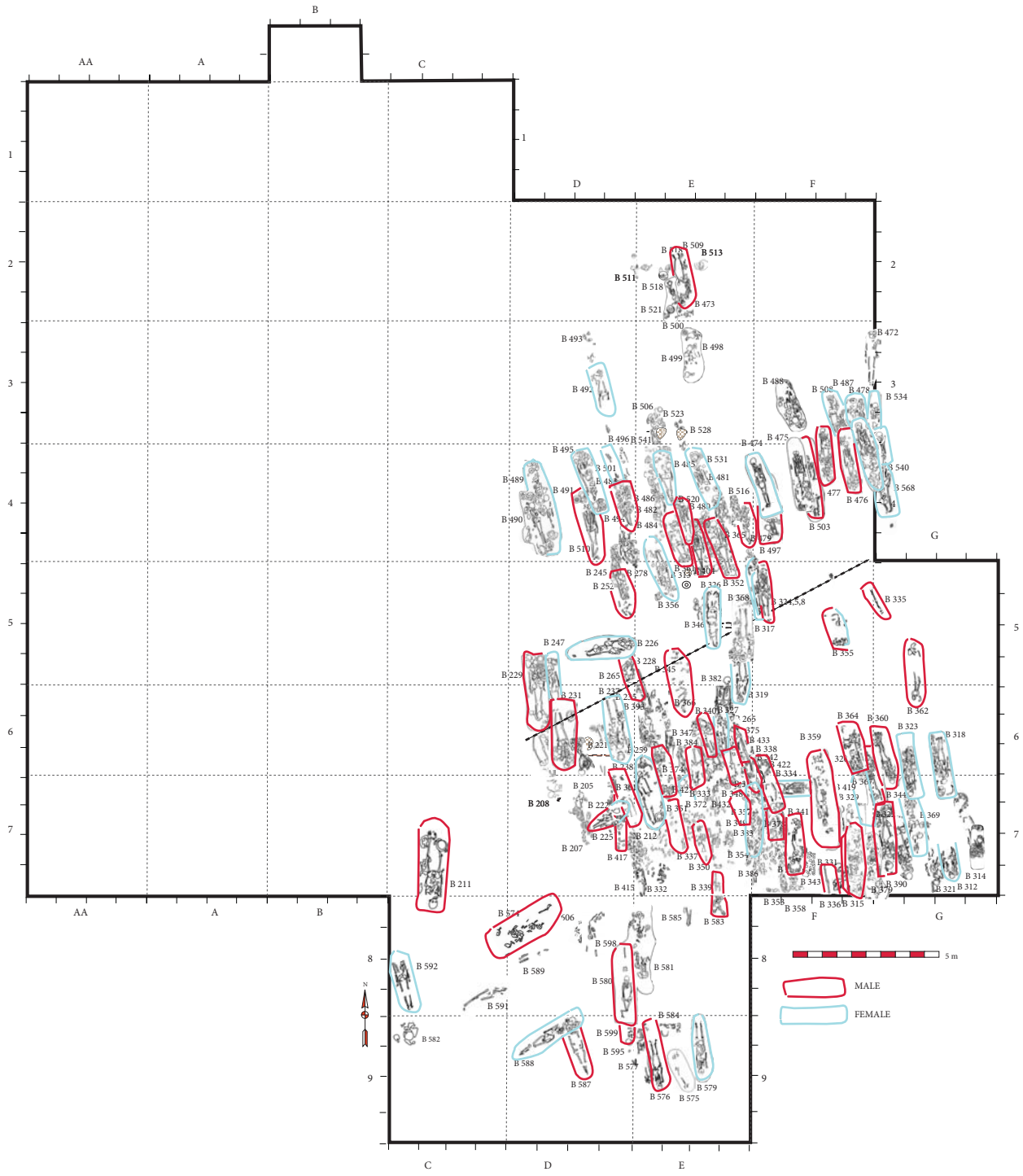


FIG. 12:1 The distribution of Iron Age 1 graves

TABLE 12:1 *The mortuary offerings for Iron Age 1 female burials, southern group*

burial no.	222	237	238	259	312	318	319	322	323	327	334	383	419	427	579	588
age	OA	MA	OA	YA	YA	OA	MO	YA	A	MA	A	MA	YA	OA	MA	MO
orientation0	90°	170°	340°	350°	S	S	S	S	S	S	S	S	S	S	S	60°
sex	F	?F	?F	F	F	F	F	F	F	F	F	F	F	F	?F.	F
depth (metres)	1.98	2.03	1.90	1.60	1.47	1.73	1.53	1.54	1. 79	1. 71	1.98	191	2.04	1.90	1.78	1.98
n pots	0	7	1	4	7	12	3	6	9	5	0	10	0	1	3	2
pot form 41	0	5	1	2	0	0	2	0	0	0	0	0	0	0	0	0
pot form 43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
pot form 45	0	0	0	0	1	3	0	2	1	2	0	1	0	0	1	0
pot form 48	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0
pot form 50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
pot form 51	0	1	0	0	3	5	1	2	2	0	0	3	0	1	2	0
pot form 55	0	0	0	0	3	0	0	2	0	1	0	2	0	0	0	0
pot form 63	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
pot form 64	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
bivalve shell	0	1	0	0	0	1	1	0	2	0	0	2	1	0	0	1
pig bones	0	1	0	0	0	1	0	0	2	0	0	1	0	0	0	1
red ochre	0	0	0	1	0	0	0	2	13	0	0	7	0	0	0	0
spindle whorl	0	0	0	0	1	0	0	2	1	0	0	1	0	0	0	0
fish skeleton	0	0	0	0	2	5	7	4	6	0	0	10	0	0	0	0
buffalo bone	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
dog bone	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
grey clay	0	0	1	0	0	0	0	0	2	0	0	1	0	0	0	0
shell earplug	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
bronze bangle	0	0	0	0	4	0	0	4	0	0	0	0	0	0	0	0
iron object	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
iron chisel	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0
iron knife	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
glass ornament	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
carnelian beads	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
agate bead	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0

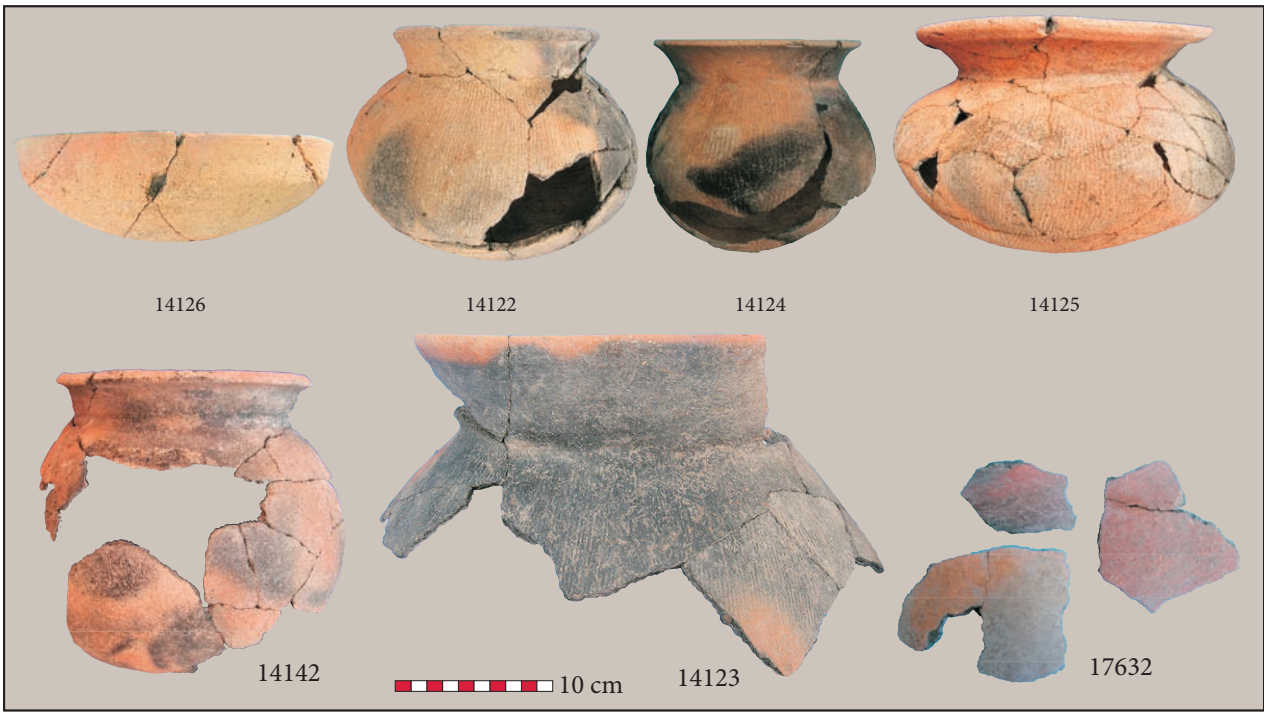


FIG. 12:2 Ceramic vessels from burial 237



FIG. 12:3 Burial 222

Burial 222 was found under burial 212, on an east to west axis. It was heavily disturbed and only the cranium and some upper limb bones survived. Two individuals have been identified, an old adult female and a young adult probable male.

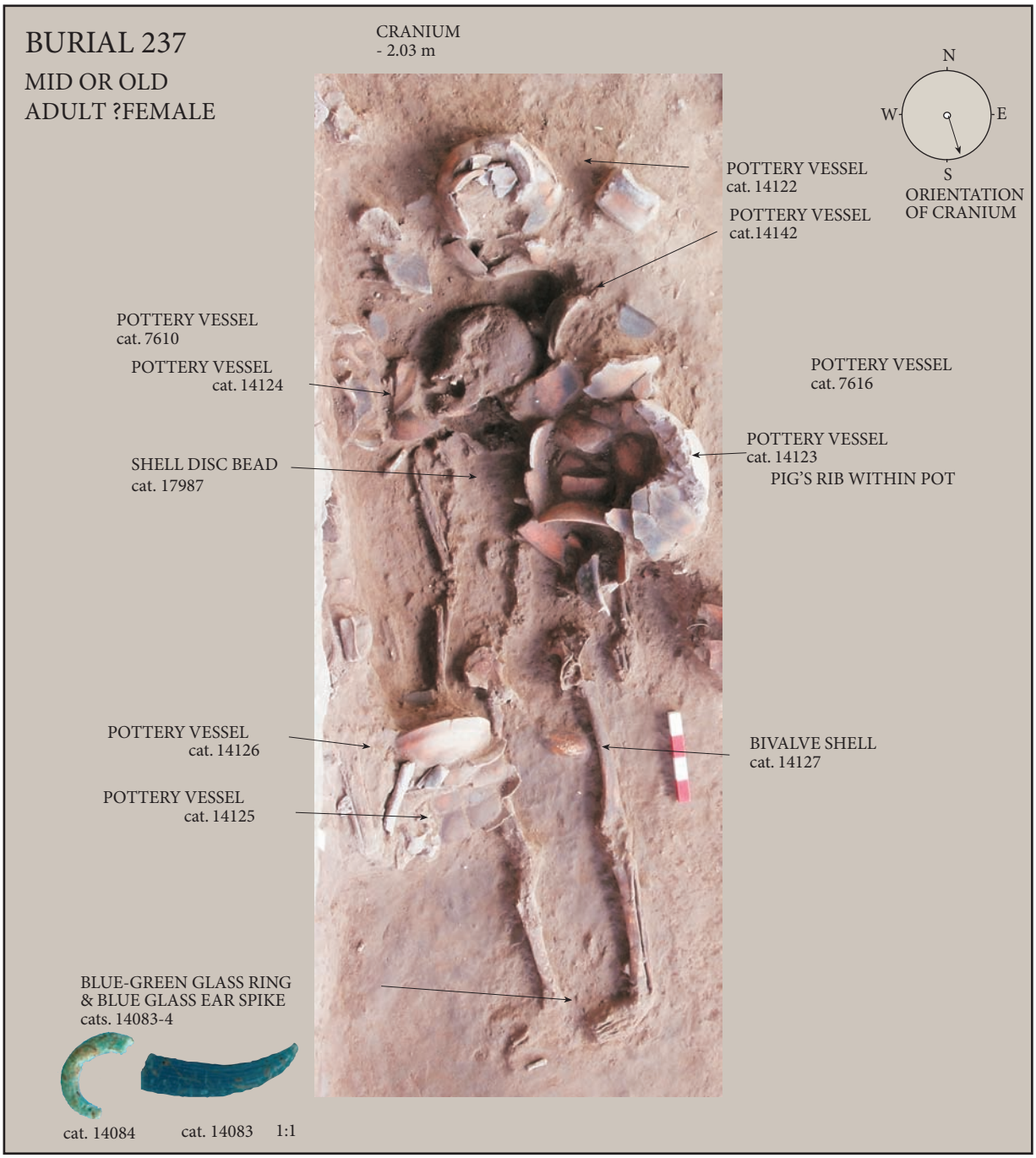


FIG. 12:4 Burial 237

Burial 237 contained the skeleton of a mid-adult ?female at a depth of 2.03 below datum. The grave was orientated with the head to the south, 170° from north. Seven ceramic vessels were positioned beyond the head, to the left of the upper body and over the right hand. Five are cord marked bowls of form 41, while the other is of form 51. A bivalve shell was found between the thighs. A blue-green glass ring and a spike of glsss were found between the ankles and a pig's rib was found in pot cat. 14123.



FIG. 12:5 Burial 238

Burial 238 is poorly preserved and many bones are missing. It lay 1.90 m below datum on an orientation with the head directed 340° from north. One form 41 pot was associated, together with a deposit of grey clay.



FIG. 12:6 Burial 238, showing the cranium and the grey clay next to the left shoulder. Scale 5 cm

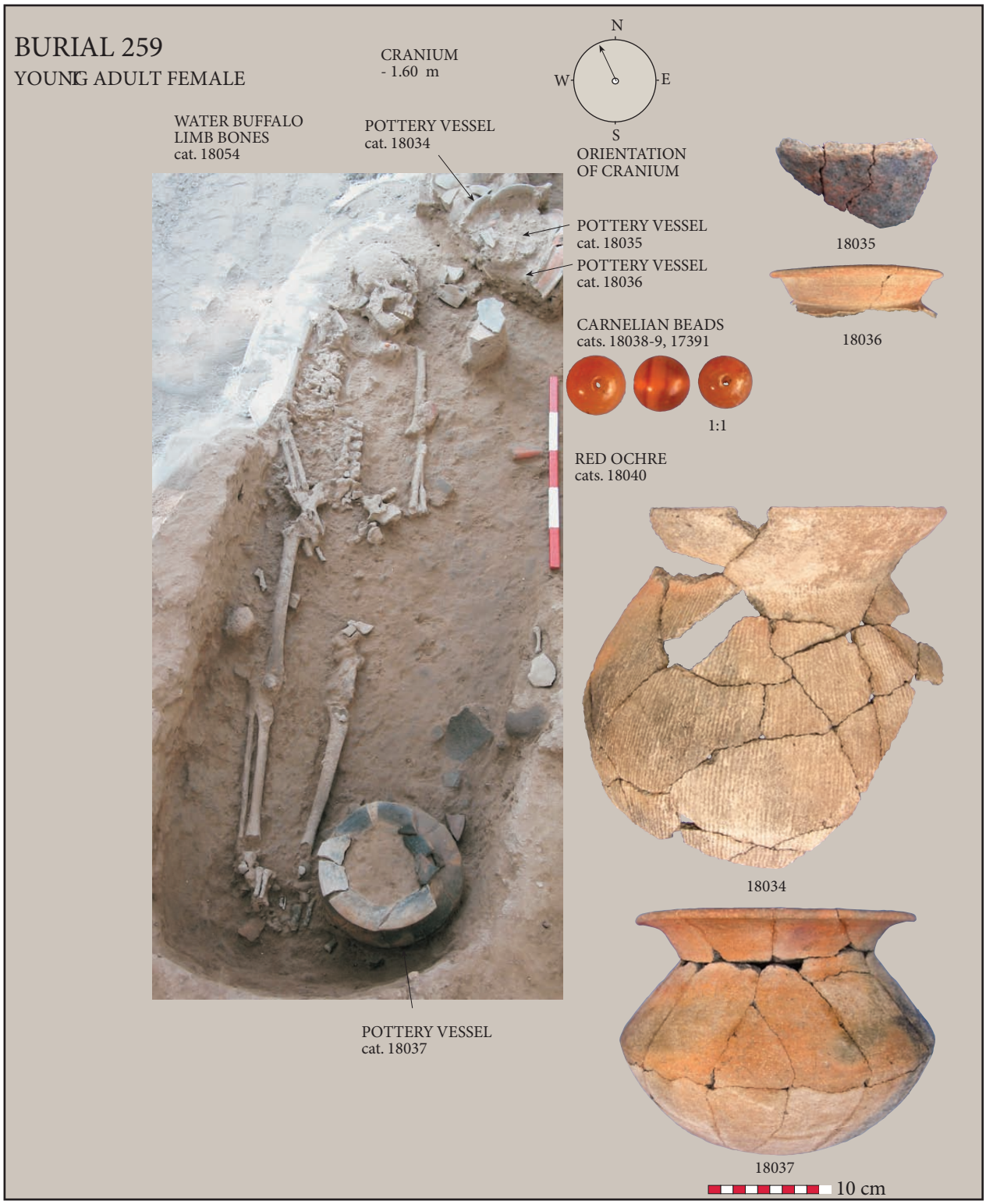


FIG. 12:7 Burial 259

Burial 259 was found at a depth of 1.60 m below datum, on an orientation with the head directed 350° from north. It contained the remains of a young woman. Three pots were found beyond the head and one beyond the feet. Two are of form 41, the others are too fragmentsry to be assigned a form. Three globular carnelian beads were found in the neck area, and articulating water buffalo limb bones were also recovered from this grave.

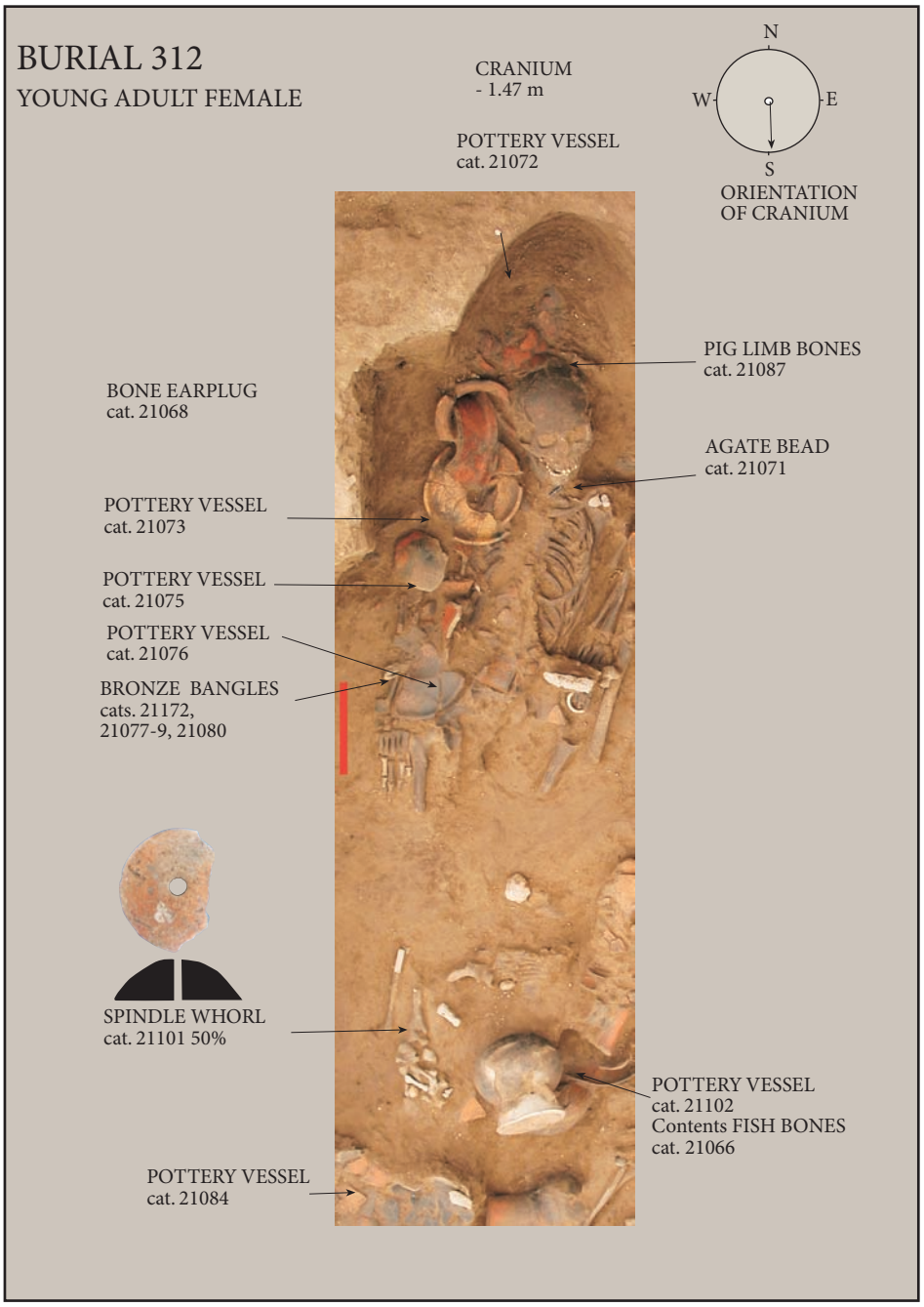


FIG. 12:8 Burial 312

Burial 312 was found at a depth of 1.47 m below datum in a grave with the head of a young woman orientated to the south. Seven pots were found down the right hand side of the skeleton and over the ankles. There are three respectively of forms 51 and 55, and a single form 45. This person wore an agate bead at the neck a bone or shell ear insert to the right of the cranium. Four bronze bangles were found on the right wrist. A spindle whorl had been placed beside the right ankle. Pot cat. 21102 contained the following fish bones: *Clarias* sp. 1 fragment of R temporal; 3 small fragments of cranium; 3 small fragments of cleithrum; 1R pectoral fin spine; *Channa striata* 1R dentary.



FIG. 12:9 Mortuary offerings with burial 312

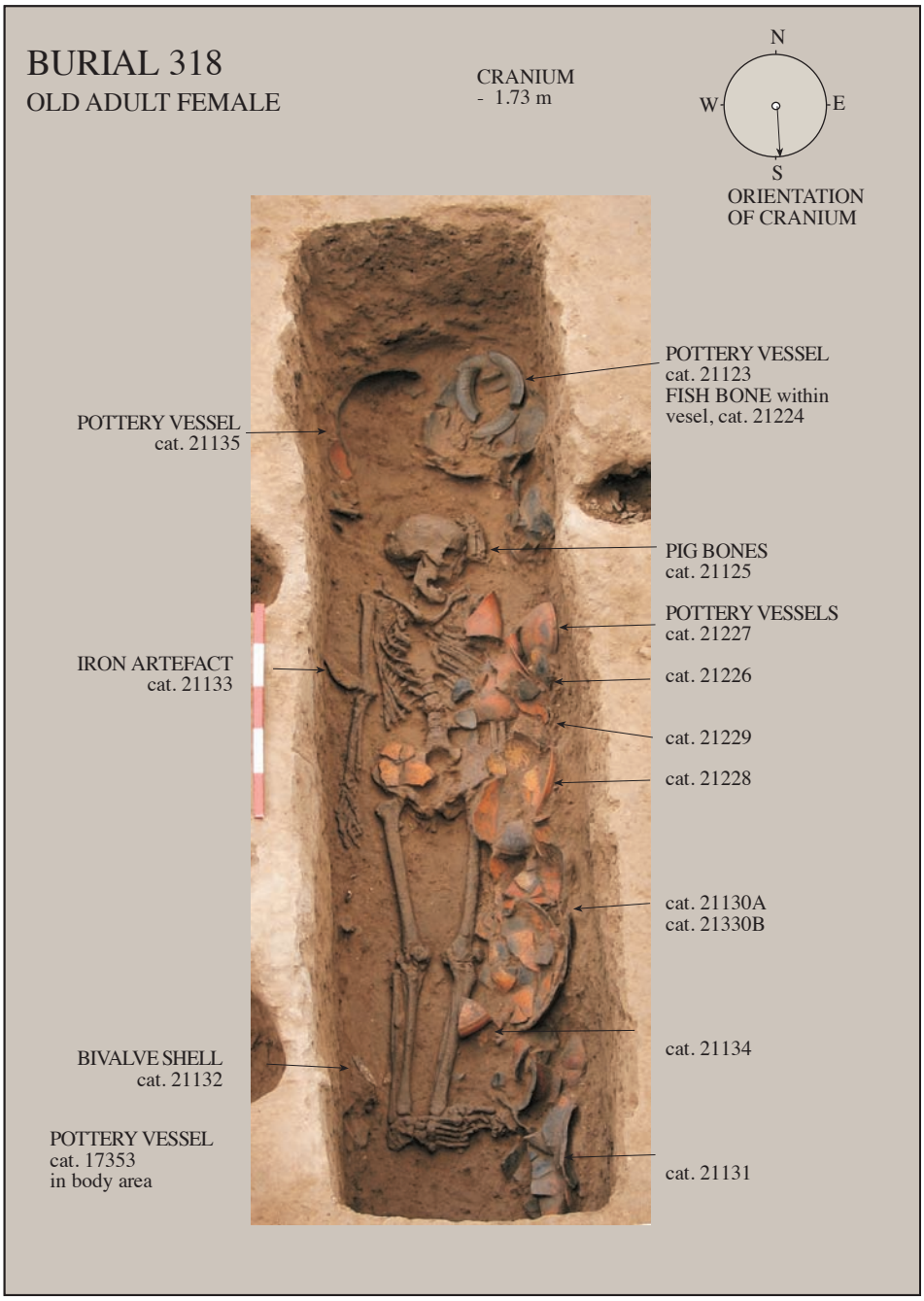


FIG. 12:10 Burial 318

Burial 318 is a complete grave, containing the remains of an adult with the head directed south. The skeleton was found at a depth of 1.73 m below datum. About 12 ceramic vessels were found, disposed beyond the head, down the left hand side of the body and over the pelvis. Five are of form 51, three of form 45 and there is one form 48. The bones of the right fore limb of a pig were found to the left of the head, and there were fish bones in pot cat. 21124 as follows: *Clarias* sp. one fragment of cleithrum; one dermethmoid; *Channa striata* one whole fish (small fish); 1 whole skull (large fish). Pot cat. 21164 contained six fish vertebrae, *Hemibagrus*/*Mystus* one left pectoral fin spine and *Anabas testudineus* one right lower pharyngeal. A bivalve shell was located beside the right ankle and an iron artefact lay by the right elbow.

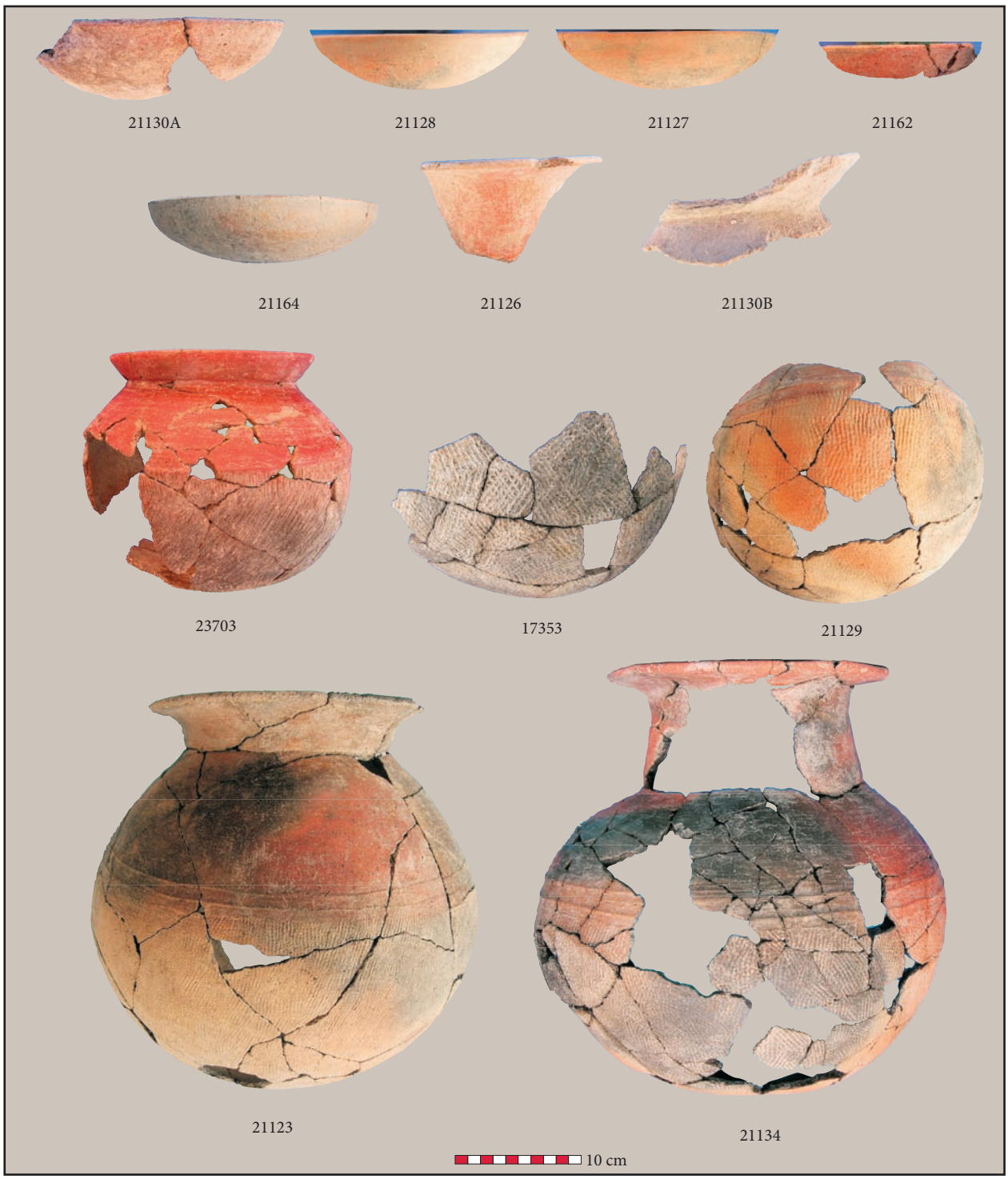


FIG. 12:11 Ceramic vessels from burial 318

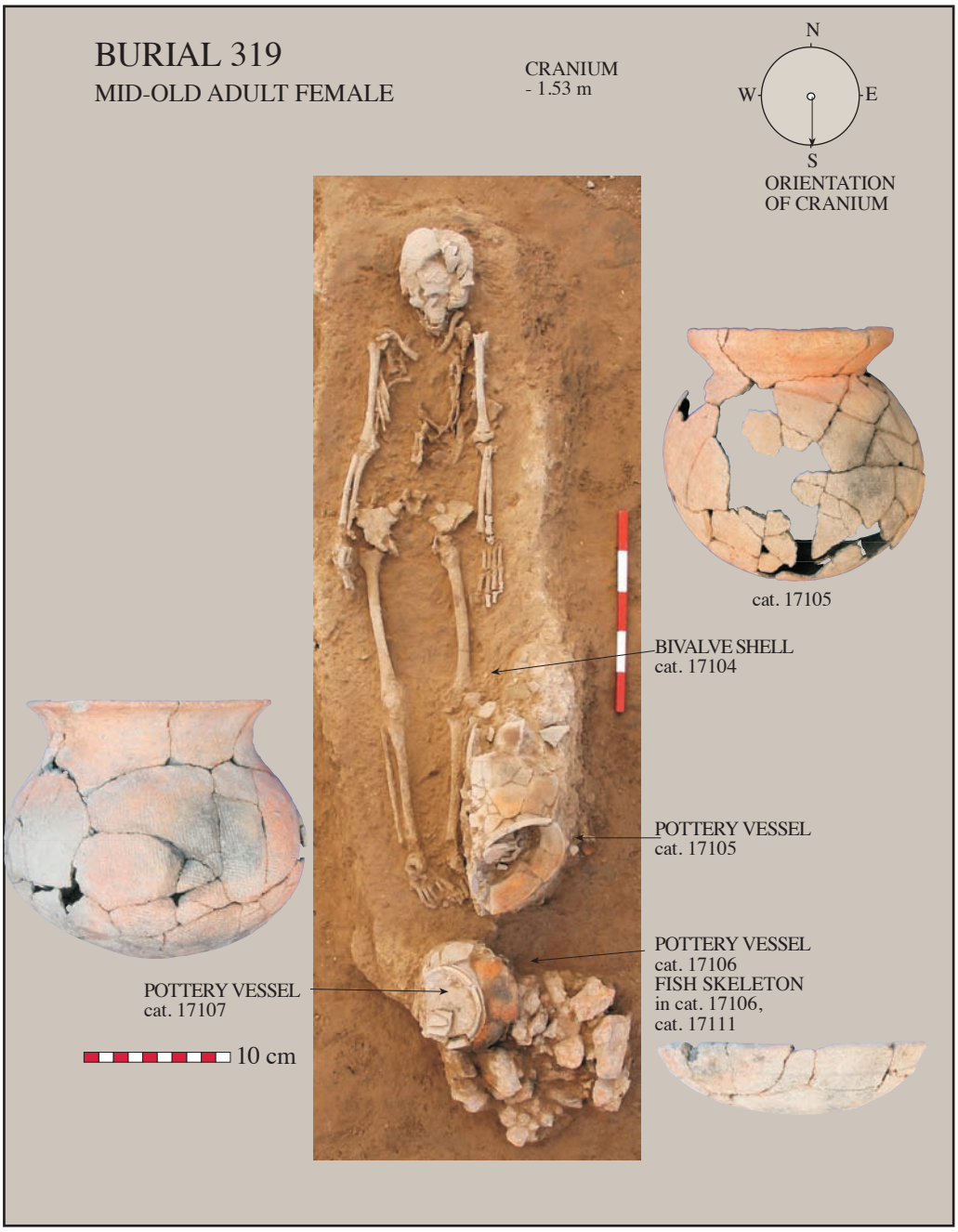


FIG. 12:12 Burial 319

Burial 319, that of an older woman, was found at a depth of 1.53 m, with the body orientated with the head directed to the south. Three pots were found beside and beyond the ankles, two of form 41 and one of form 51. Pot cat. 12105 contained five fish vertebrae and two right pectoral fin spines and six skull fragments of *Clarias* sp., a pectoral fin spine of *Hemibagrus*/*Mystus*, one pectoral fin spine of *Ompok*/*Wallago*, a right frontal, post temporal and articular bone of *Anabas testudineus* and a right palatine and left maxilla of *Channa striata*. Pot cat. 17106 contained the left supraorbital of *Clarias* sp. and the complete skeleton of *Channa striata*. A bivalve shell was present beside the left knee.

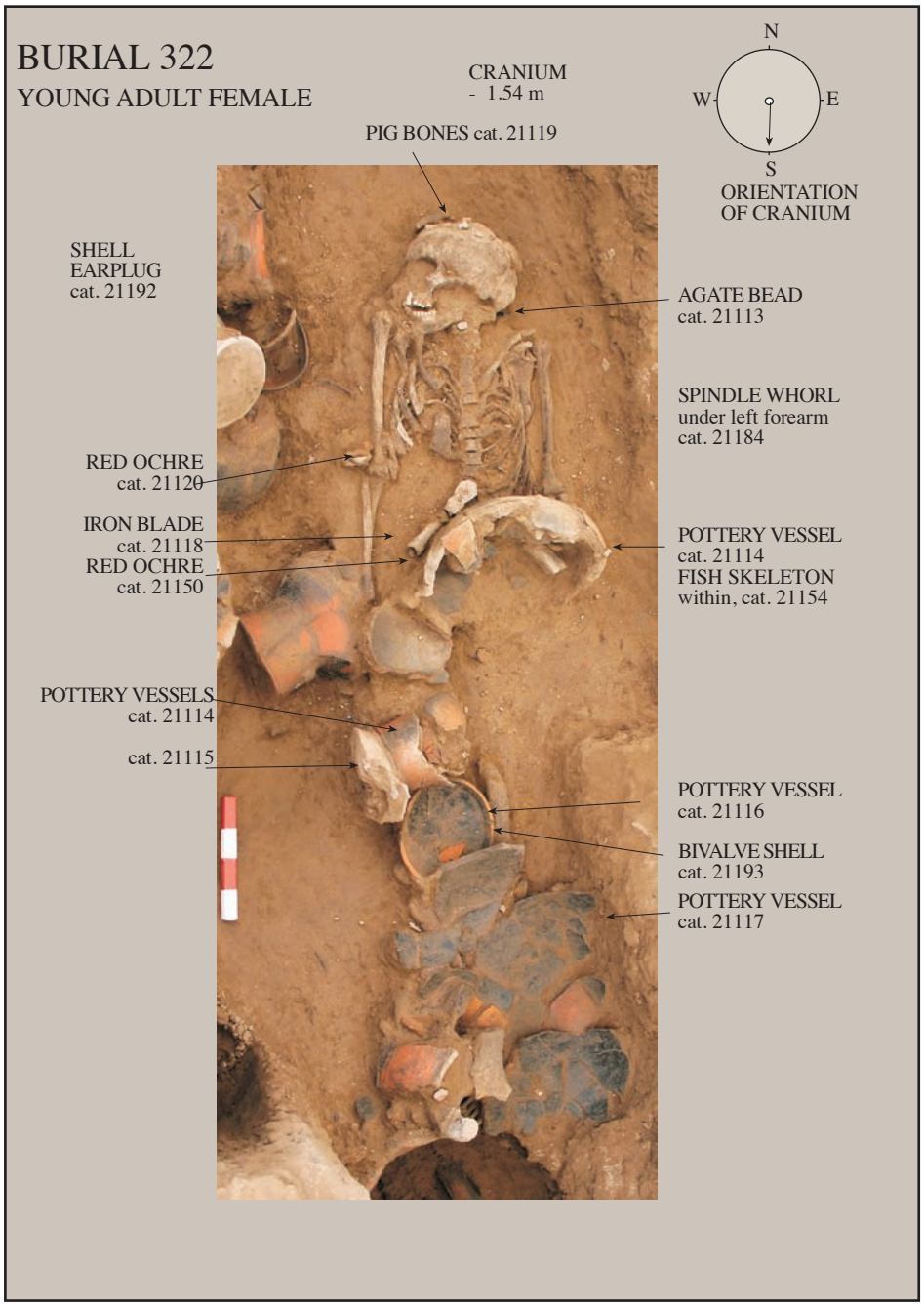


FIG. 12:13 Burial 322

Burial 322 was found at a depth of 1.54 m below datum, in a grave with the head directed to the south. The grave is complete and undisturbed. Pottery vessels lay over the lower part of the body. There are two each of forms 51, 45 and 55. This person wore an agate bead at the neck, and a shell earplug was found to the right of the head. Two deposits of red ochre were uncovered, one by the right elbow and the other over the abdomen. The remains of five fish were contained within pot cat. 21114 as follows: seven fish vertebrae, *Clarias* sp. 2L pectoral fin spine, *Hemibagrus nemurus* 1R pectoral fin spine, *Anabas testudineus* 1L preopercular; 1L frontal bone and *Channa striata* 1 whole skull. A socketed iron chisel was positioned over the abdomen. Two spindle whorls were found, one by the right elbow, the other under the left forearm.



FIG. 12:14 Mortuary offerings with burial 322

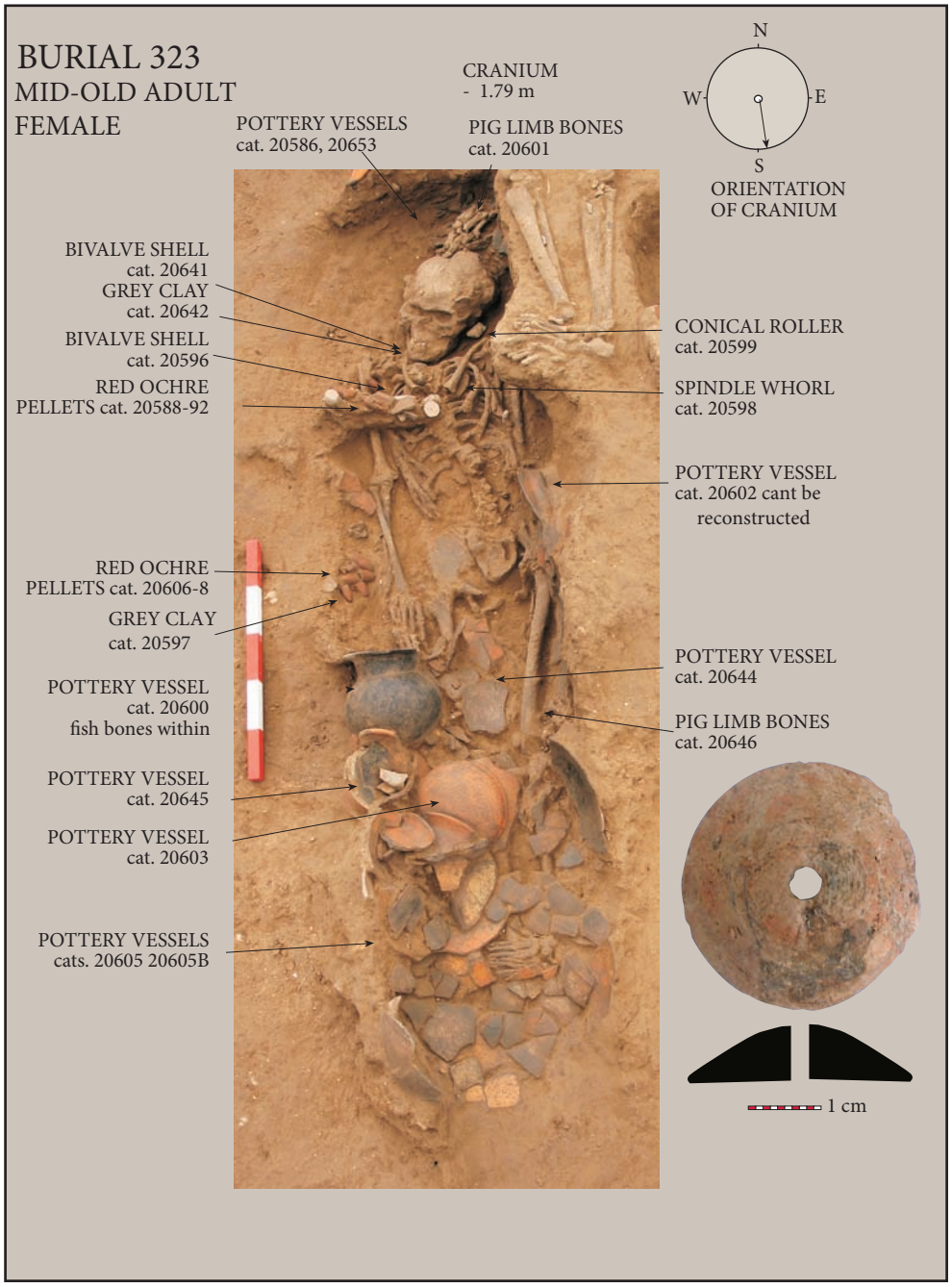


FIG. 12:15 Burial 323

Burial 323 involves a mid to old probable female, interred at a depth of 1.79 m with the head orientated to the south. The grave is relatively narrow and the ceramic vessels associated, of which there are about nine, line the edge as if constrained within a rounded coffin. There are two pots of form 51, three of form 48 and a single example of forms 45 and 63. This woman was accompanied by a relatively rich set of mortuary goods. There is a spindle whorl, seven pellets of red ochre and two bivalve shells over the chest, and two deposits of grey clay, one on one of the bivalve shells and the other by by the lower right arm. Six pellets of red ochre were also found in this part of the grave. Pig's limb bones had been placed beside the left hand and the bones of the right fore limb beyond the head. Pot cat. 20600 contained: *Clarias* sp. a fragment of neurocranium; *Monopterus albus* one right dentary and *Anabas testudineus*, a fragment of skull. Fish bone from under the lid pot cat. 20603 (cat. 20651) comprised nine fish vertebrae, *Clarias macrocephalus* one whole skull and*Channa striata* one whole skull. A further skull of *Channa striata* lay to the left of the legs.

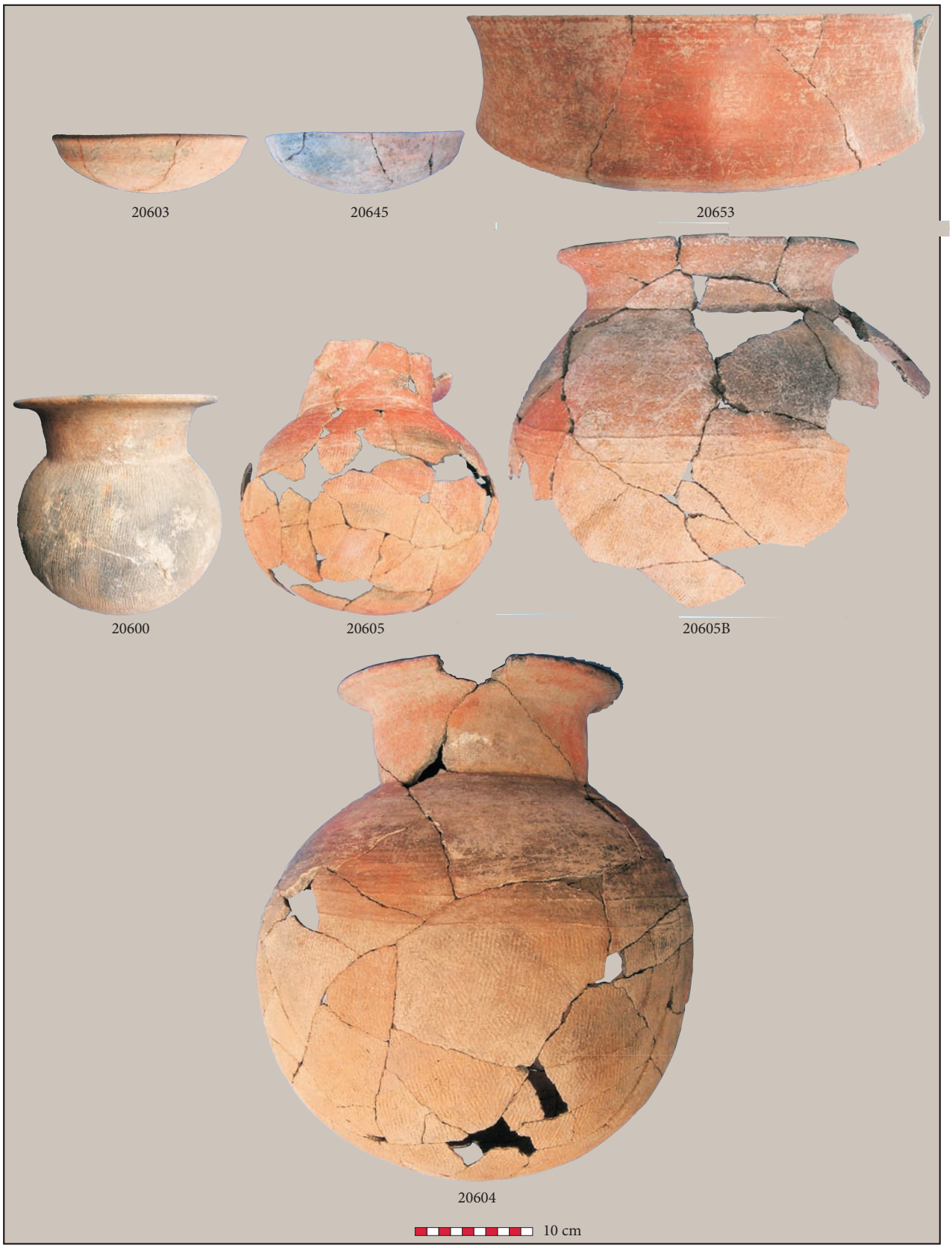


FIG. 12:16 Ceramic vessels from burial 323

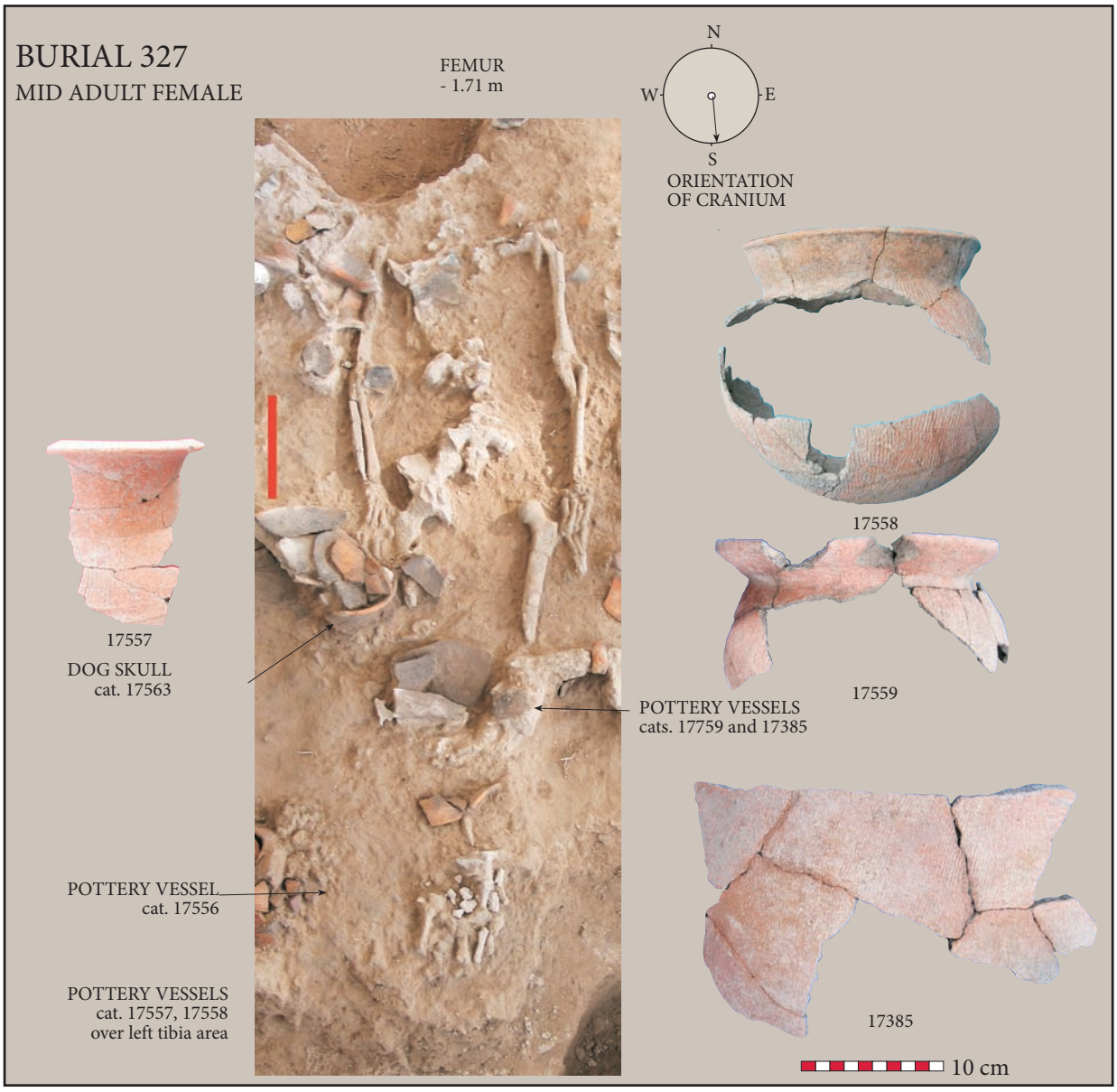


FIG. 12:17 Burial 327

Burial 327, that of a mid adult female, was disturbed in prehistory and the cranium is missing. It was found at a depth of 1.71 m and orientated with the head to the south. Five ceramic vessels werefound in association, one of which is possibly of form 55 and other two of form 45. A dog's skull lay beside the right hand.



FIG. 12:18 Burial 334

Burial 334 contained the skeleton of a young adult woman interred on a virtually unique orientation for this period with the head orientated to the east It may well be that the superposition of other burials over the head and foot areas of this grave disturbed any mortuary offerings. Just one dog bone was found in the ankle area.



FIG. 12:19 Burial 419

Burial 419 contained the skeleton of a young adult woman interred with the head orientated to the south. The arms were crossed over the abdomen. One bivalve shell was found, next to the right arm.

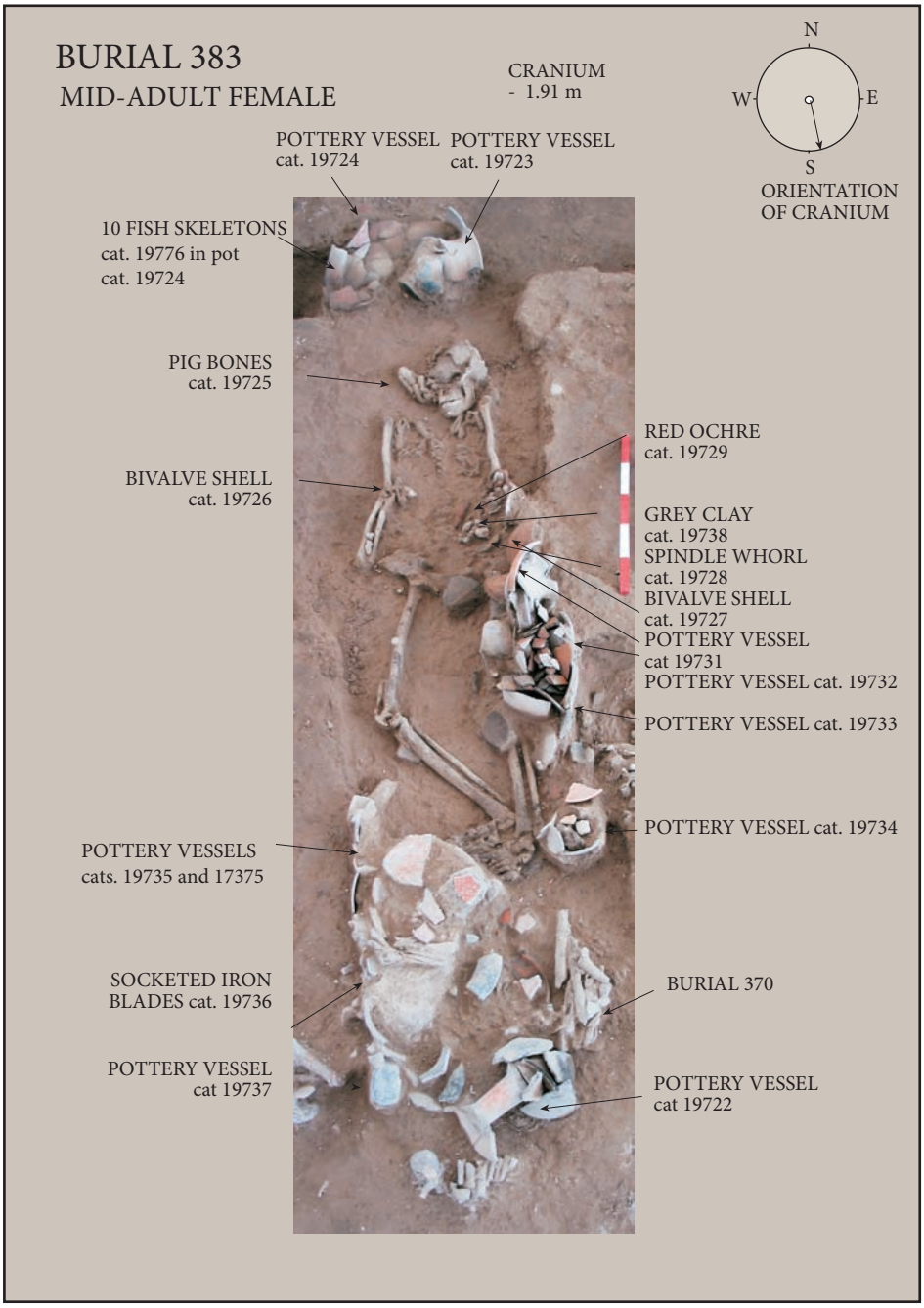


FIG. 12:20 Burial 383

Burial 383 contained the skeleton of a mid-adult female, interred at a depth of 1.91 m below datum with the head directed to the south. At least 10 pots were found in association, beyond the head, down the left hand side of the body and beyond the feet. They include the unique form 64, raised on a high pedestal, and single examples of forms 45 and 50. There are also two of form 55 and three of form 51. Beyond the feet, there was a set of at least seven iron tools, thin bladed and looking like chisels and knives, all contained within a woven bag. Pig's limb bones were identified beyond the skull, and seven red ochre pellets were found over the left hand, alongside a deposit of grey clay and a spindle whorl. There were two bivalve shells, one by the left hand and the other beside the right elbow. Ten fish skeletons were found in pot 19724 beyond the head. They comprise: seven *Channa striata,* one *Channa lucius*, one *Clarias* sp. and one *Hemibagrus/Mystus*.



FIG. 12:21 Mortuary offerings with burial 383

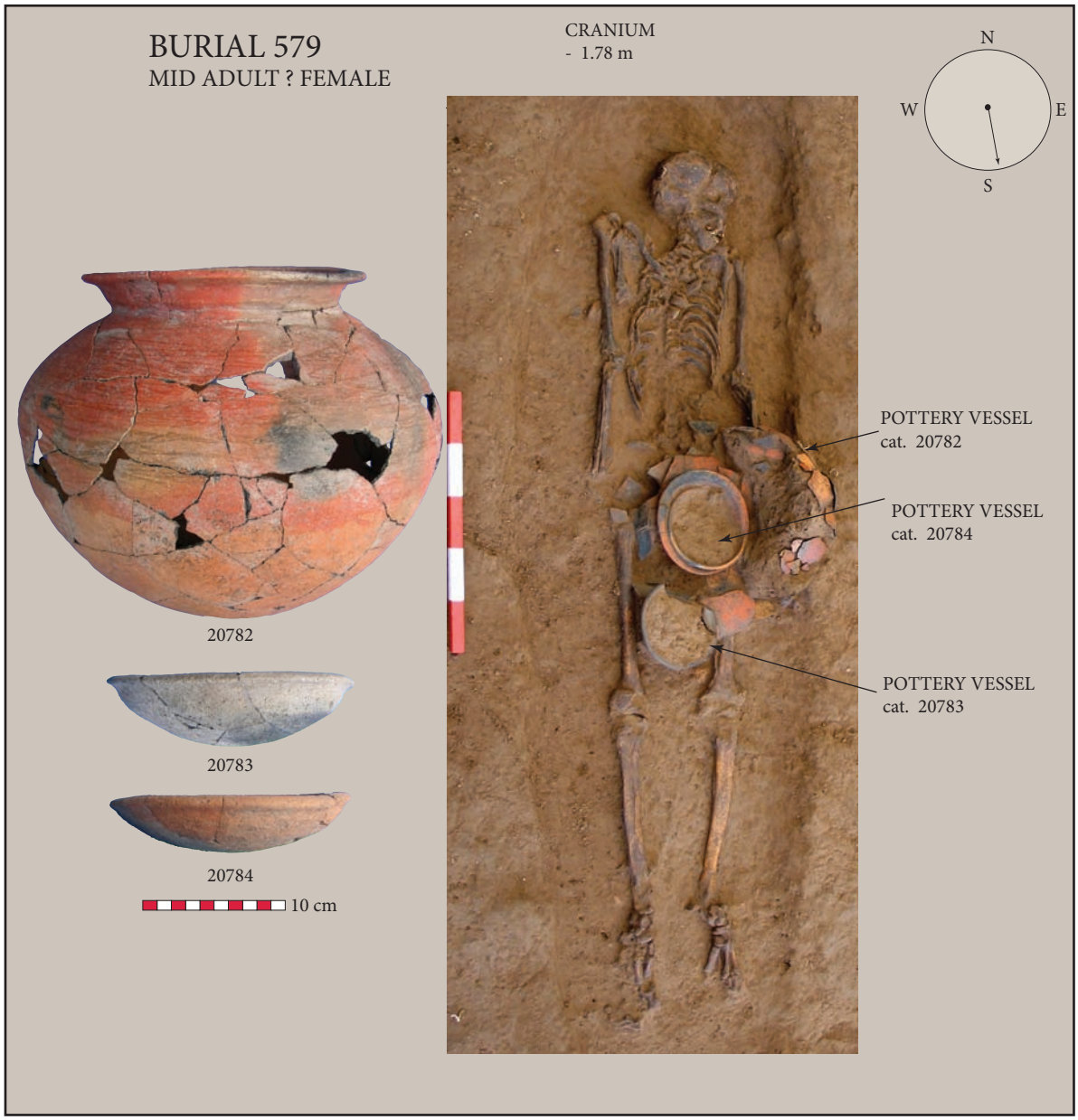


FIG. 12:22 Burial 579

Burial 579 was located at a depth of 1.78 m below datum. The grave was orientated with the head 170° from north. Thee pots were found over the abdomen, two of form 51 and the other of form 45.

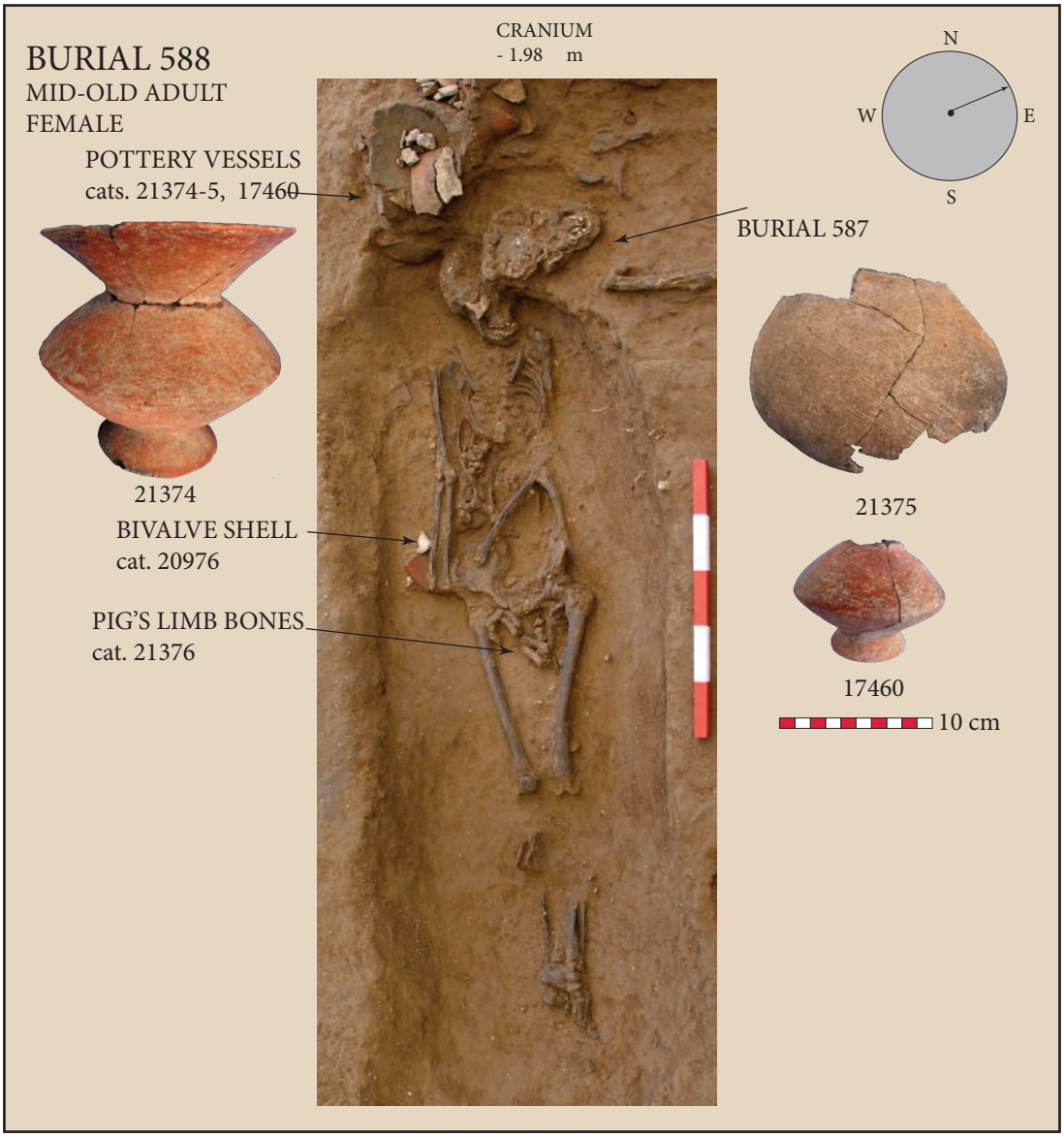


FIG. 12:23 Burial 588

Burial 588 lay adjacent to burial 587, the heads touching each other. It contained the skeleton of a mid to old woman, interred at a depth of 1.98m below datum and orientated with the head 60° east of north. Two pots of form 43 and one indeterminate vessel were found by head, while pig's limb bones were located between the thighs. A bivalve shell had been placed beside the right arm.



FIG. 12:24 Burial 592

Burial 592 contained a young woman found in a relatively complete condition although a pit had been dug through the knee area and the head is missing. It was found at a depth of 2.08 m below datum and orientatated 340° from north.

XIII THE MALE BURIALS OF IRON AGE PERIOD 1: SOUTHERN GROUP

C.F.W. HIGHAM

The southern group of burials is distinguished from the Bronze Age 5 graves only by the presence of iron artefacts in some of interments. The western burials are very concentrated and intercut each other but as one progresses to the west, the graves are usually intact and undisturbed. There is a series of burials to the southwest of the main concentration, which are described below as part of the southern group.

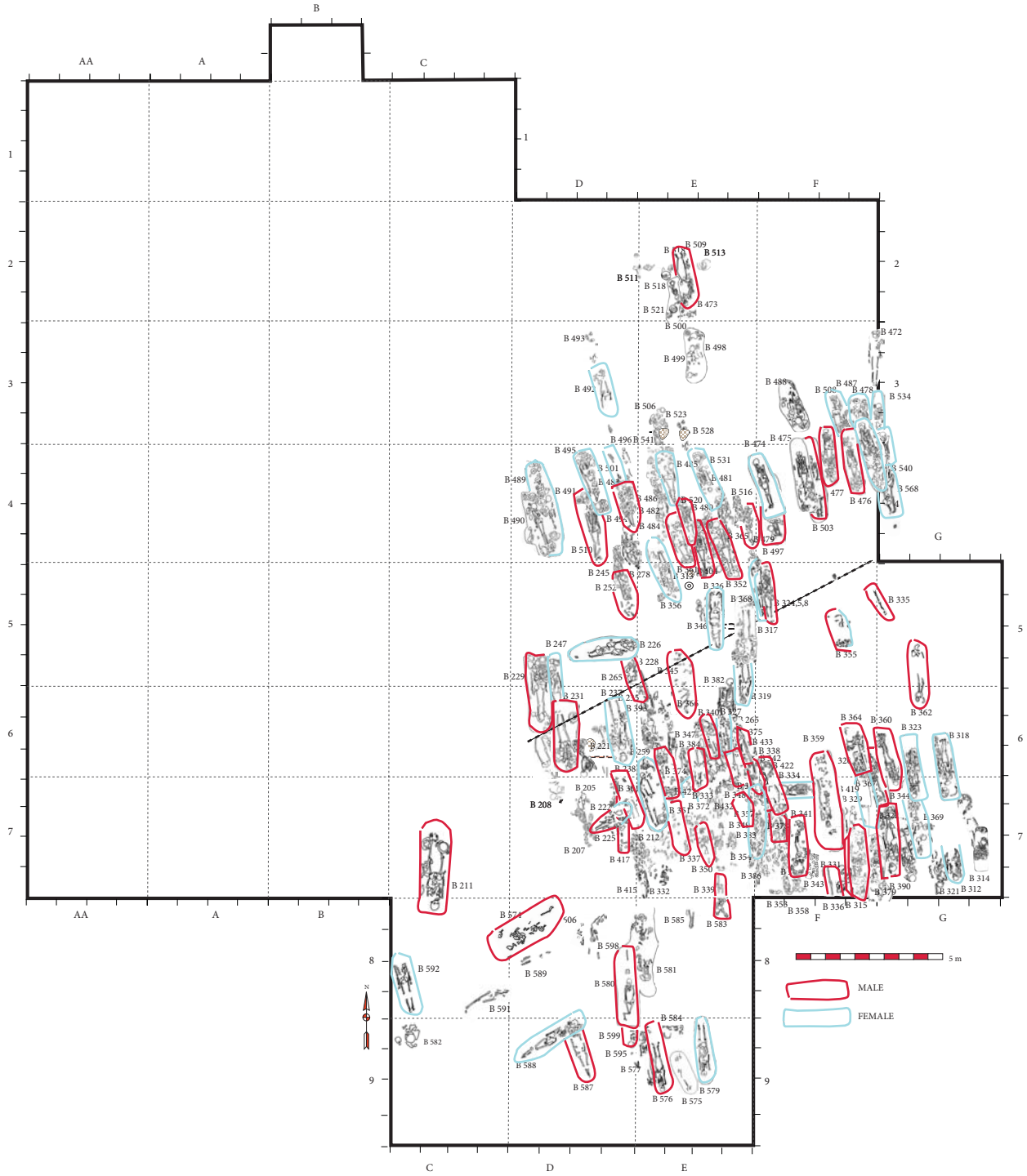


FIG. 13:1 The distribution of Iron Age 1 graves

TABLE 13:1 *The mortuary offerings for Iron Age 1 male burials, southern group*

burial no.	211	212	222:1	228	231	265	315	320	330	333	335	337	338	340	341	345	348
age	MO	YA	AYA	MA	MA	YA	OA	YMA	A	MA	A	MO	A	A	MA	YA	Y-MA
orientation	S	170°	90°		340°	170°	S	S	160°	170°	140°	S	S	S	170°	S	S
sex	?M	?M	?M	M	M	M	M	M	?M	M	M	M	?M	?M	?M	?M	M
depth (metres)	2.13	1.96	1.98	1.31	1.99	1.62	1,82	1.71	1.68	1. 61	1.68	1.76	1.90	1.63	1.86	1.65	1.78
n pots	9	2	0	6	3	15	8	6	4	8	0	0	4	4	7	0	5
pot form 5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
pot form 34	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
pot form 41	3	0	0	3	1	3	0	2	0	0	0	0	0	0	0	0	0
pot form 43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
pot form 45	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0
pot form 48	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
pot form 51	2	1	0	1	1	6	3	2	2	3	0	0	1	2	2	0	2
pot form 55	0	0	0	0	0	1	2	1	0	0	0	0	1	1	2	0	0
pot form 57	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
pot form 58	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
pot form 61	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
bivalve shell	0	0	0	0	0	0	0	1	3	1	0	0	0	0	1	0	0
pig bones	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
red ochre	0	0	0	0	0	0	0	2	0	3	0	0	0	1	13	0	1
spindle whorl	0	0	0	0	0	0	0	0	0	1	0	0	1	0	3	0	0
glass earring	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bos bone	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
buffalo bone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
fish skeleton	2	1	0	2	0	2	2	0	0	0	0	0	3	3	4	0	0
dog bone	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
grey clay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
shell bangle	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0
bronze bangle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
iron object	3	0	0	0	1	0	1	0	0	0	0	0	0	0	4	4	3
iron hoe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
iron knife	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
iron spear	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
iron billhook	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
lead tool	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
iron chisel	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
iron point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
crucible	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 13:1 *The mortuary offerings for Iron Age 1 male burials, southern group* (cont.)

burial no.	350	351	357	360	362	364	367	374	378	379	386	390	417	433	574	576	580	587
age	A	A	YA	MA	OA	YA	YA	Adol.	MOA	A	YA	MA	A	YA	A	MA	MO	YA
orientation	S	355º	S	160º	N	170º	S	S	S	S	S	S	S	S	SW	170º	355º	340º
sex	?M	M	M	M	M	M	?M	?M	M	?M	?M	M	M	?M	?M	?M	M	?M
depth (metres)	1.91	1.84	1.80	1.70	1.94	2.48	1. 71	1.78	1.84	1.87	1.80	1.85	1.89	1.99	1.25	1.49	1.92	1.90
n pots	2	2	7	6	3	7	6	1	10	6	6	6	3	1	4	0	1	2
pot form 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
pot form 41	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
pot form 44	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
pot form 45	0	0	1	0	1	1	0	0	1	1	1	3	0	0	0	0	0	1
pot form 48	0	0	0	0	0	0	1	0	2	2	0	0	1	0	0	0	0	0
pot form 51	0	1	3	3	0	2	1	0	4	3	2	1	0	0	2	0	0	0
pot form 55	0	0	2	2	1	1	1	0	1	0	0	2	0	0	0	0	0	0
pot form 56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
pot form 60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
pot form 61	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 70	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
pot form 72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
bivalve shell	1	0	0	1	0	2	0	0	1	0	1	1	0	0	0	0	1	0
pig bones	0	0	0	0	0	1	0	0	2	0	0	2	0	1	0	0	0	0
red ochre	0	1	1	1	0	3	2	1	2	1	0	11	1	0	0	0	1	0
spindle whorl	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0
glass earring	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bos bone	0	0	0	0	0	0	0	0	4	1	0	1	0	0	1	0	0	0
fish skeleton	0	0	0	5	7	0	1	0	4	16	0	0	0	0	0	0	0	0
buffalo bone	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
grey clay	0	0	0	0	0	1	1	1	0	1	0	1	0	0	0	0	0	1
shell bangle	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
bronze ring	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bronze anklet	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bronze/iron spear	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
iron object	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
iron knives	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
iron spear	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0
iron billhook	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
lead tool	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
iron chisel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
iron point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

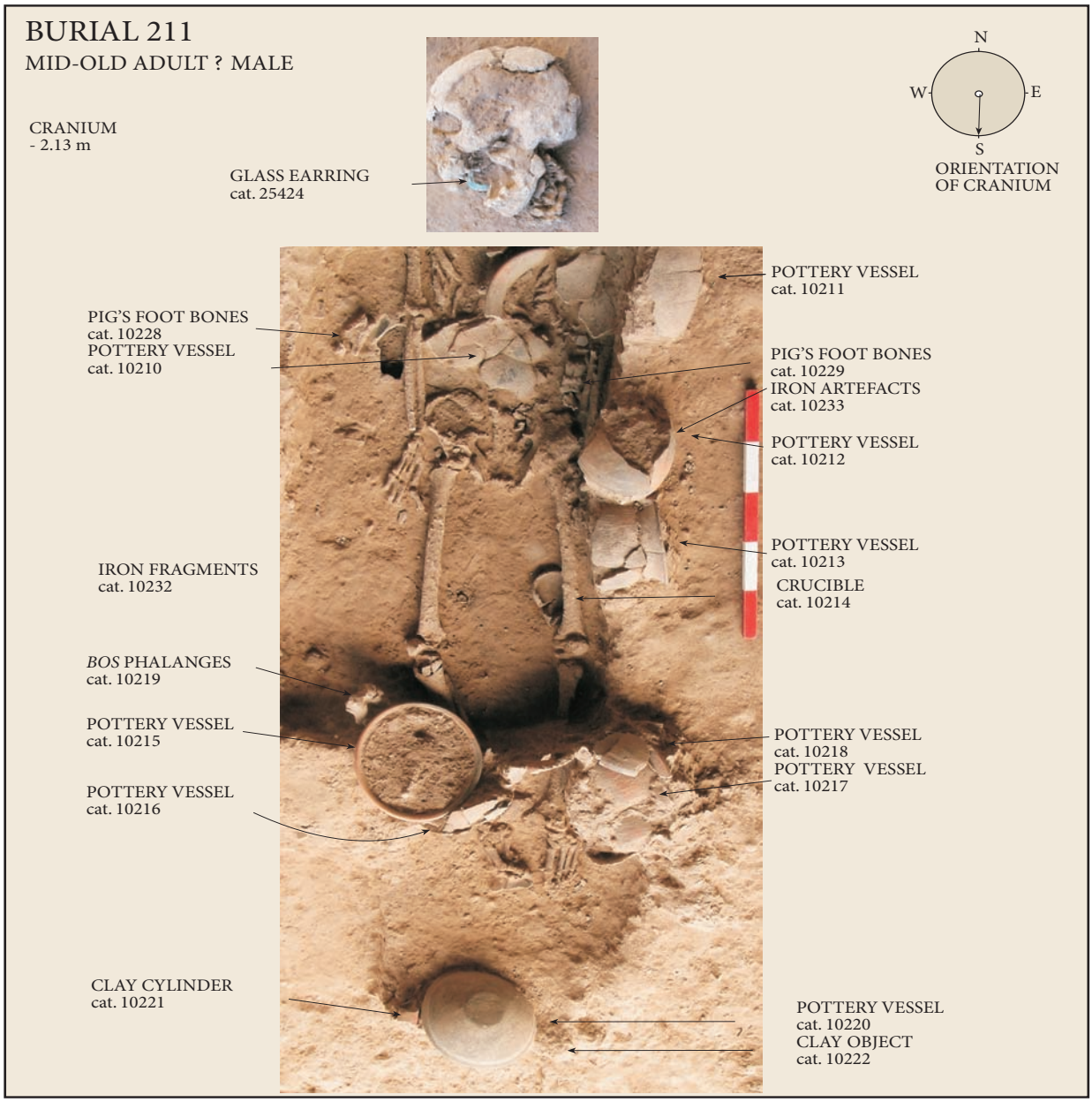


FIG. 13:2 Burial 211

Burial 211 was found at a depth of 2.13 m below datum, and orientated with the head to the south. It is isolated from other Iron Age burials. Eight or nine ceramic vessels were recovered from this grave of which six could be reconstructed. Three are of form 41 and two form 51. Pot cat. 10217 contained fish bones: *Monopterus albus* 1L articular; 1L supracleithrum and *Channa striata* 1L lower pharyngeal; 1R premaxilla. The bones of the right fore limb of a pig were found beside the left arm, with a second set of foot bones by the right arm. The first and second phalanges of *Bos* were also present, under the pot by the right ankle. A complete crucible was found under the left femur. This individual was also accompanied by three placements of thin iron objects of a sort that in other burials comprised blades and points. one set was found between the femora, another beside the left forearm and a third on the right femur. Three years after the excavation of this grave, an extension of the excavated area to the south uncovered the cranium. This person wore a blue glass earring on the right ear.

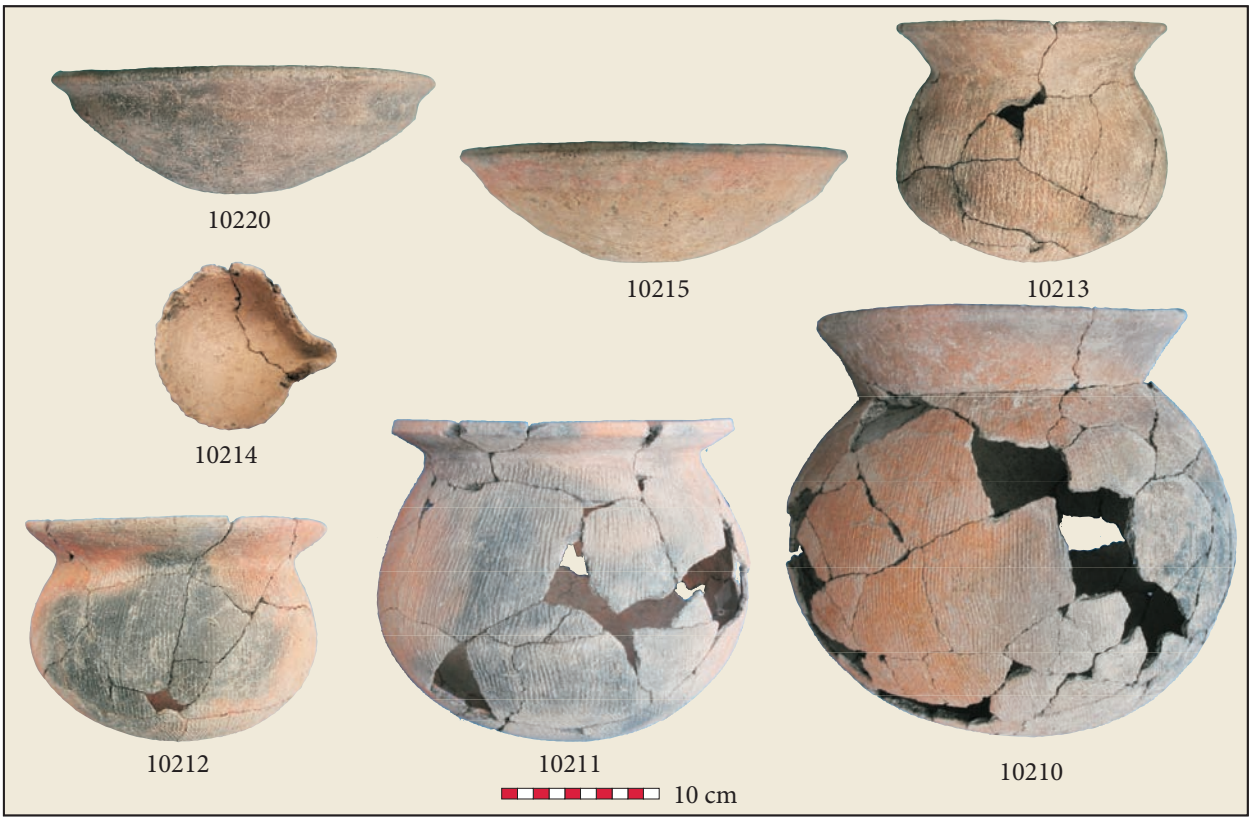


FIG. 13:3 The ceramic vessels from burial 211



FIG. 13:4 Burial 211 showing the crucible and iron tools by the left arm. Scale 10 cm

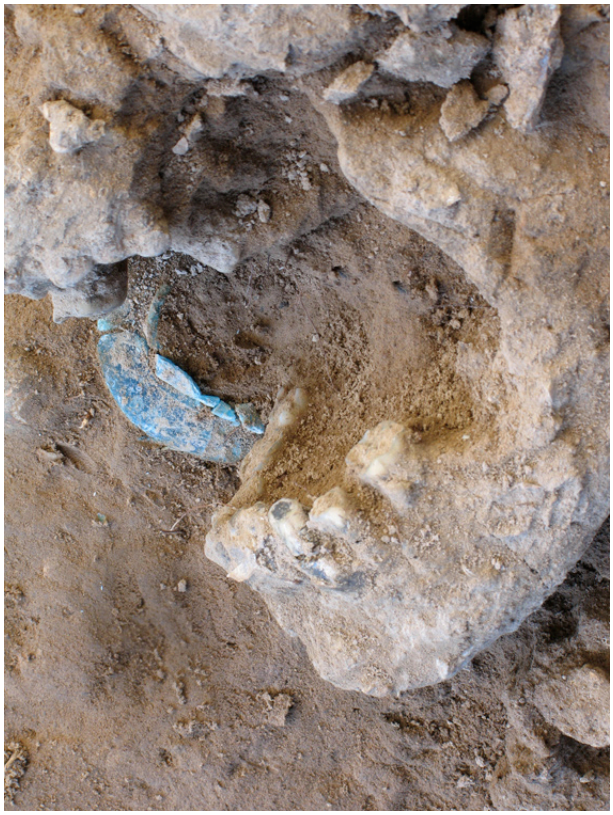


FIG. 13:5 Burial 211 showing the glass earring

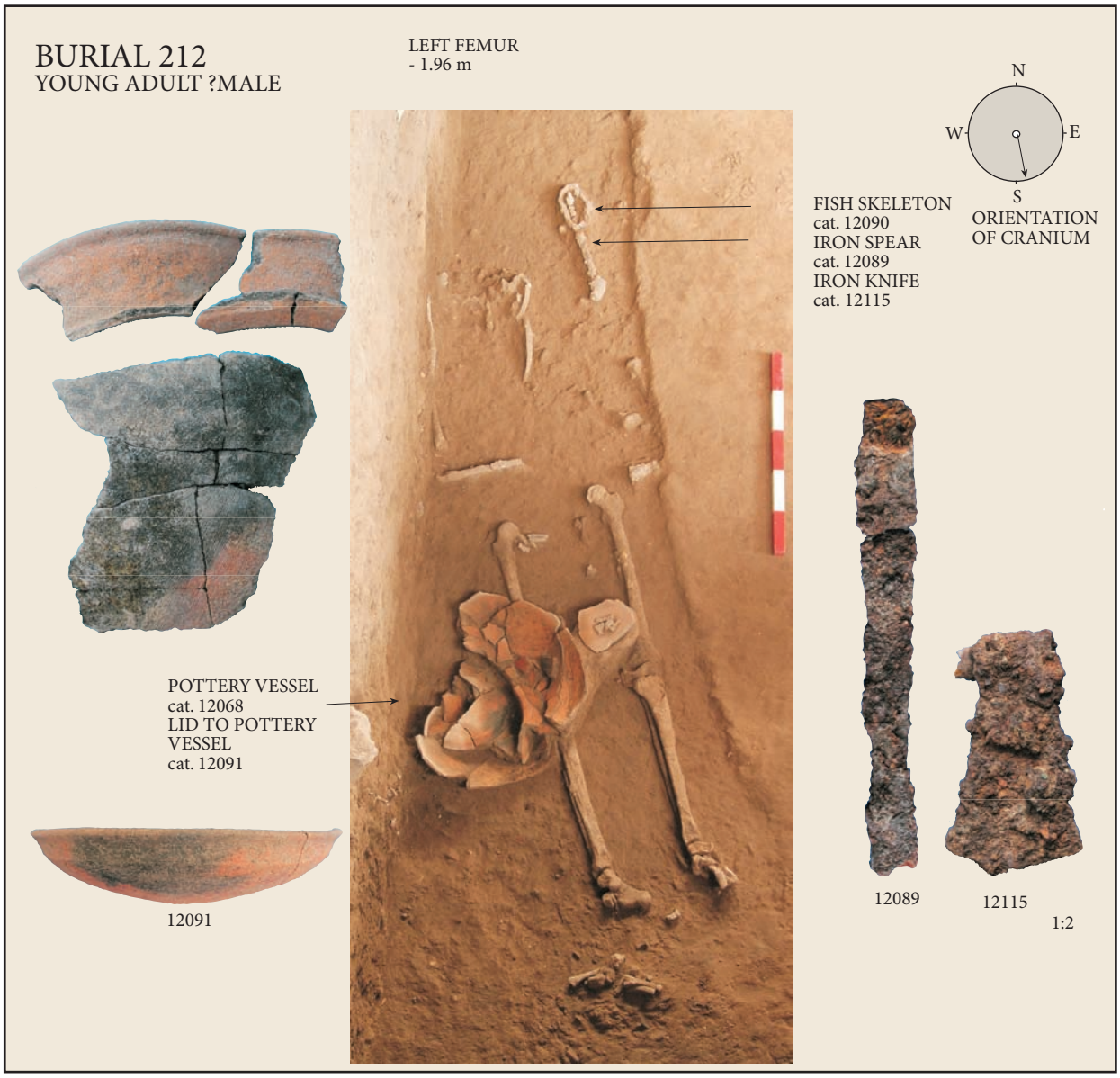


FIG. 13:6 Burial 212

Burial 212 was found at a depth of 1.96 m below datum, with the head orientated 170° from north. It was only partially preserved, there being no cranium or bones above the femora. Two pots were found beside and over the right knee, one of which is of form 51. There are two iron artefacts, one a knife and the other probably a socketed spear. These lay beyond the head, close to a fish skeleton.



FIG. 13:7 Burial 212, showing the iron artefact and fish skeleton. Scale 5 cm



FIG. 13:8 Burial 222

Burial 222 was found under burial 212, on an east to west axis. It was heavily disturbed by only the cranium and some upper limb bones survived. Two individuals have been identified, an old adult female and a young adult probable male.

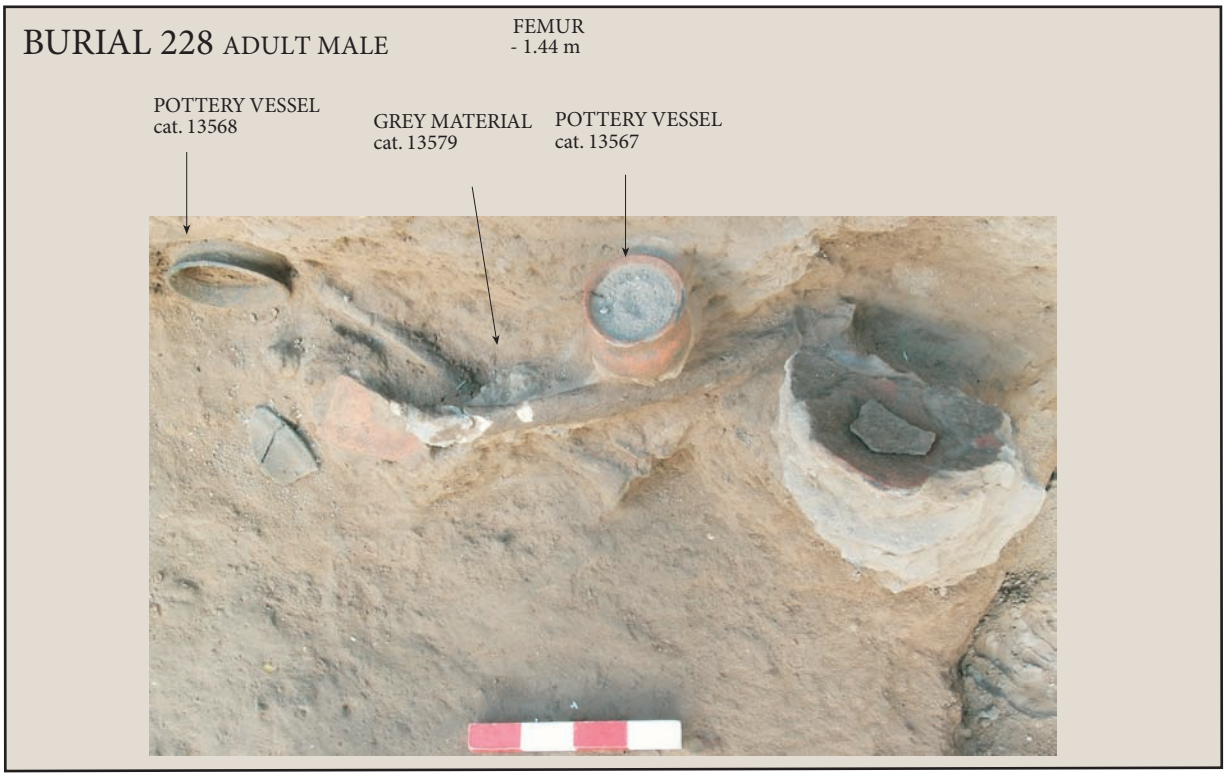


FIG. 13:9 Burial 228

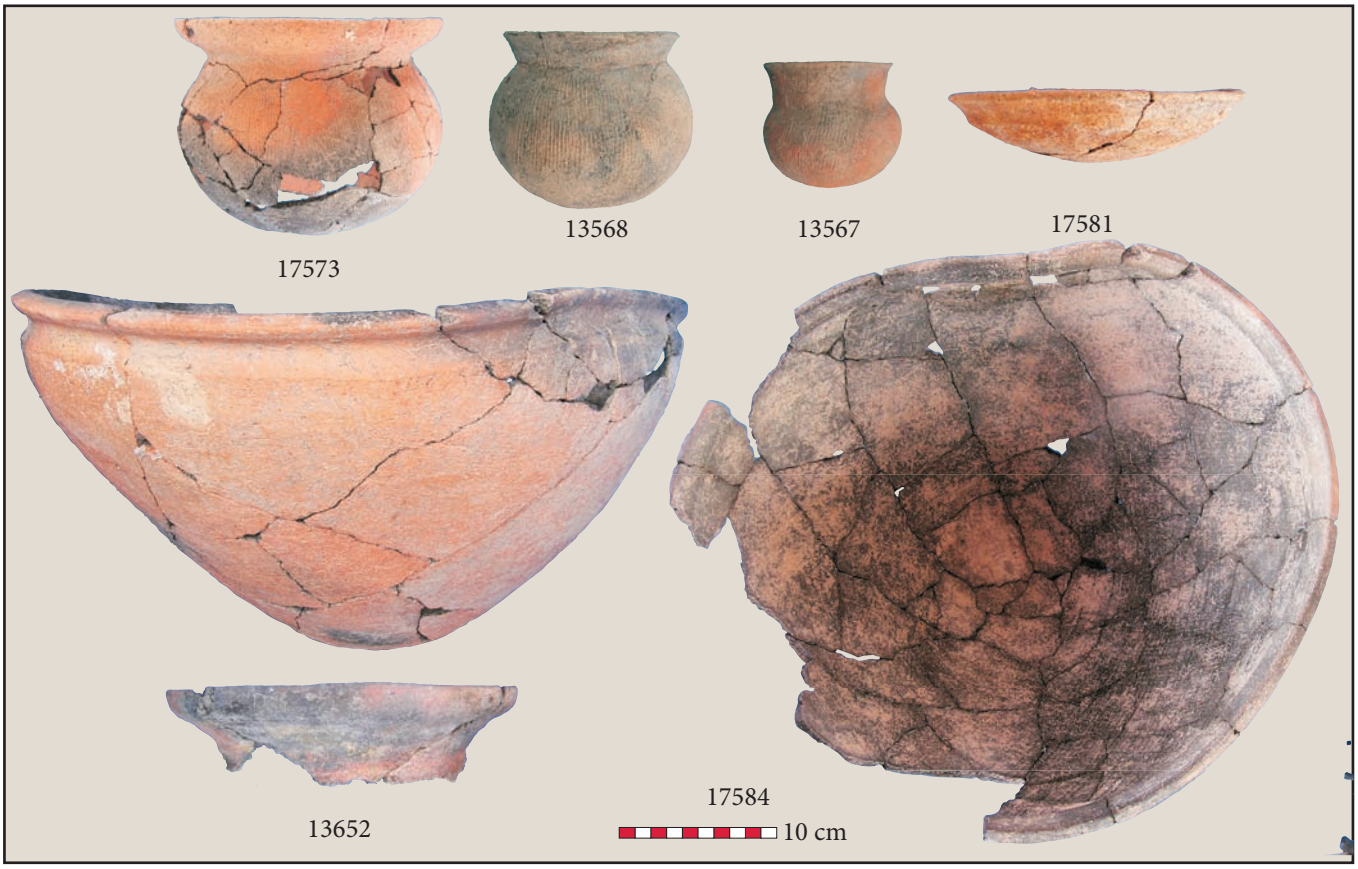


FIG. 13:10 Ceramic vessels from burial 228

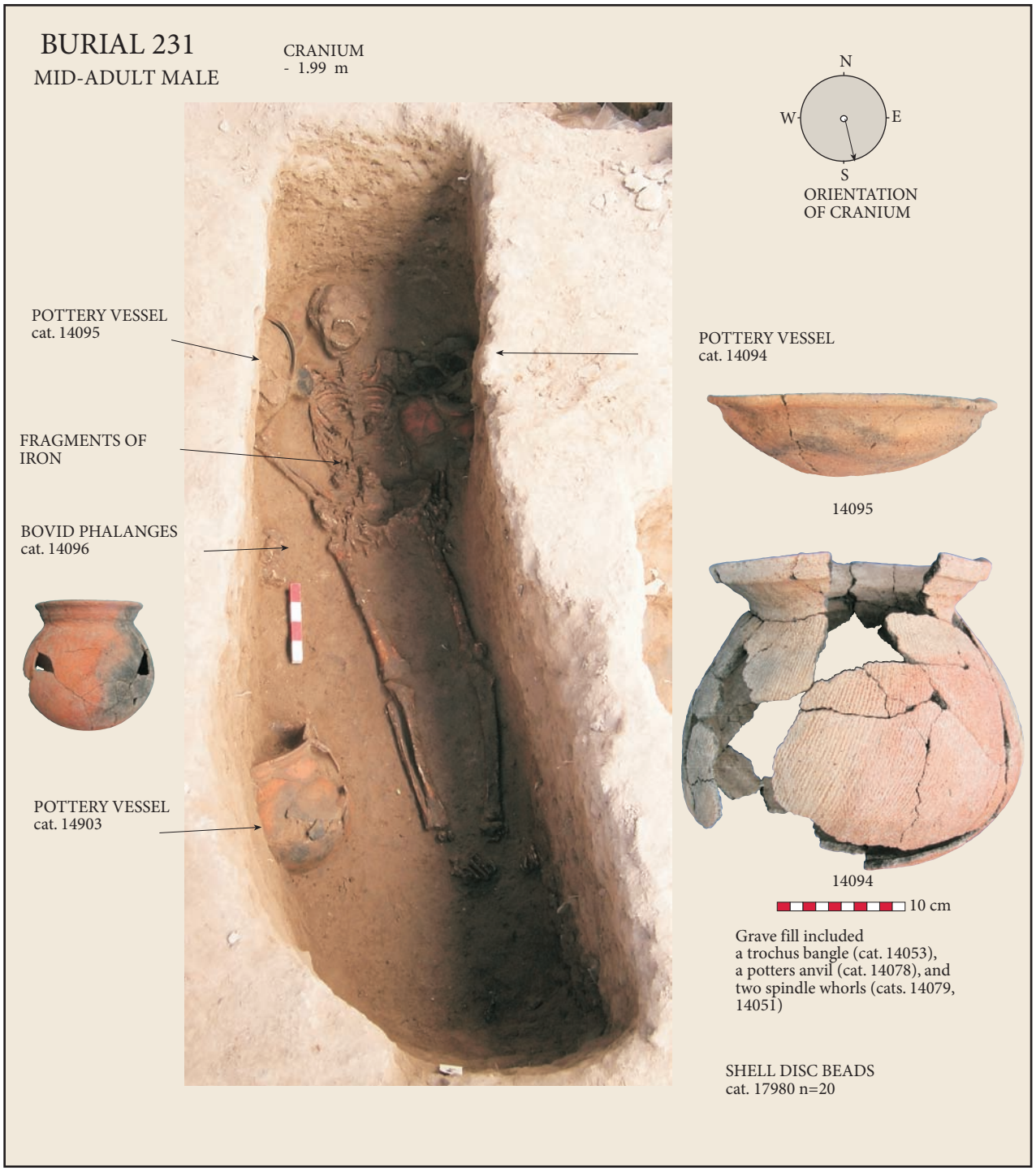


FIG. 13:11 Burial 231

Burial 228 lay at a depth of 1.31 m. It survived as a collection of bones that looked as if they had been disturbed and replaced in prehistory. Six pottery vessels might have been associated with this individual. There are three of form 41, and one each of forms 51 and 57. Pot Cat. 13568 contained 26 vertebrae (from small fish) and some fish bones including: *Hemibagrus*/*Mystus* 1L, 1R pectoral fin spine & cleithrum (still in place and from a small size fish); 1 dorsal fin spine and *Channa striata* 1R quadrate.

Burial 231 contained the complete skeleton of a mid adult male. The body was found at a depth of 1.99 m below datum, oriented with the head directed 165° from north. The grave goods comprised three pots, placed by the shoulders and the right ankle. They belong to forms 5, 41 and 51. The articulating phalanges and the right upper femur of a bovid were found beside the right hand, and fragments of iron lay over the right ribs and pelvis.

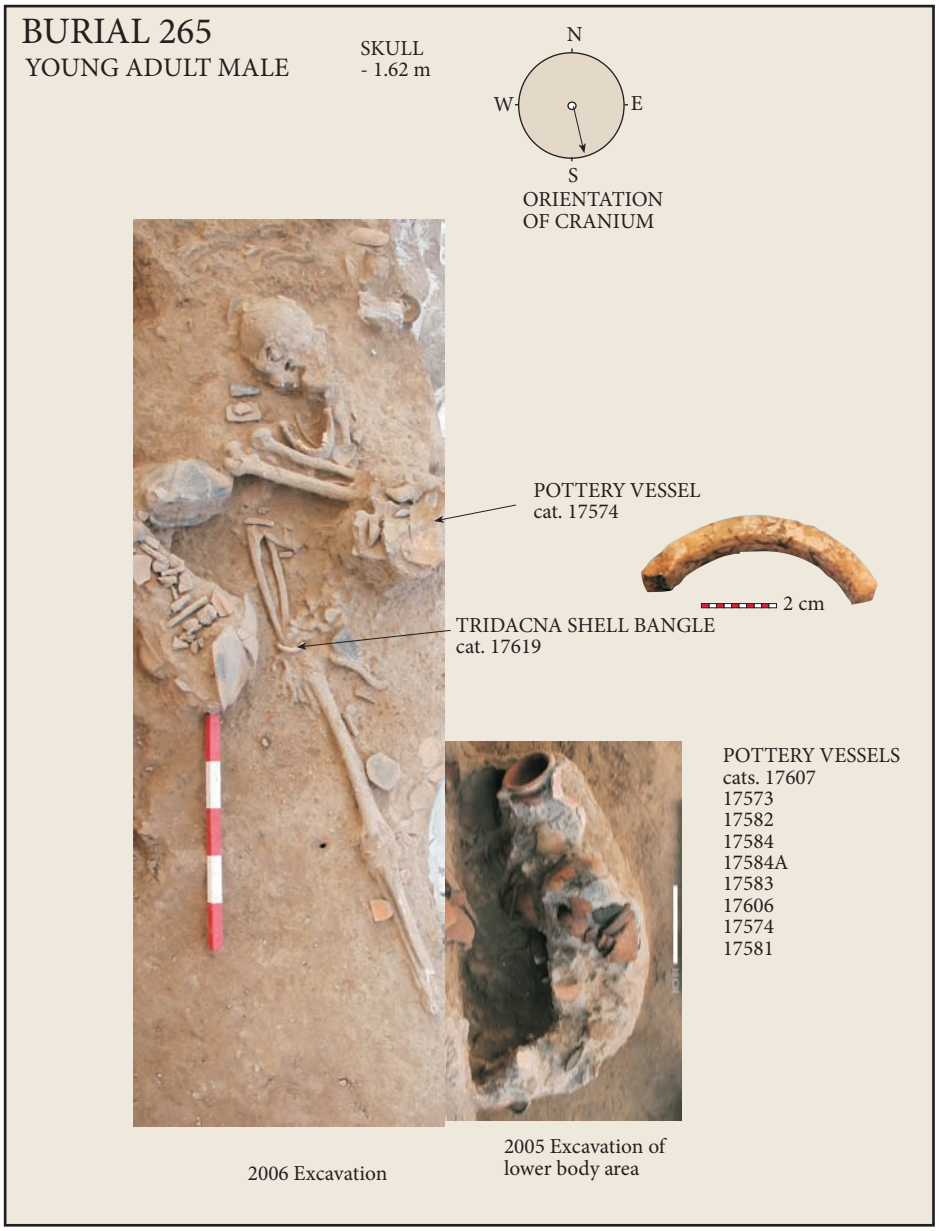


FIG. 13:12 Burial 265

Burial 265 contained the partial skeleton of a young man, at a depth of 1.62 m below datum. His grave was orientated with the head 170° from north. At least 15 pottery vessels were found, one by the chest and the rest in groups beyond the head and feet. Six are of form 51, three of form 41 and and there a single example of forms 45, 55, 57 and 58. He wore a tridacna shell bangle on the left wrist. The following fish bones were found in pot cat. 17608: two fish vertebrae and *Clarias* sp. a small fragment of skull; *Channa striata* one right maxilla.

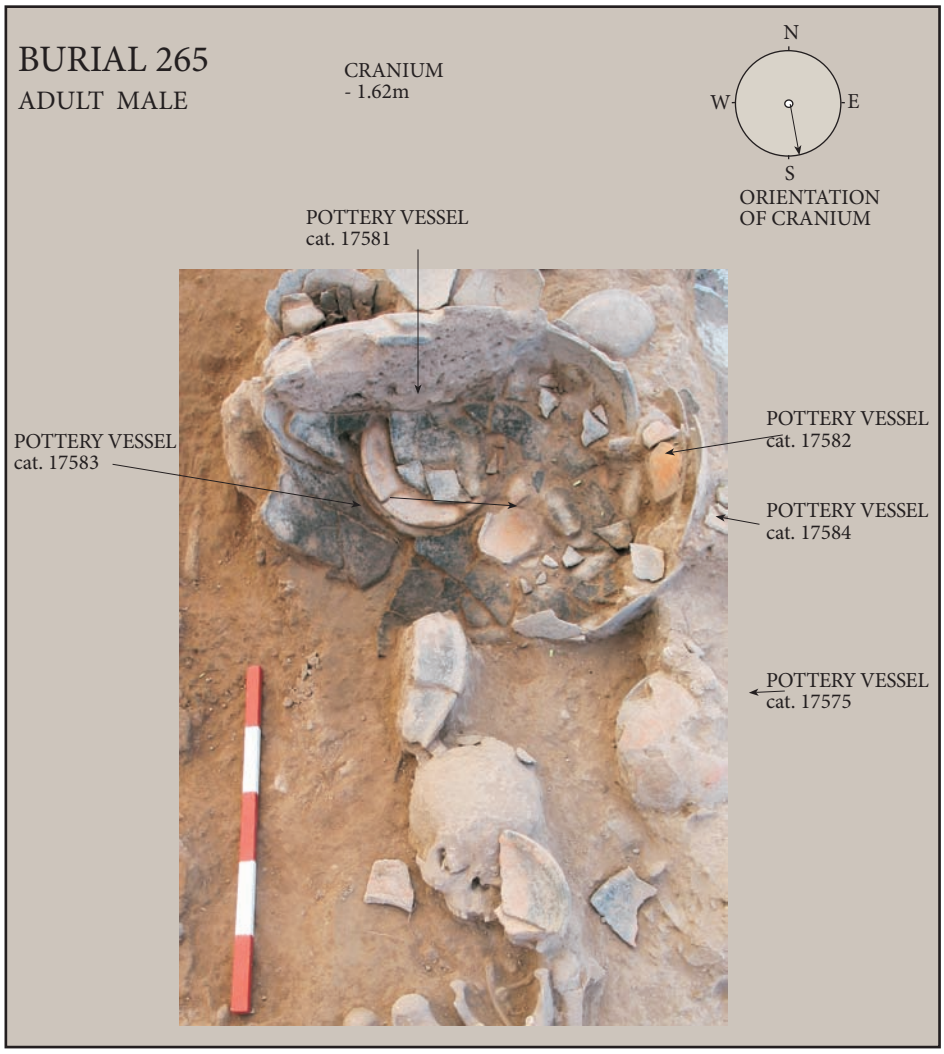


FIG. 13:13 The head area of burial 265





FIG. 13:14 Above, close up of the cranium and displaced mandible of burial 265, scale 5 cm. Right, note the relocated femur. Scale 10 cm

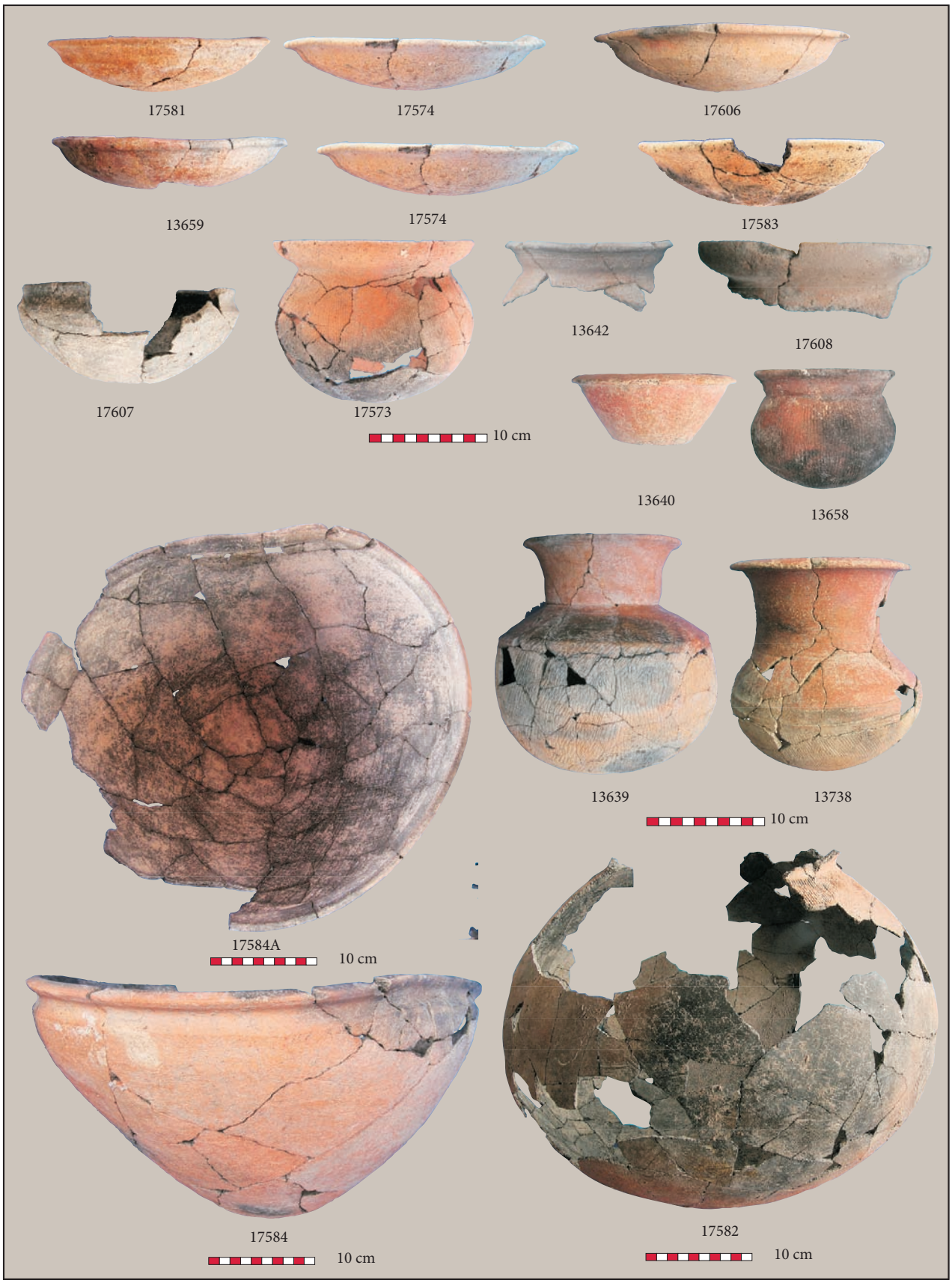


FIG. 13:15 Ceramic vessels from burial 265

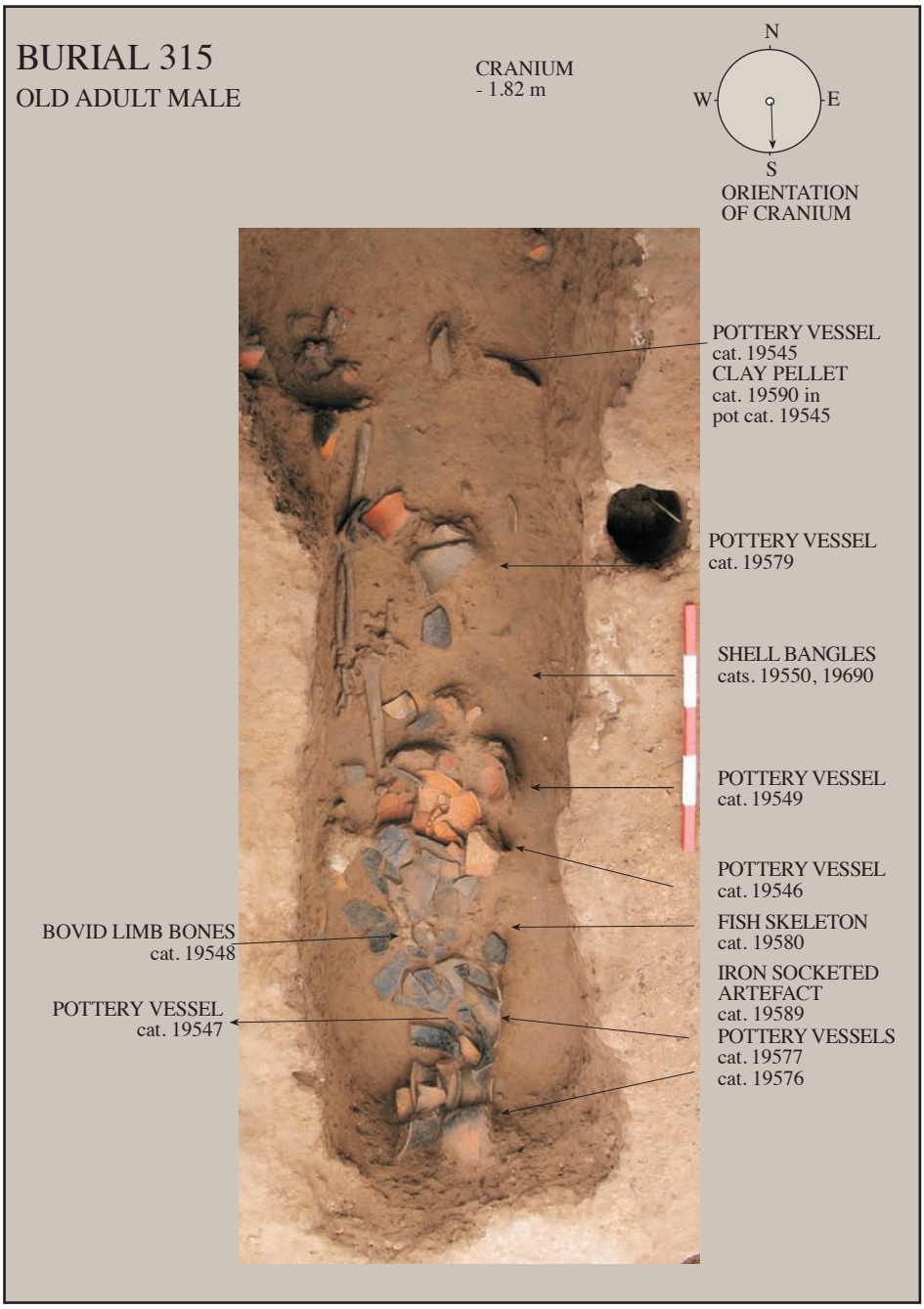


FIG. 13:16 Burial 315

The grave cutting for burial 315 was found at a depth of 1.32 m below datum, and the body was found 50 cm deeper with the head directed to the south. Seven pottery vessels were found over the lower limbs and beyond the feet with one beyond the head area. They belong to forms 51 (3), 55 (2) and forms 45 and 61. A socketed iron artefact was identified beyond the feet. Articulating bovid bones from the distal metapodial to the third phalanx were found over a broken pottery vessel by the right knee. The following fish bones were found in pot cat. 195413: *Clarias* sp. 1R pectoral fin spine and cat. 19580, *Channa striata* 1 whole skull. This person wore two shell bangles on the left wrist.



FIG. 13:17 Mortuary offerings with burial 315

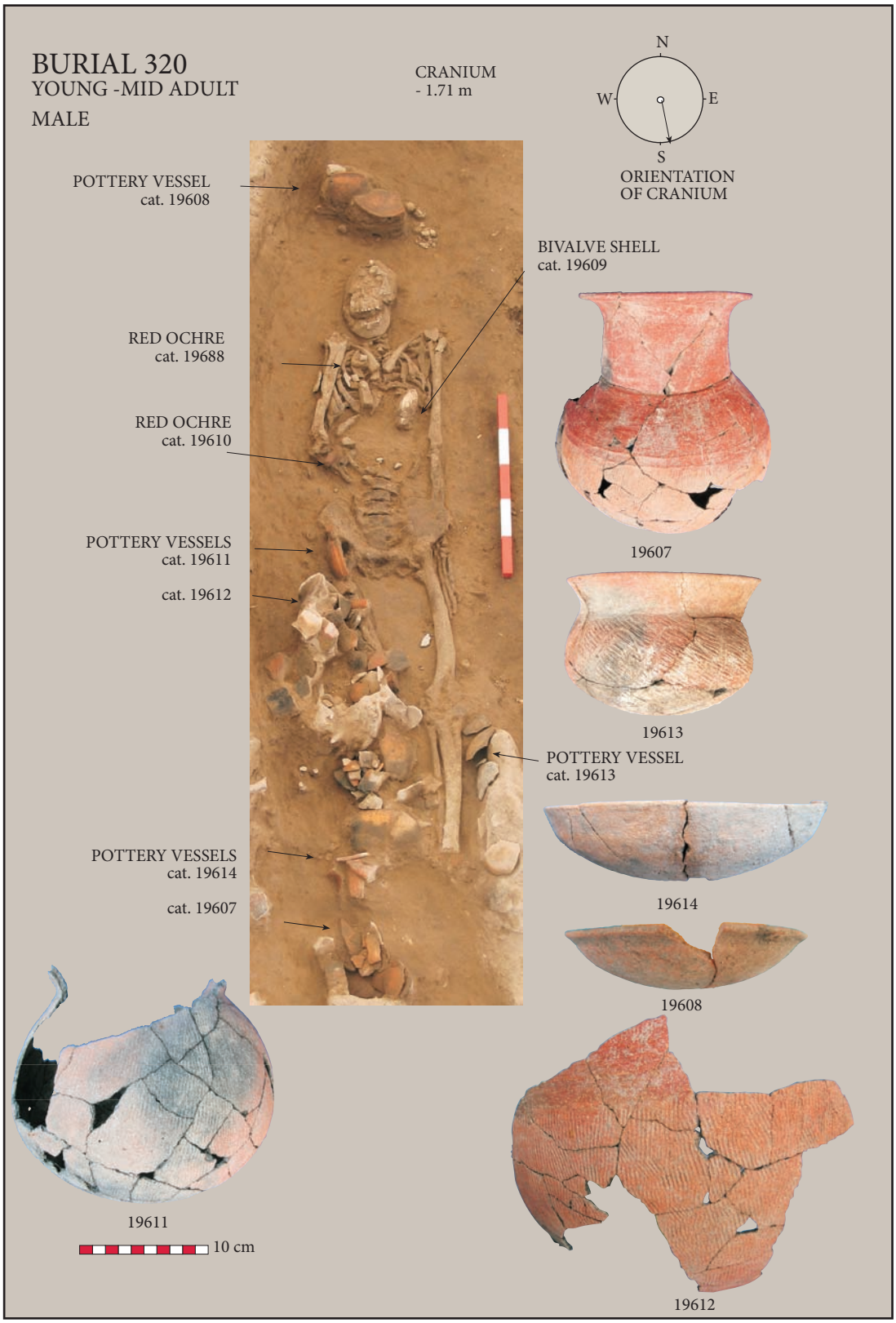


FIG. 13:18 Burial 320

Burial 320 was found at a depth of 1.71 m below datum, orientated with the head to the south. It contained the remains of a young-mid adult man. Six pottery vessels were found in association, beyond the had and over the right legs down to beyond the feet. Two are form 41, two form 51 and one of form 55. Two pieces of red ochre were found by the right elbow and over the chest, a bivalve shell was also found over the chest.

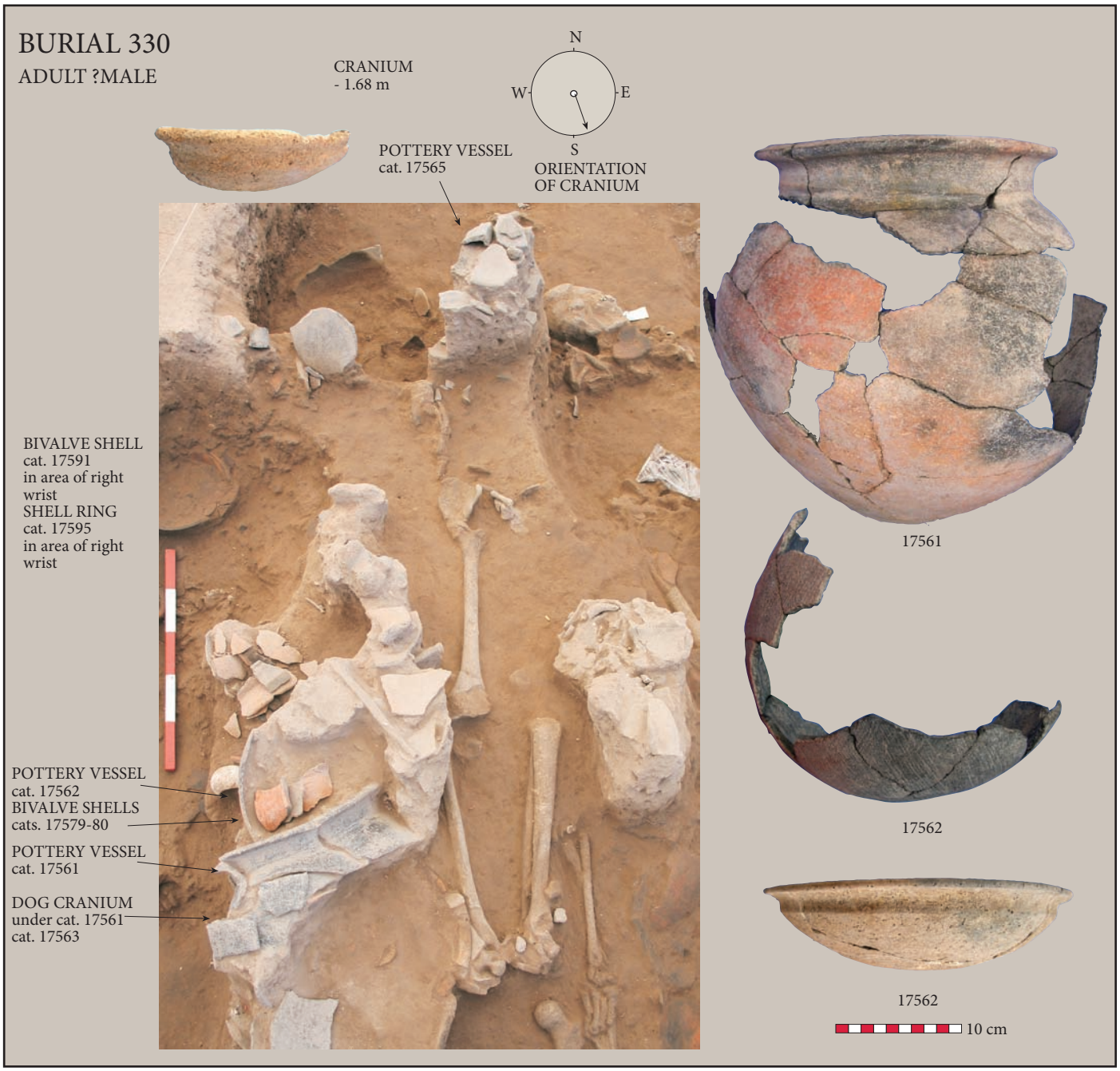


FIG. 13:19 Burial 330

Burial 330, that of an adult ?male, was found at a depth of 1.68 m below datum in a grave orientated with the head directed 160° from north. Four pottery vessels were found beside the legs, with one beyond the head. Two are of form 51, with one of form 45. There are also three bivalve shells, two beside the right leg and other other in the vicinity of the right wrist. A shell ring, possibly a bangle, was found in this area as well, while a dog's skull lay under the pots beside the lower limbs.

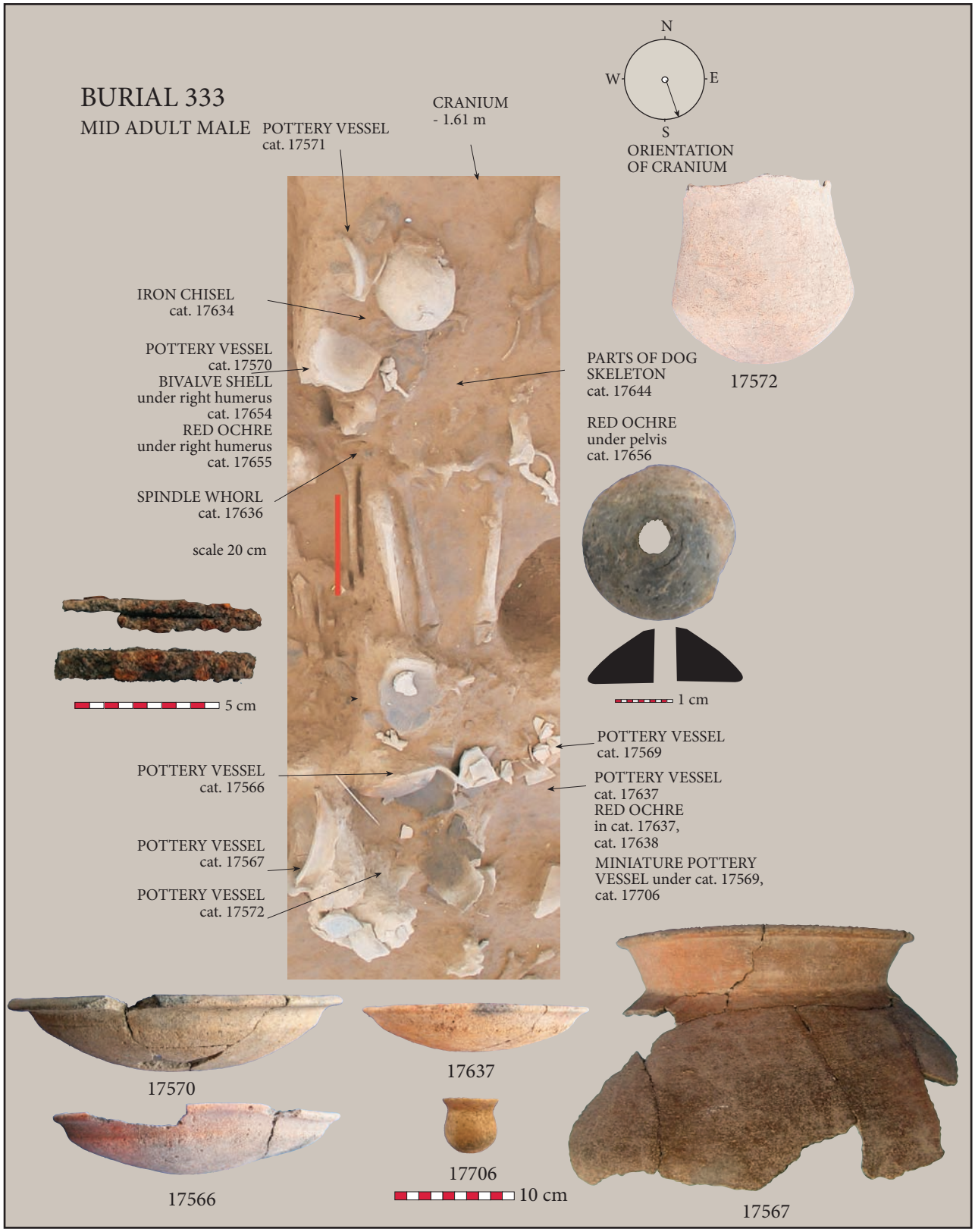


FIG. 13:20 Burial 333

Burial 333 was found at a depth of 1.61 m below datum, with the grave oriented with the head 170° from north and contained a mid adult male. The grave was incomplete. Surviving mortuary offerings comprises eight pots of which three were of form 51, with one of form 34 and another of form 61. In addition, there were three pieces of red ochre, a spindle whorl, dog bones and an iron chisel.

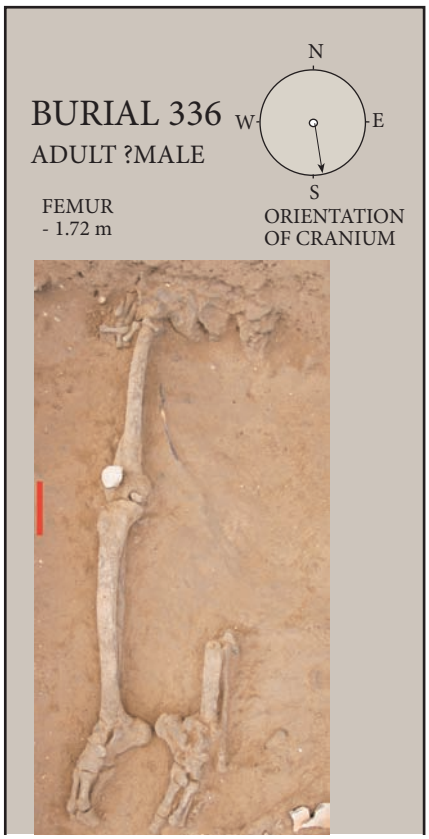


FIG. 13:21 Burial 336

Burial 336 was found at a depth of 1.72 and orientated with the head to the south. Only the skeleton of an adult ?male from the waist to ankles was uncovered.



FIG. 13:22 Burial 335

Only one arm of this adult male has survived. It was found at a depth of 1.68 m below datum, orientated with the head to the southeast.

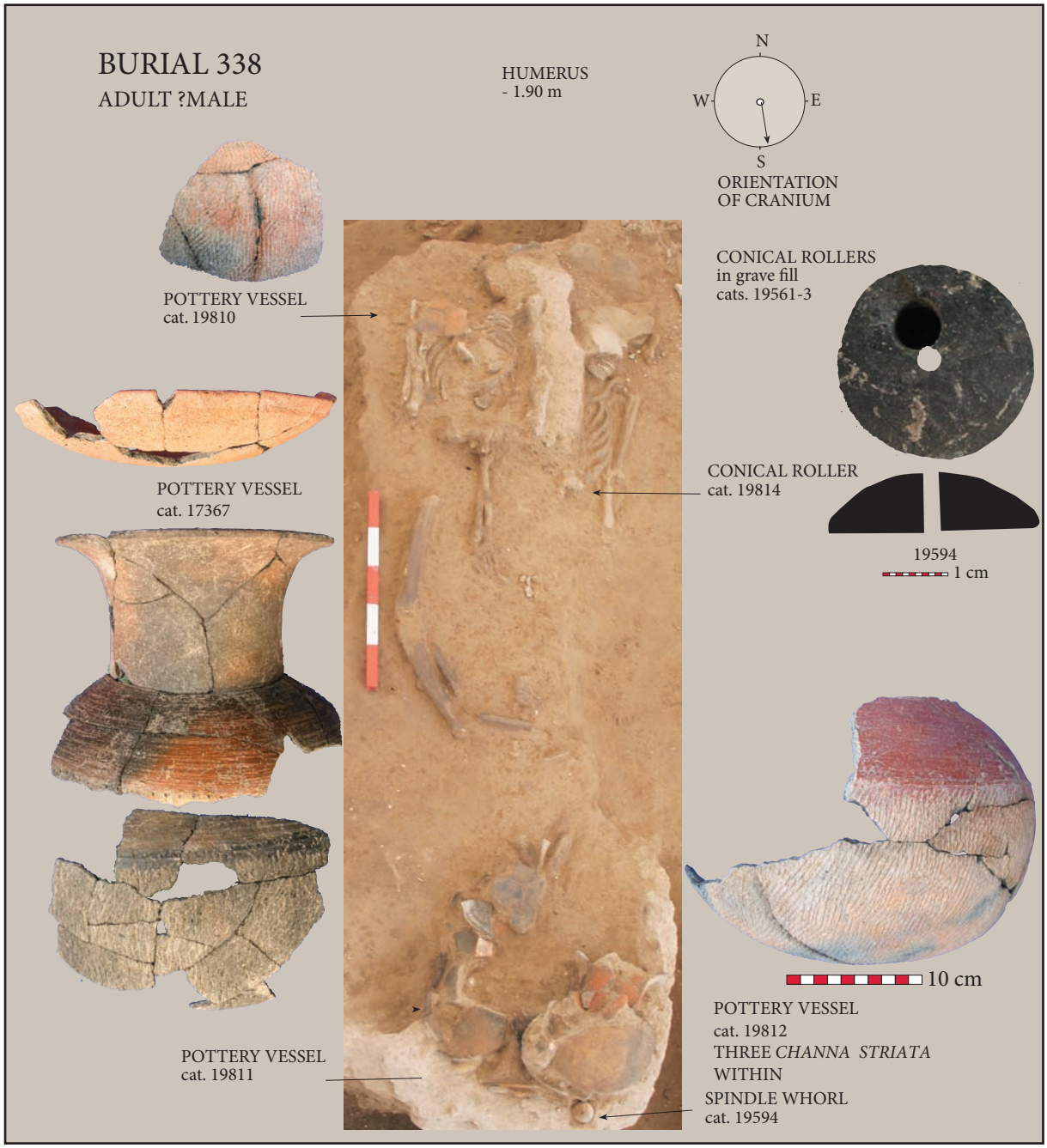


FIG. 13:23 Burial 338

Burial 338 contained the remains of an adult ?male at a depthof 1.90m, with the head orientated to the south. Two of the four pottery vessels in association, placed beyond the ankles and over the right shoulder could be assigned forms 51 and 55 respectively. A spindle whorl was found beside the ankles. Pot cat. 19812 contained the skeletons of three *Channa striata*.

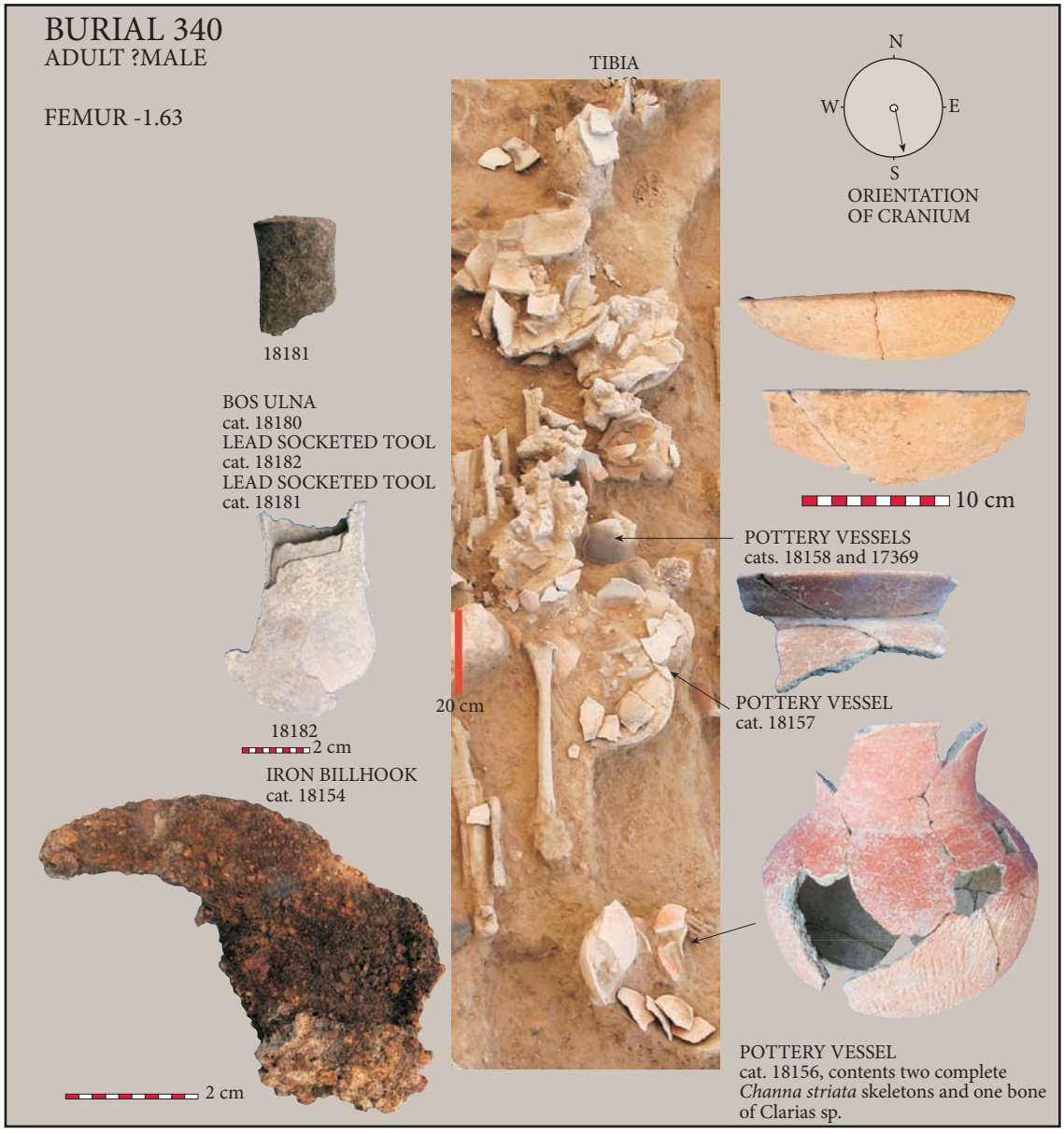


FIG. 13:24 Burial 340

Burial 340 is disturbed. It was found at a depth of 1.63 m below datum on an orientation with the head of an adult probable male to the south. There are four pottery vessels in association, distributed on the left hand side of the body. Two are of form 51, and the others are form 55 and 45. Two remarkable lead castings were also found, each comprising a thin layer of lead over a clay core in the form of a small axehead. There was also a deposit if red ochre and the ulna of a bovid. The contents of pot cat. 18156 included a fragment of *Clarias* sp. right pectoral fin spine and the skeletons of two *Channa striata.*

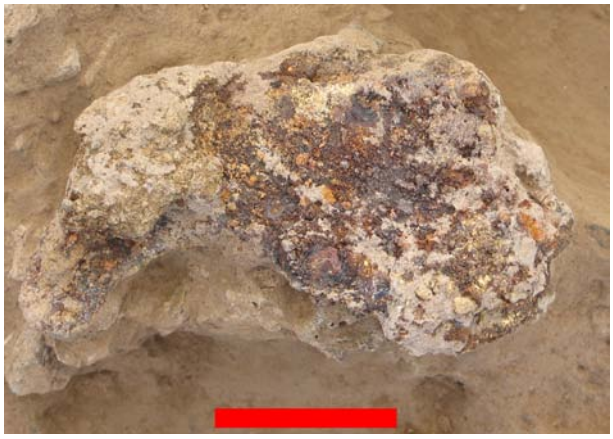


FIG. 13:25 Burial 340, showing the iron billhook *in situ*. Scale 5 cm

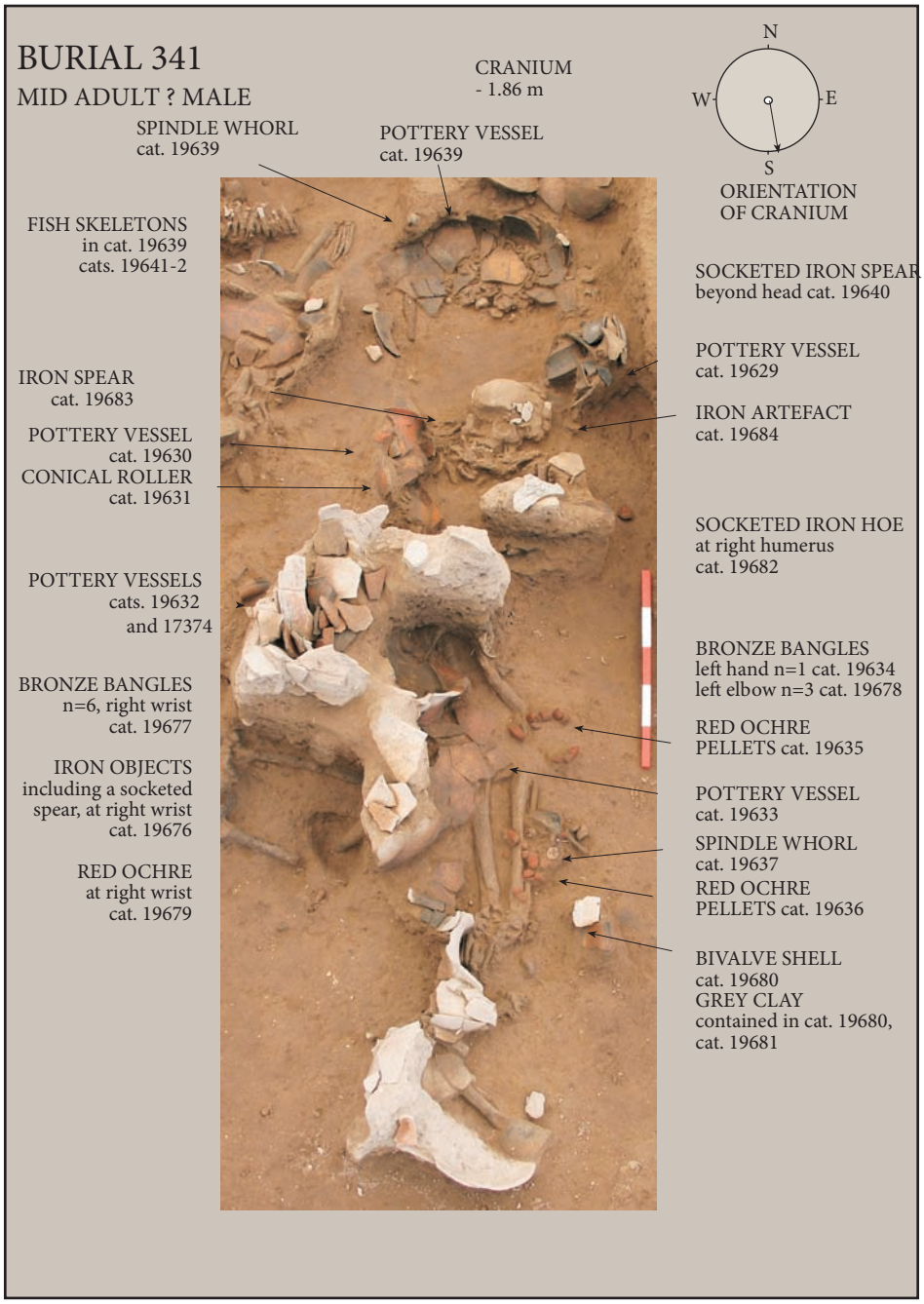


FIG. 13:26 Burial 341

Burial 341 was found at a depth of 1.86 m below datum, with the head orientated 170° from north. It contained the skeleton of a mid adult ?male. Seven pottery vessels were found over the body and beyond the head. Two are of form 51, and there are two also of form 55, with one each of forms 43 and 45. This person was accompanied by a lot of iron: there is a socketed iron spear beyond the head, and a hoe at the upper right arm. A kit of at least seven iron tools including a possible spear or knife point was found by the right hand. There were also at least 13 red ochre pellets lay be the left knee, the left shin and the right wrist. Three spindle whorls were found, two at the left shin and the other over ceramic vessel 19639 beyond the head. This same pot contained the skull of the fish *Clarias macrocephalus* and two skeletons of *Channa striata*. Pot cat. 19629 contained the neurocranium of *Channa striata*. This person wore ten bronze bangles, six on the right and four on the left arm. A bivalve shell beside the left ankle contained grey clay.

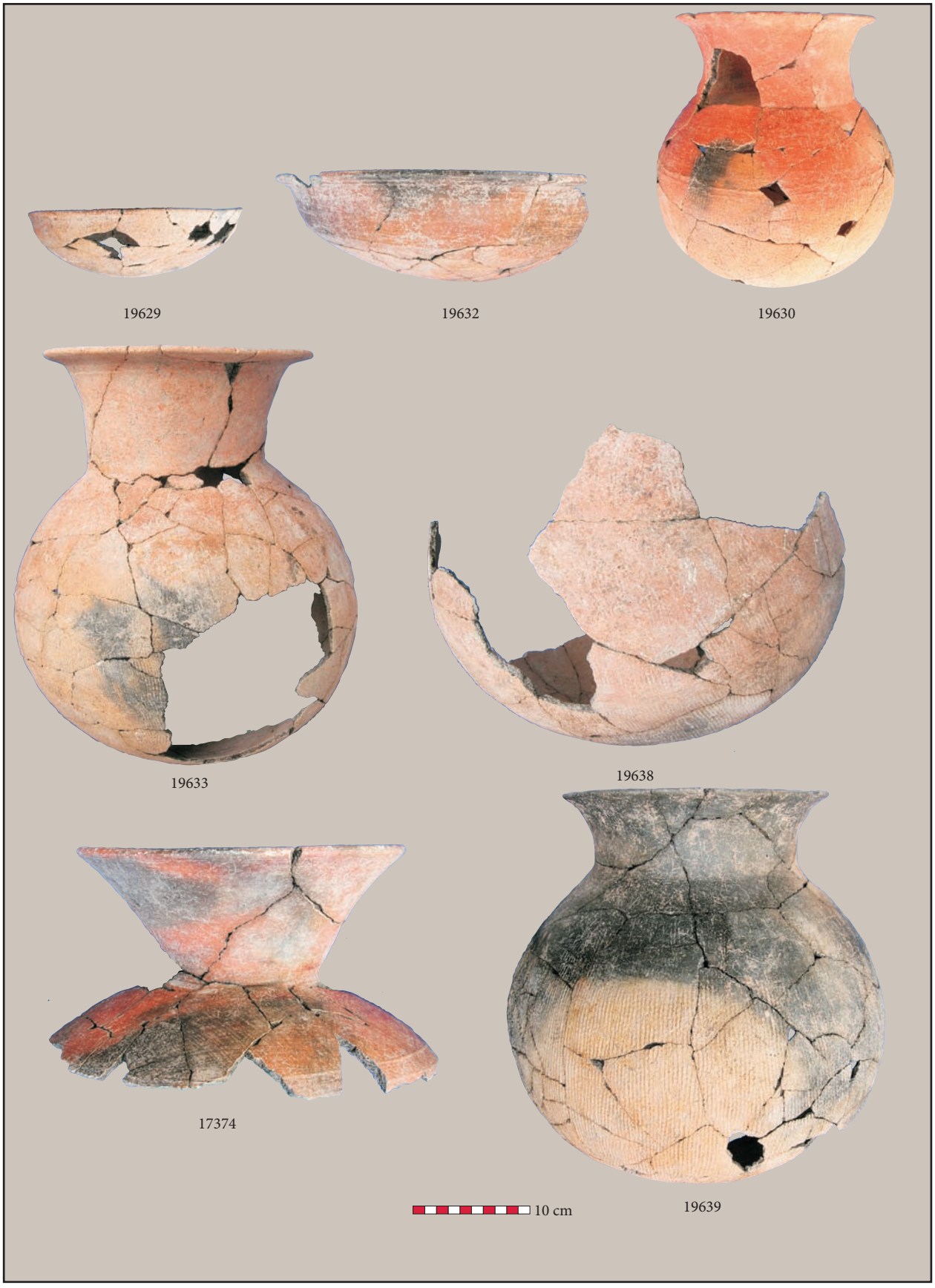


FIG. 13:27 Ceramic vessels from burial 341

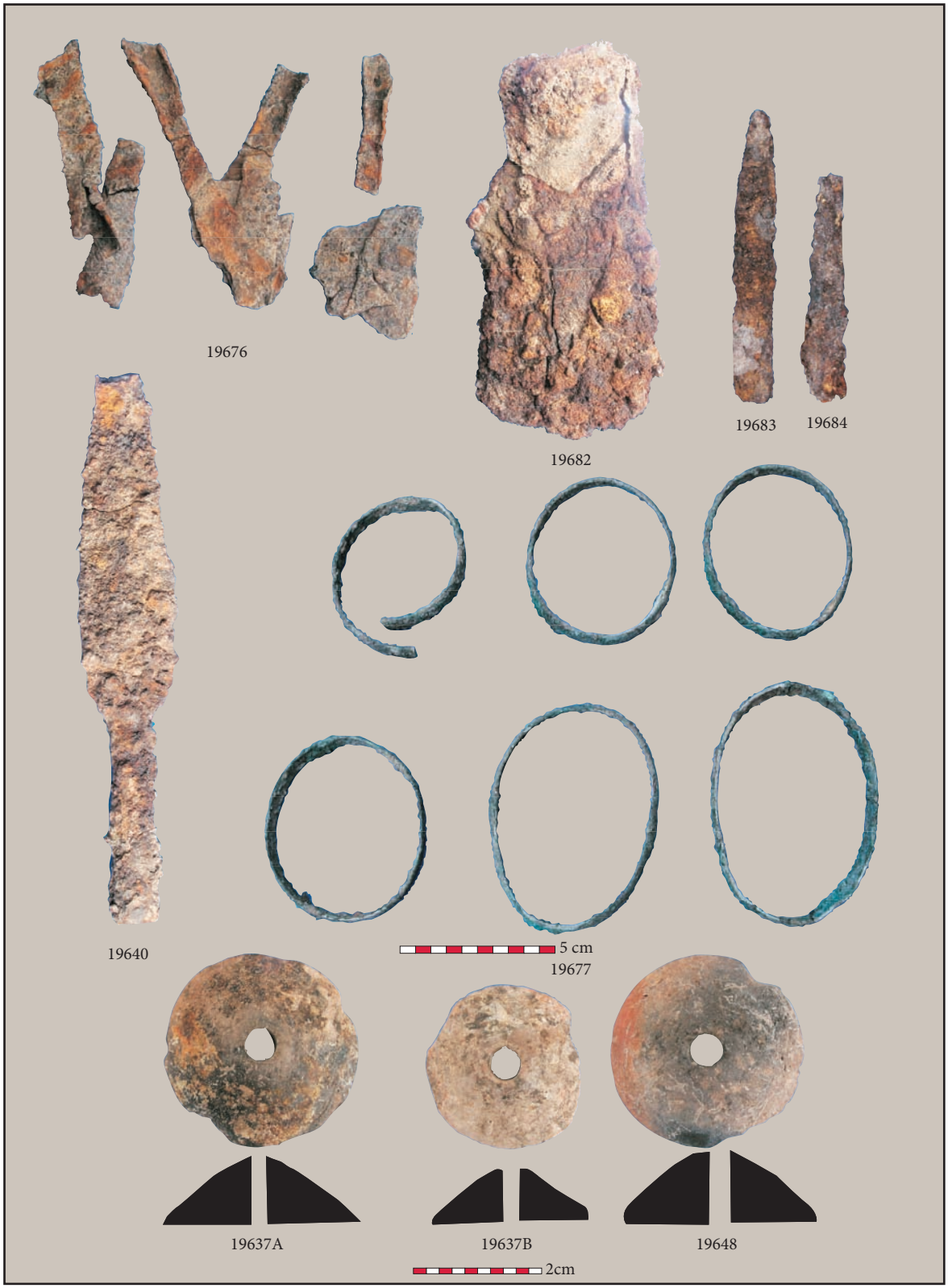


FIG. 13:28 Mortuary offerings with burial 341



FIG. 13:29 Burial 345

Burial 345 contained the badly disturbed remains of a young adult probable male. Found at a depth of 1.65 m below datum, the head was orientated to the south. Nine iron artefacts were found among the bones. Three look like points, one a possible knife and another may have been a spear. Some grey clay was also found.

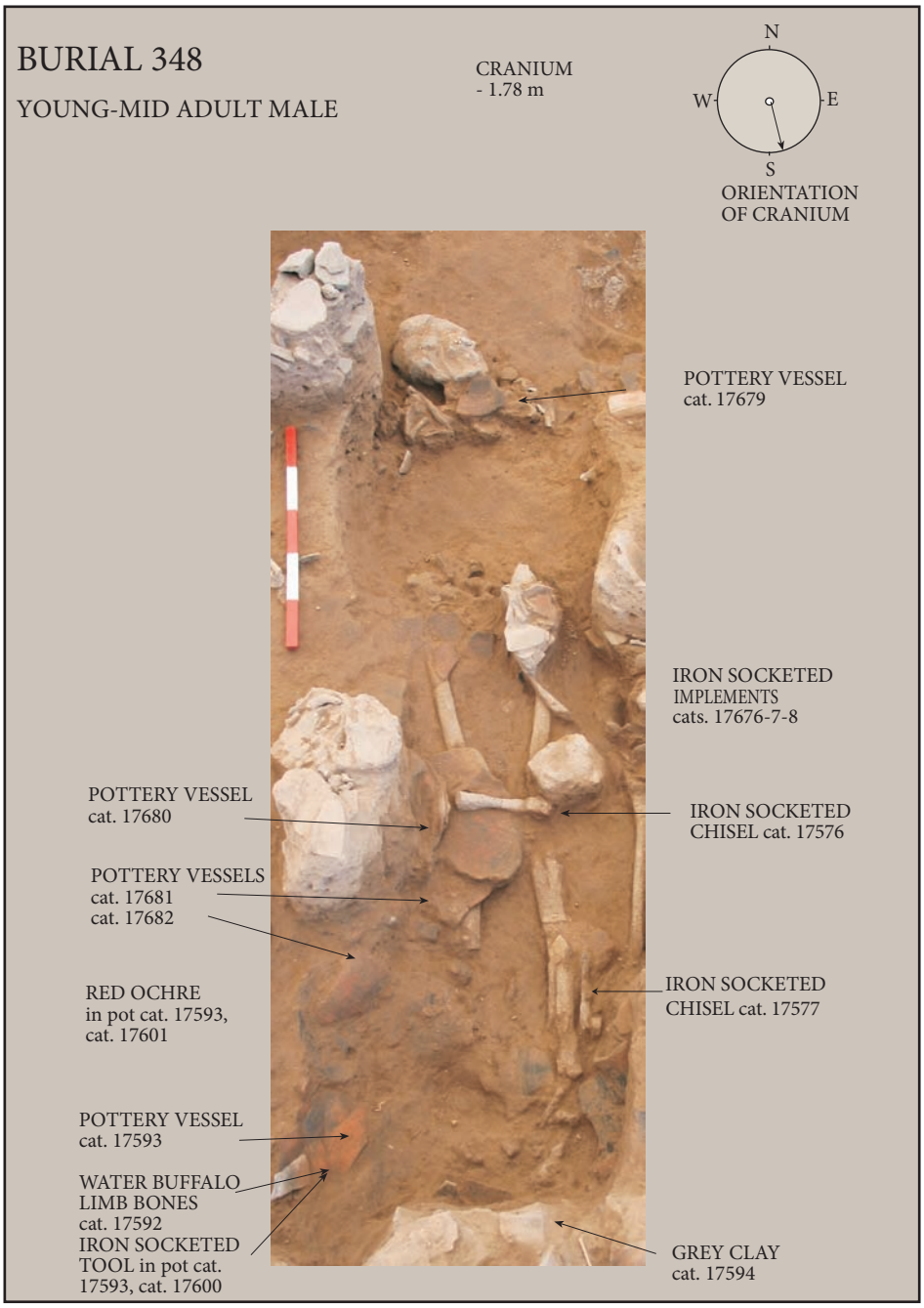


FIG. 13:30 Burial 348

Burial 348 was found at a depth of 1.78 m below datum, with the head orientated 160° from north. It contained the remains of a young to mid adult man. Five pottery vessels were found in the grave, three being fragmentary and the other two assigned to form 51. One of the former contained water buffalo bones. This person was interred with at least six iron tools three of which are socketed and look like chisels. The other three are not assigned a possible use. Pot cat. 17593 contained red ochre. A deposit of grey clay was found beyond the ankles.

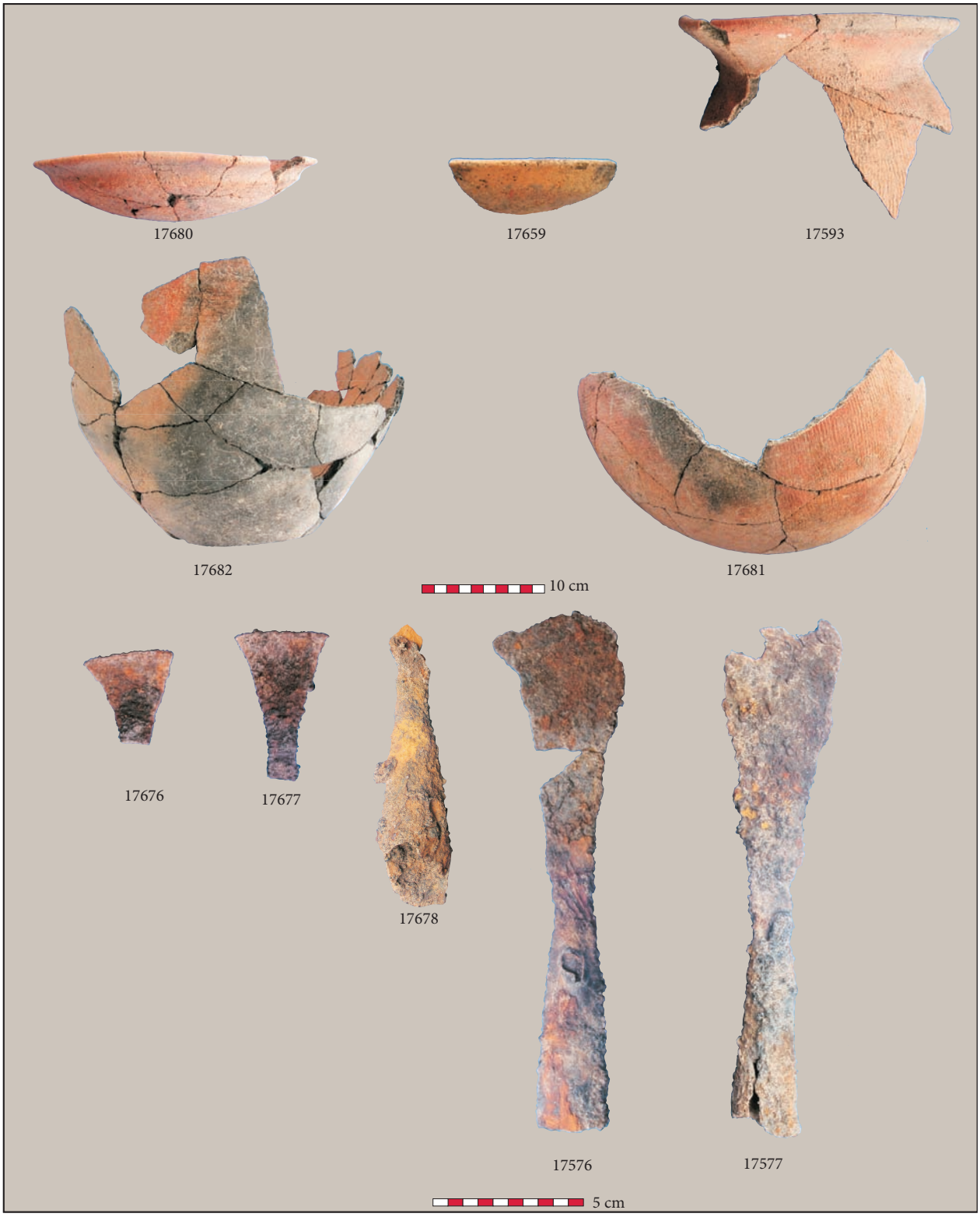


FIG. 13:31 Mortuary offerings with burial 348

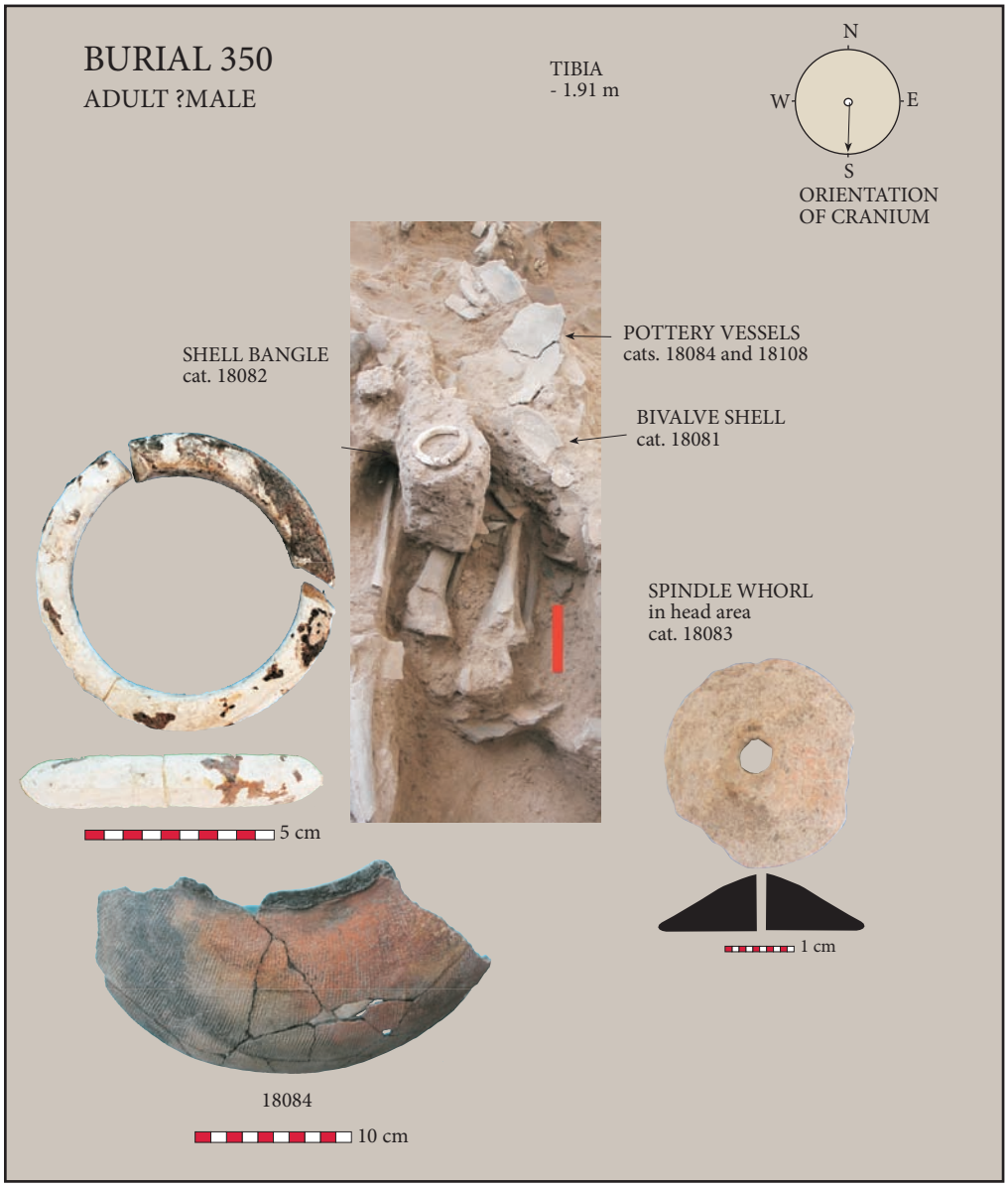


FIG. 13:32 Burial 350

Burial 350 was found at a depth of 1.91, among a complex group of disturbed burials. It contained the partial skeleto of an adult probable male. It was orientated with the head to the south, and comprises only a set of tibiae just west of burial 337. A shell bangle lay in the conjunction, along with a spindle whorl, a bivalve shell and two pots of indeterminate form. Burial 337 itself comprised two tibiae and a femur of a mid to old male

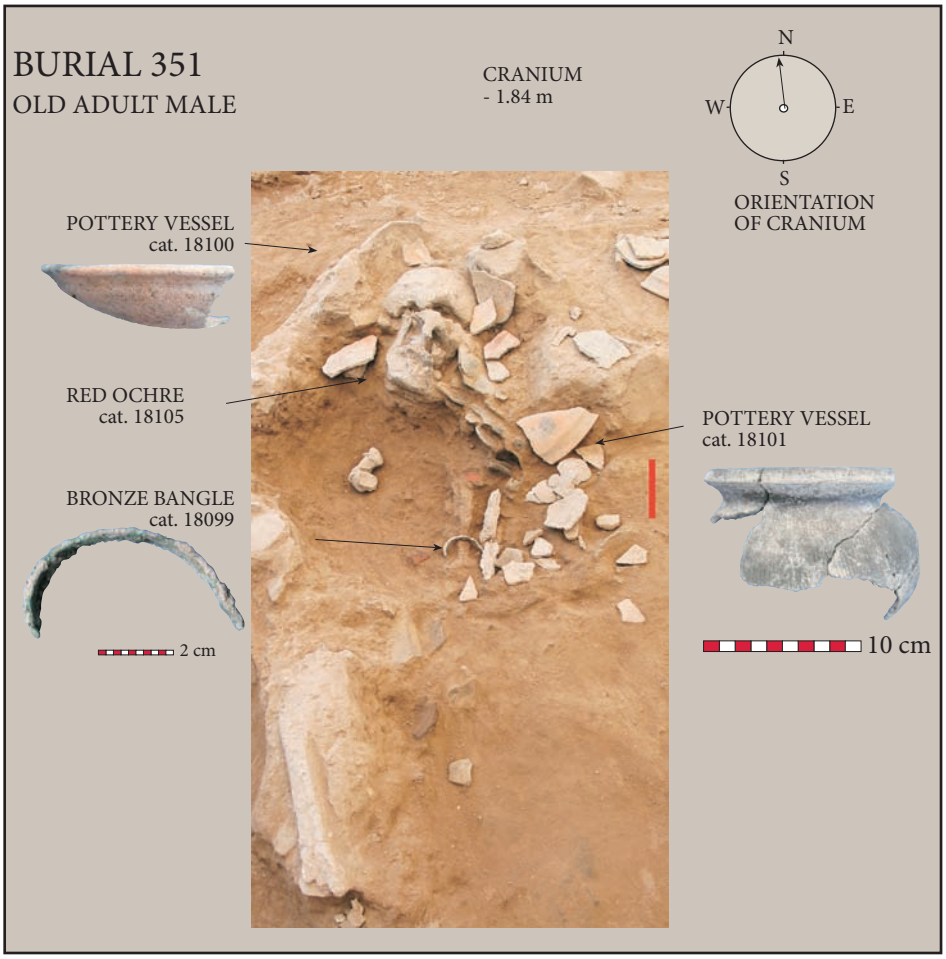


FIG. 13:33 Burial 351

Burial 351 is very fragmentary burial of an old adult man. It was found at a depth of 1.84 m and orientated with the head 355° from north. This man was accompanied by two pots, one of form 51 and the other of form 41. This person wore a bronze bangle on the left wrist, and some red ochre was found with the skeleton.



FIG. 13:34 Burial 357

Burial 357 was found at a depth of 1.60 with the head orientated to the south. It contained a very young adult male. Seven pottery vessels accompanied this man, three of form 51, two of form 55 and one of form 45. A spindle whorl was found on the chest, along with red ochre. Two glass earrings were found, one on each side of the head.

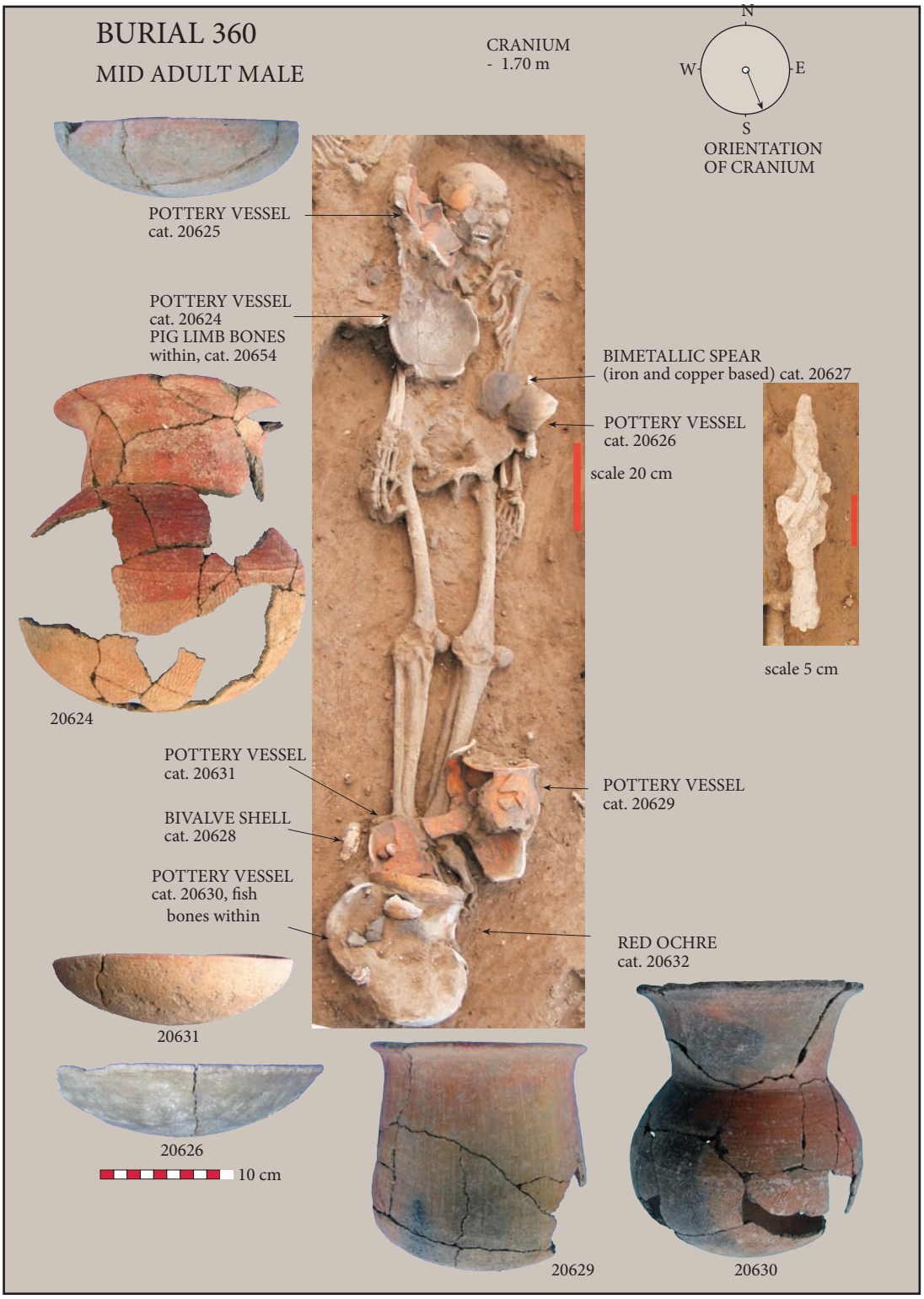


FIG. 13:35 Burial 360

Burial 360 was found at a depth of 1.70 m below datum, with the head orientated 160° from north. A total of six pottery vessels were distributed over the chest , left arm and ankles. Three of these are form 51, there are two of form 55 and one of form 61. A bivalve shell was found by the right ankle and red ochre beyond the feet. This person was also accompanied by a bimetallic spear, with an iron blade and socketed bronze haft. Pot cat. 20630 contained six fish vertebrae and *Clarias* sp. one left articular (from a very small fish) and seven small fragments of neurocranium; *Monopterus albus* one urohyal; *Anabas testudineus* one left, two right lacrymal and 8 small fragments of skull.



FIG. 13:36 Burial 362

Burial 362 was interred at a depth of 1.94 m below datum, with the head orientated to the north. It involved an old adult male. One of three ceramic vessels is of form 55 and the other that can be reconstructed is form 45. The conical roller by the ankles may not have been in association with this person.

The following fish bones were found: contents of pot cat. 20102, two fish vertebrae and *Clarias* sp. 1L, 1R pectoral fin spine; *Hemibagrus*/*Mystus* 1R pectoral fin spine; *Anabas testudineus* 1L lacrymal, one parasphenoid and four fragments of skull and *Channa striata* 2L, 1R ceratohyal; 1R maxilla; 2L cleithrum. Pot cat. 20103 contained five fish vertebrae and *Hemibagrus*/*Mystus* 1L, 1R pectoral fin spine; *Ompok*/*Wallago* 1R pectoral fin spine and *Channa striata* 1R post-temporal.

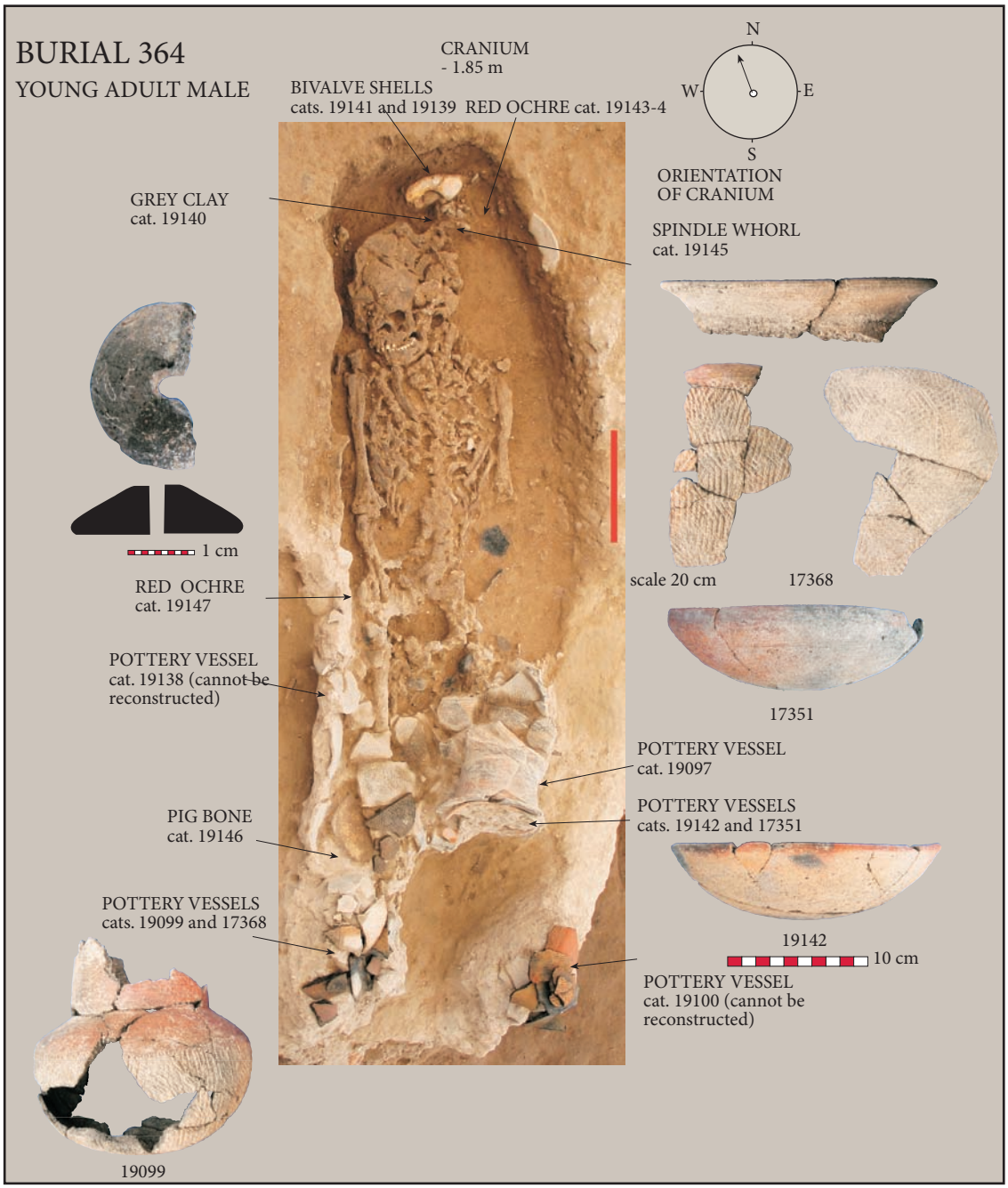


FIG. 13:37 Burial 364

Burial 364 was found at a depth of 2.48 m below datum, on an orientation with the head 170° from north. it contained the remains of a young adult male. Seven pots were found, over the legs and beyond the ankles. Of those that could be reconstructed, two are form 51, one is form 55 and one is probably of form 45. Several mortuary offerings lay just south of the skull, including two bivalve shells, grey clay, red ochre and a spindle whorl. More red ochre was present beside the right hand and the limb bones of a pig were located beside the right ankle.

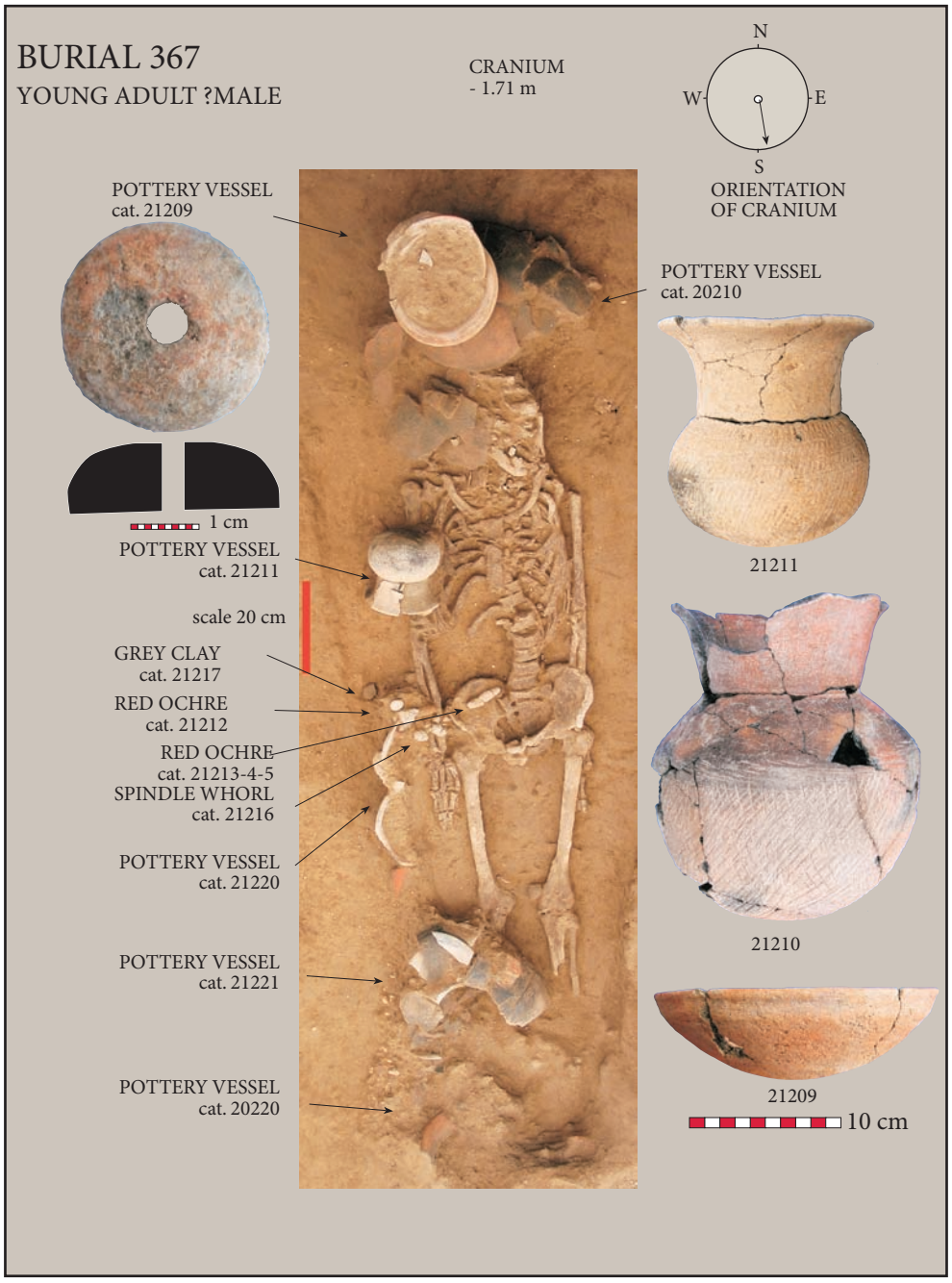


FIG. 13:38 Burial 367

Burial 367 is that of a young probable male, buried at a depth of 1.71 m below datum, with the head orientated to the south. Six pottery vessels were associated three of which could be reconstructed: there is one apiece of forms 48, 51 and 55. By the right hand, there is an assemblage of red ochre, grey clay and a spindle whorl. Pot cat. 21211 contained a fragment of cleithrum (ventral) and one fragment of neurocranium from *Clarias* sp

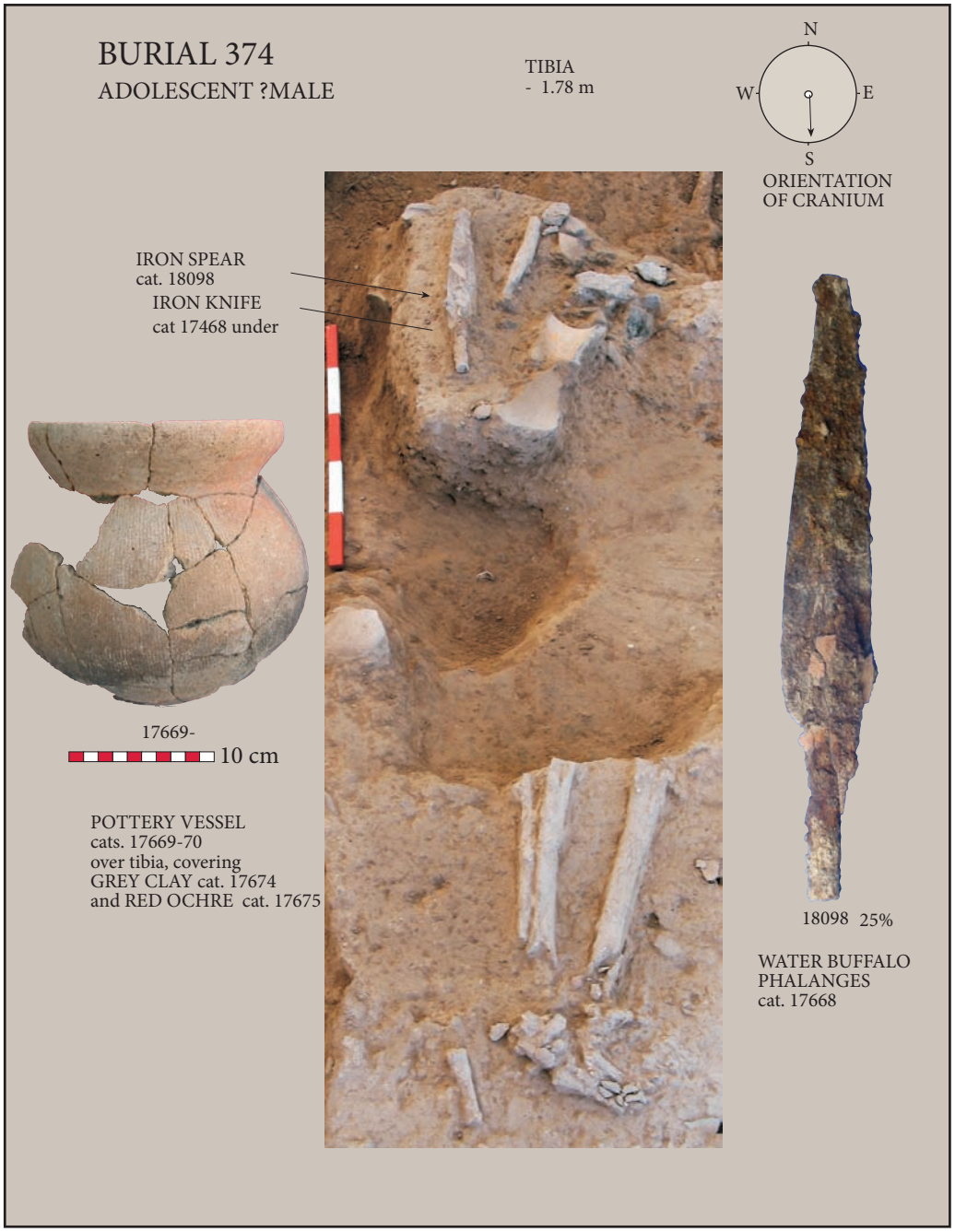


FIG. 13:39 Burial 374

Burial 374 was very seriously disturbed in antiquity. It was found at a depth of 1.78 m below datum, and the grave was orientated with the head to the south and contained an adolescent ?male. A very large socketed iron spear was found in the head area, lying over an iron knife. One pottery vessel of form 41 was probably associated with this person. Grey clay and red ochre were found under this pot. An articulating set of water buffalo phalanges lay over the ankles

Burial 378 was found at a depth of 1.84 m with the head directed to the south. It contains the remains of a mid to old adult man. Ten pottery vessels were found over the body. Of these, four are of form 51, and there are two of form 48, with a single example of forms 44, 45 and 55. There are two deposits of pig bones, beyond the feet and over the chest. Four fish skeletons were found beyond the feet from the following species: *Channa lucius*, *Clarias macrocephalus*, *Clarias* sp. and *Channa striata*.There are also two deposits of red ochre beyond the head and over the right arm. A bivalve shell was also present beyond the head.

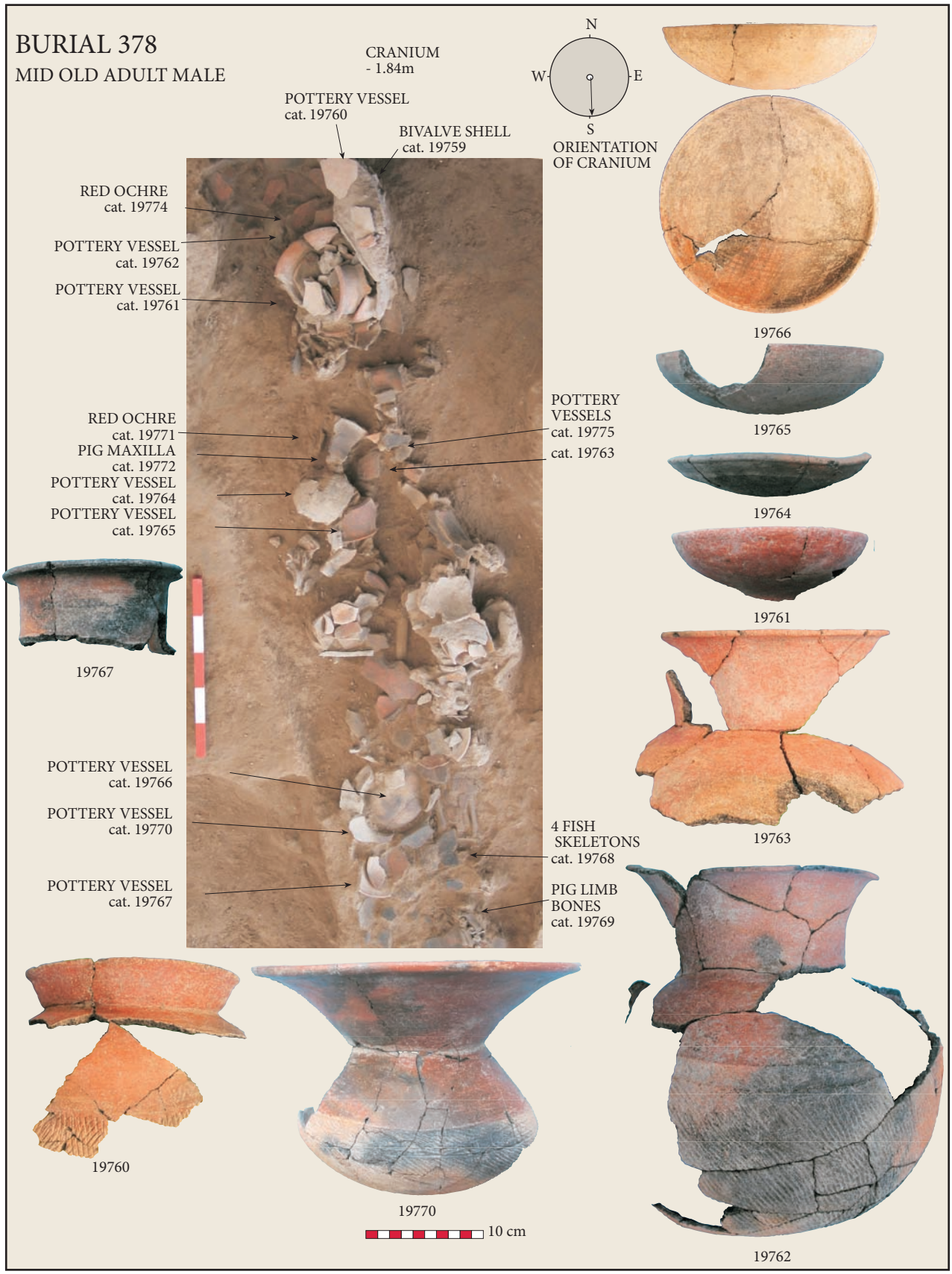


FIG. 13:40 Burial 378

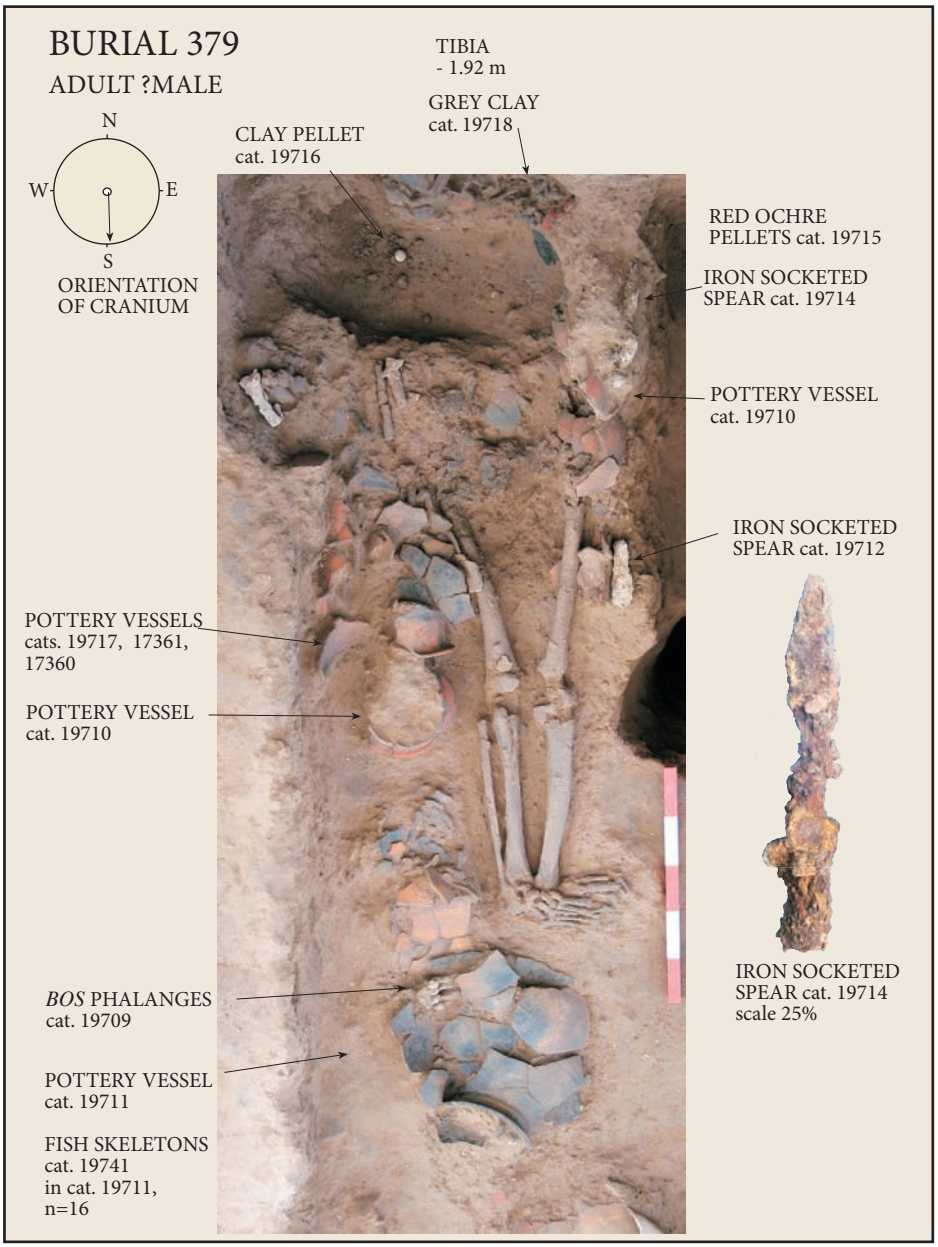


FIG. 13:41 Burial 379

Burial 379 was found at a depth of 1.92 m below datum, orientated with the head to the south. It contained the remains of an adult ?male. The cranium area lies further to the south in an unexcavated area of the site. This individual was interred with at least six ceramic vessels, three of form 51, two of form 48 and one of form 45. This last pot contained 16 fish skeletons as follows: *Channa striata* (7), *Channa lucius* (1), *Channa* sp. (4), *Clarias macrocephalus* (1), *Clarias* sp. (2), *Anabas testudineus* (1). Bovid phalanges were found in the same area as the fish. In the area of the shoulders, we found some red ochre and grey clay. this person was interred with a socketed iron spear and the socket of what may have been a second such weapon.



FIG. 13:42 The bovid phalanges in pot cat. 19711. The 16 fish skeletons were revealed when the sherds were removed. Scale 5 cm



FIG. 13:43 The ceramic vessels from burial 379



FIG. 13:44 The fish skeletons from burial 379. Scale 5 cm



FIG. 13:45 The upper skeleton of burial 379, showing the iron spear alongside the scale. Scale 5 cm

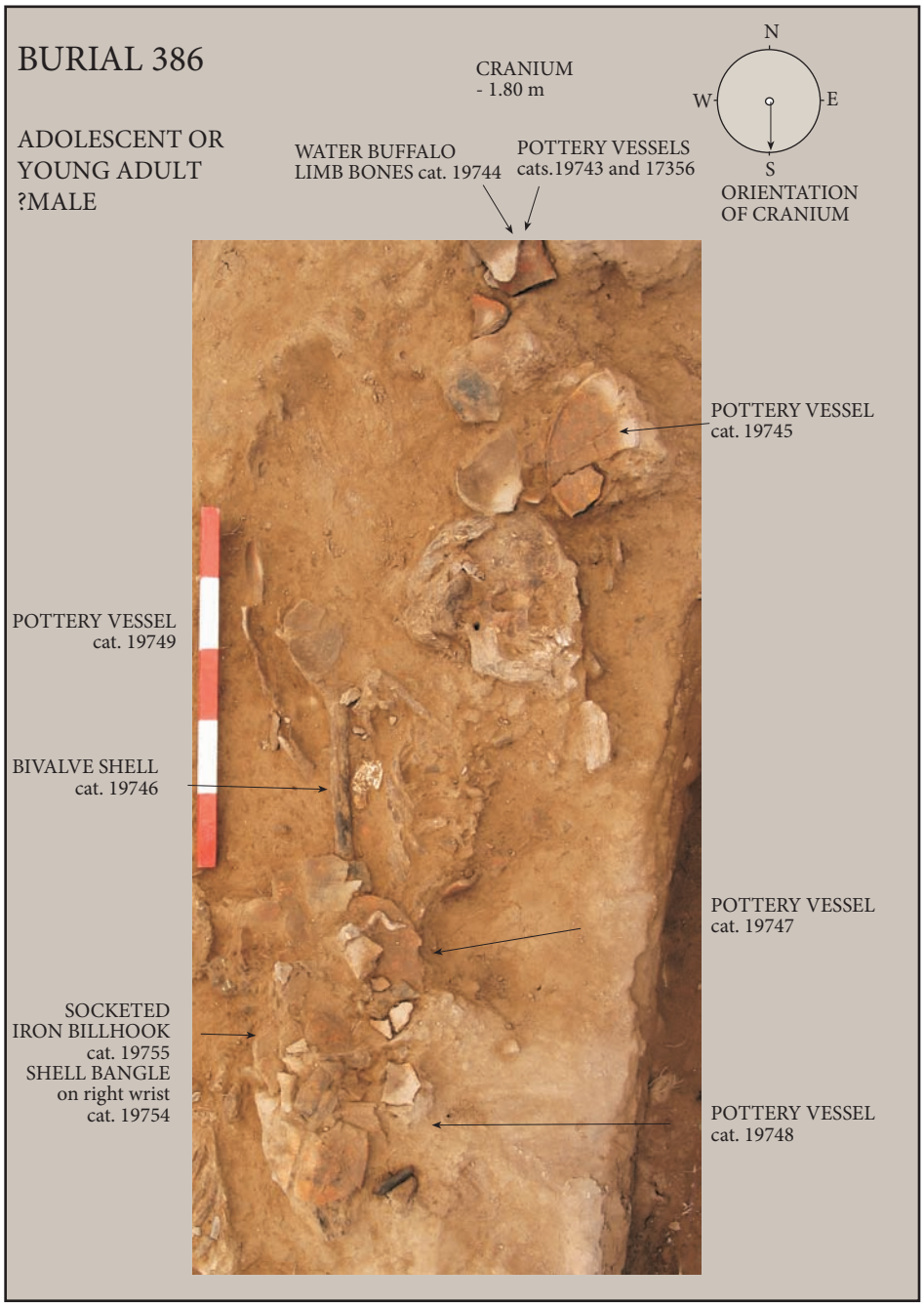


FIG. 13:46 Burial 386

Burial 386 was found at a depth of 1.80 m below datum, with the head directed to the south. It contains the skeleton of an adolescent our young adult ?male. Six pottery vessels lay beyond the head and over the right side of the body. Two are of form 51 and there is one example of 45. A bivalve shell was found inside the right humerus and water buffalo third phalanges were present within a pot beyond the head. This person wore a shell bangle on the right wrist, and a socketed iron billhook was found beside the right wrist.

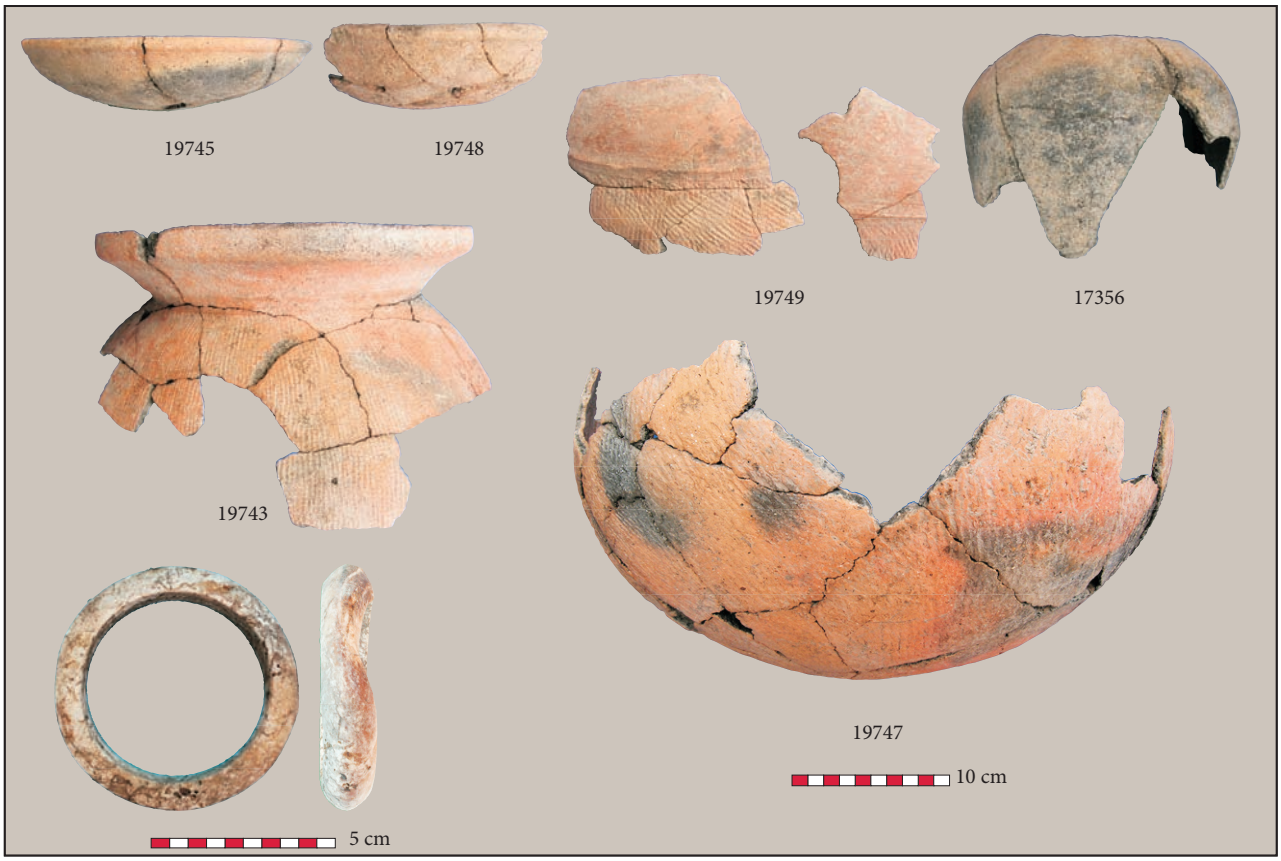


FIG. 13:47 Mortuary offerings with burial 386



FIG. 13:48 Burial 386, showing the shell bangle. Scale 5 cm



FIG. 13:49 Burial 386, showing the cranium and the pottery vessel beyond . Scale 5 cm

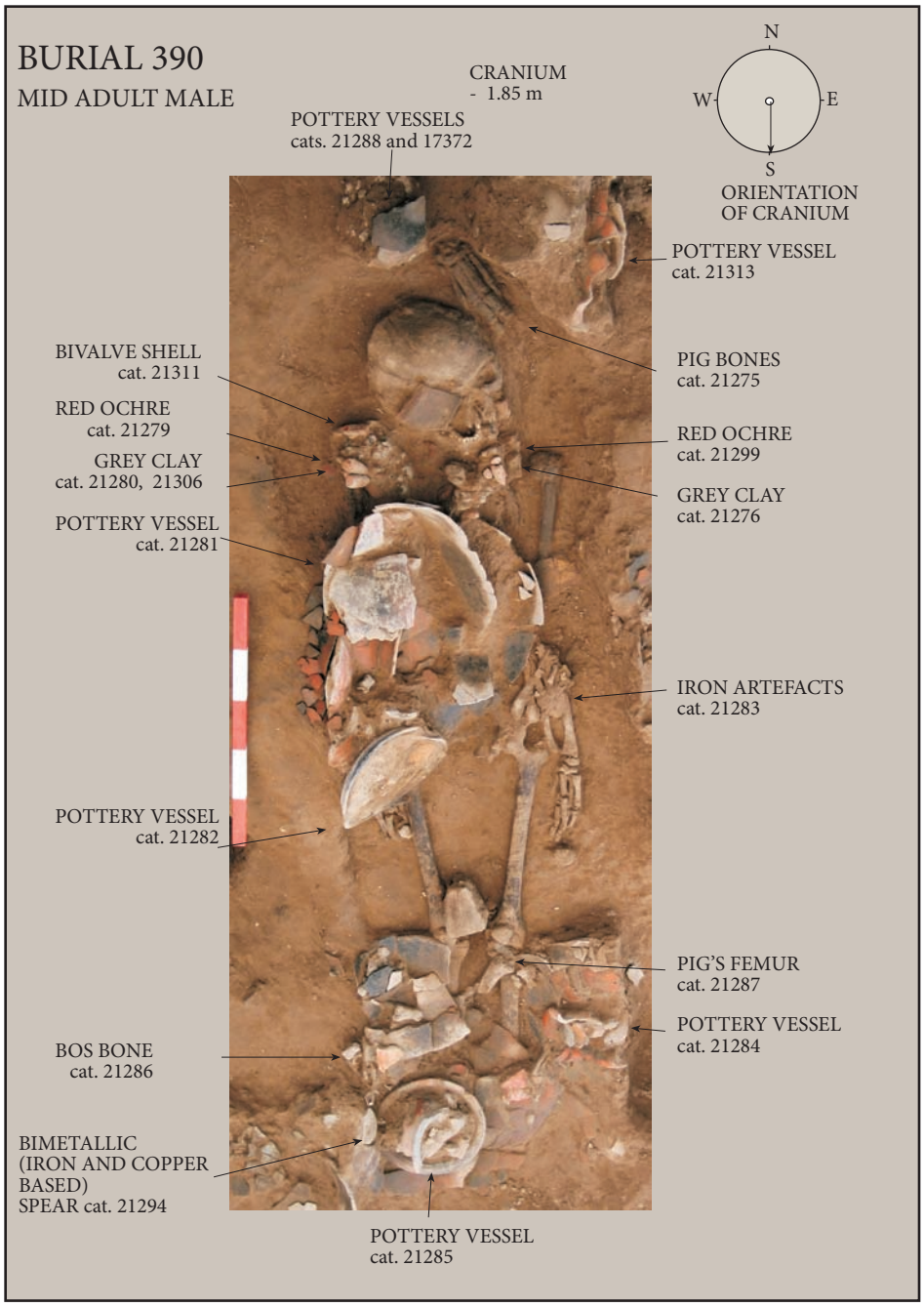


FIG. 13:50 Burial 390

Burial 390 is the complete grave of a mid adult man, interred at a depth of 185 m below datum, with the head orientated to the south. He was accompanied by one pot of form 51, three of form 45 and two of form 55, A spear with an iron blade and bronze haft lay to the right of the feet, and a set of iron implements, probably knives was found by the left hand. Other mortuary offerings included a bivalve shell, at least 11 red ochre pellets distributed round the head and two sets of pig bones one beside the head and the other by the left knee. A *Bos* bone was found in pot cat. 21285. Finally a deposit of grey clay lay beside the head.

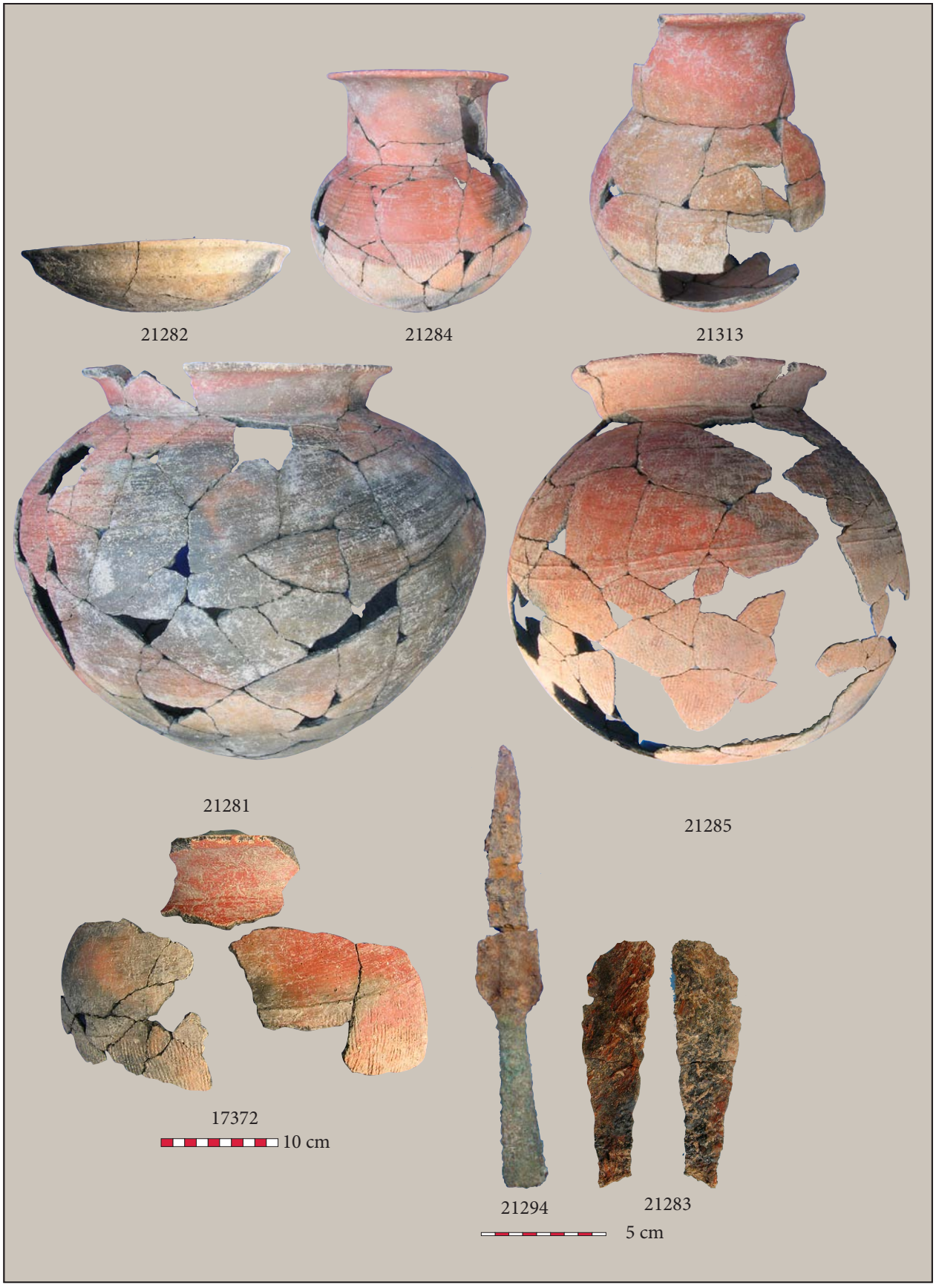
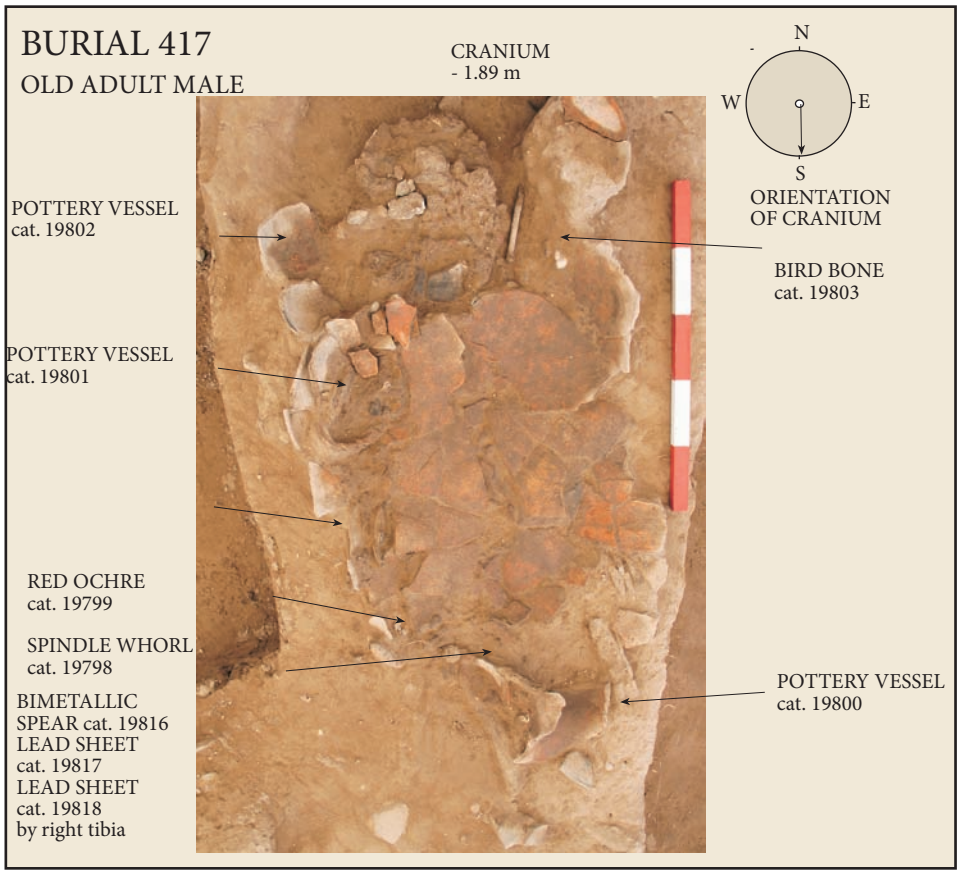


FIG. 13:51 Mortuary offerings with burial 390



Burial 417 contains an adult male found at a depth of 1.89 m and orientated with the head to the south. At least three pottery vessels were found over the upper part of the body, one being of forms 48 and 70. There was also a bimetallic spear, with an iron blade and bronze haft. Two most unusual artefacts of lead were found in the vicinity of the right hand, alongwith red ochre, and a spindle whorl.

FIG. 13:52 Burial 417



FIG. 13:53 Mortuary offerings with burial 417



FIG. 13:54 Burial 433

Burial 433 is a relatively complete mid adult male burial, found at a depth of 1.99 m below datum. The grave was orientated with the head to the south. A pottery vessel and pig bones were located near the right shoulder.



FIG. 13:55 Burial 576

Burial 576 is a complete adult, found at a depth of 1.49 m below datum. The head was orientated 170° east of north. No grave goods were found. The grave lies alongside burial 577, which orientated in the opposite direction.

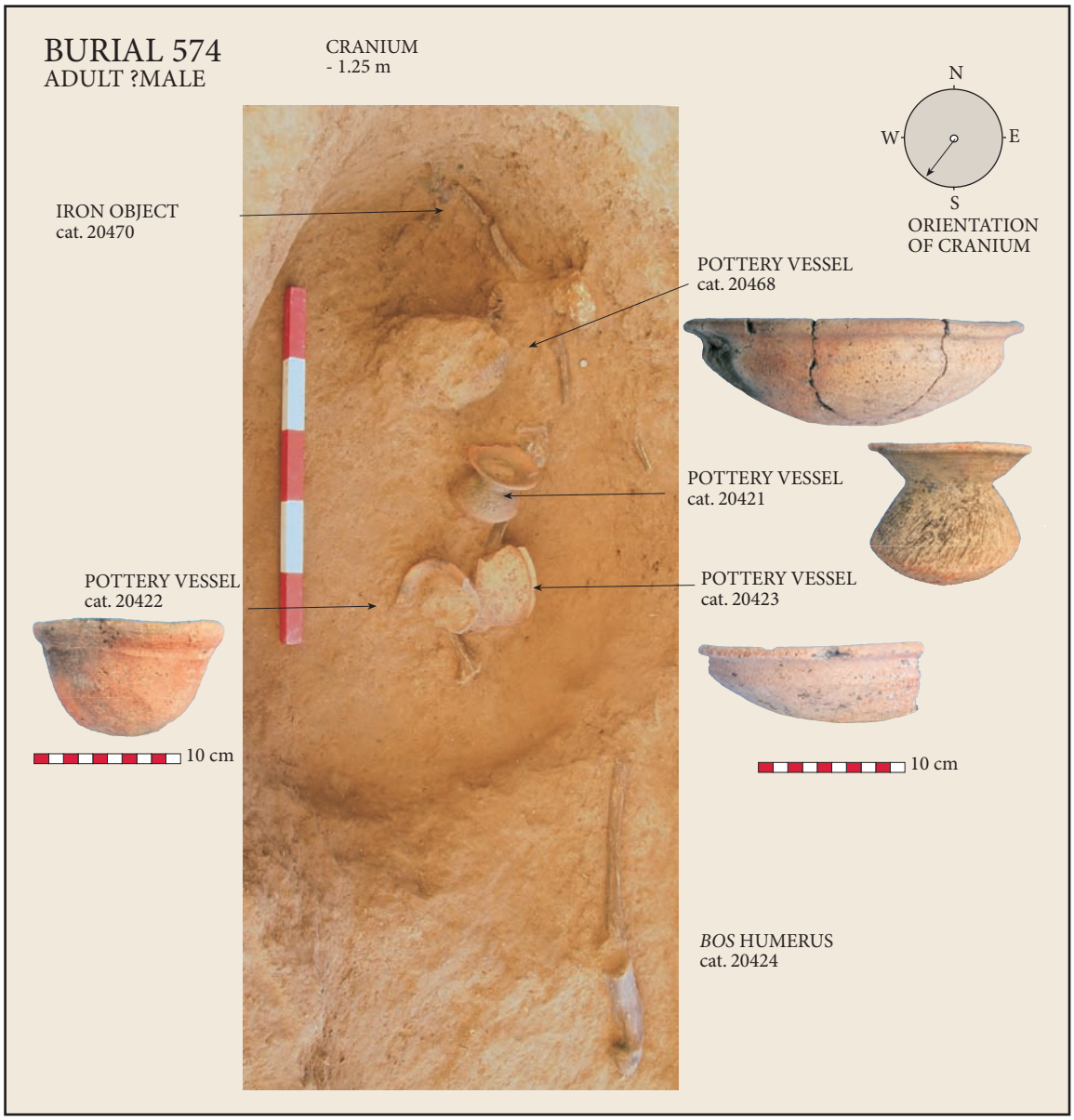


FIG. 13:56 Burial 574

Burial 574 involved an adult probable male, interred at a depth of 1.25 m below datum on an orienation with the head to the southwest. It was disturbed in antiquity. An iron artefact lay beyond the head, and a *Bos* humerus in the leg area. Four pots were found, two of form 51. The forms of the other two are unusual, and have their closest fit with forms 56 and 60.

Only the lower leg bones of burial 585 survived. The body of this adult ?male was interred with the head directed to the north. One pot of form 51 was found on the right femur.

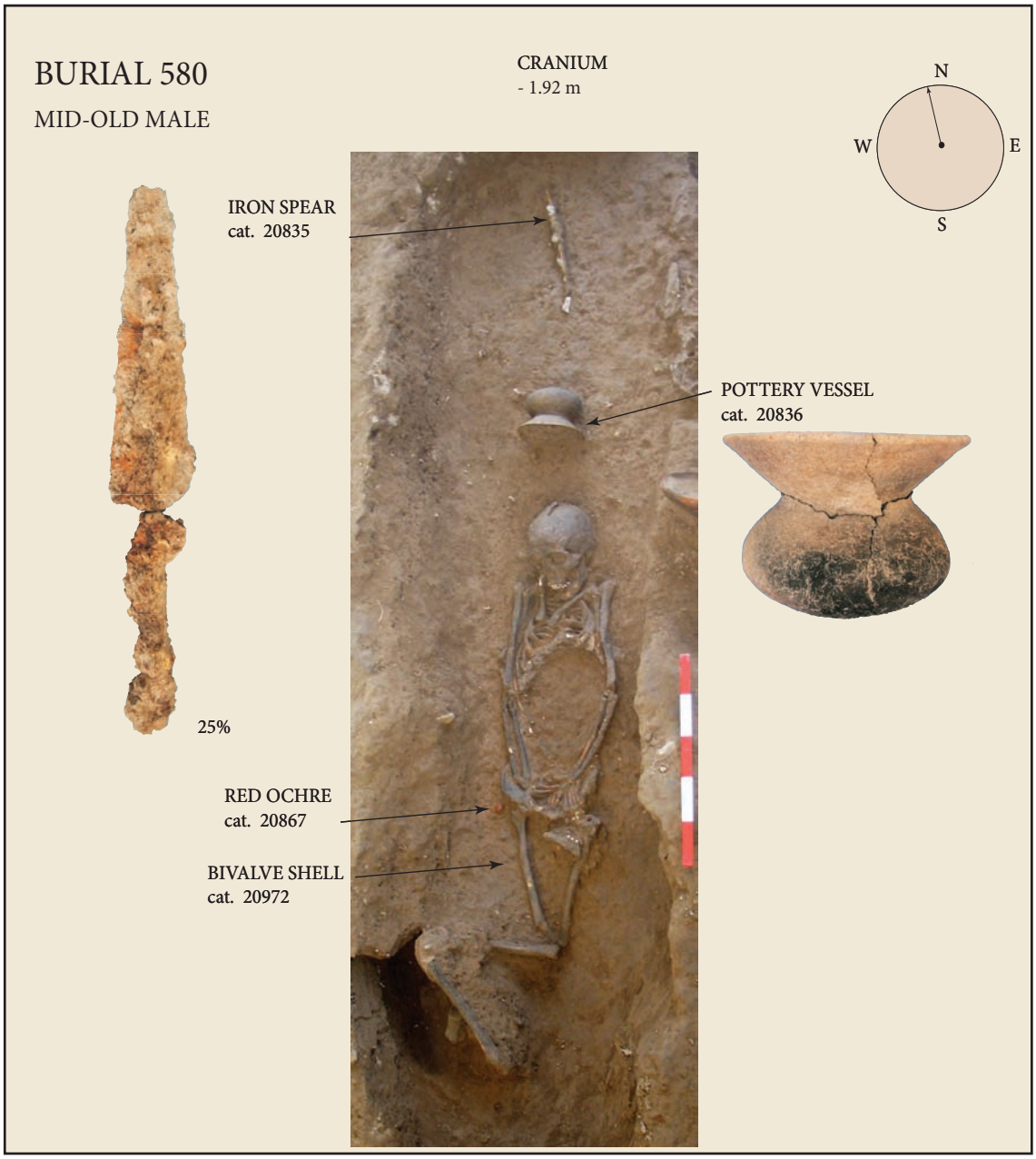


FIG. 13:57 Burial 580

Burial 580 lay on a northerly orientation in the southern part of the excavated area. The lower part of the grave was disturbed in antiquity. It was found at a depth of 1.92 m below datum. A pottery vessel of form 5 lay beyond the head, and further still to the north, and on the same orientation of the burial there was a large, socketed iron spear. Red ochre and a bivalve shell beside the right hand complete the set of mortuary offerings.



FIG. 13:58 Burial 580, showing a close up view of the upper body and ceramic vessel. Scale 10 cm



FIG. 13:59 Burial 587

Burial 587 was found at a depth of 1.90m, placed with the head directed 340° from north. It lay adjacent to the mid-old woman in burial 588, the heads touching each other. Two pots lay beside the cranium: one is of form 45, the other form 72. A deposit of grey clay was found in the same area as these pots.

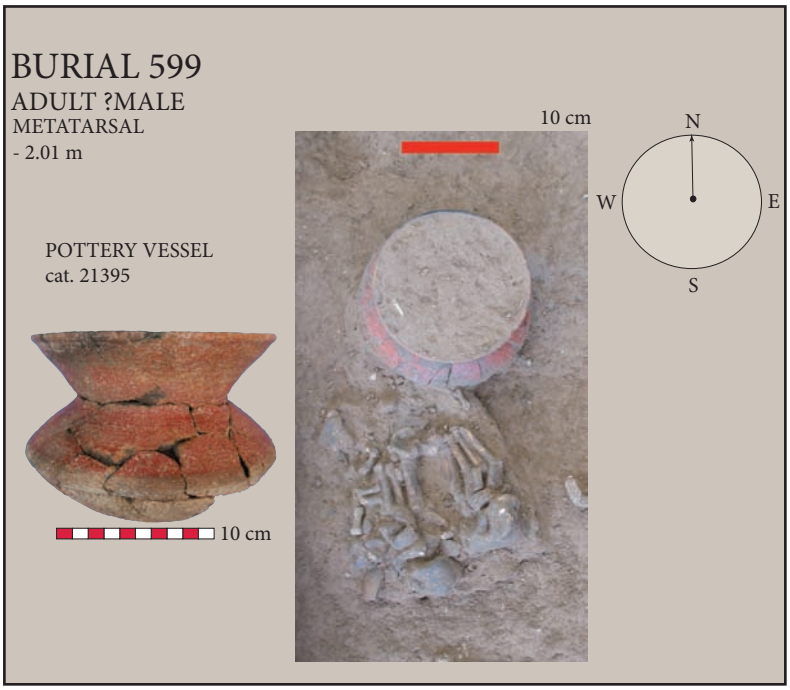


FIG. 13:60 Burial 599

Burial 599 comprised only the foot bones of an adult ?male, at a depth of 2.01 m below datum. The body was orientated with the head to the north. A single pot of unusual form, resembling form 50, was located beside the bones. Pot cat. 21395 contained eight fish vertebrae, *Clarias* sp., 1 small fragment of neurocranium and *Channa striata* 1L premaxilla.

XIV ADULT BURIALS OF IRON AGE PERIOD 1: SOUTHERN GROUP

C.F.W. HIGHAM

This chapter describes the adult burials of the southern group for which cannot at present be designated either male or female.

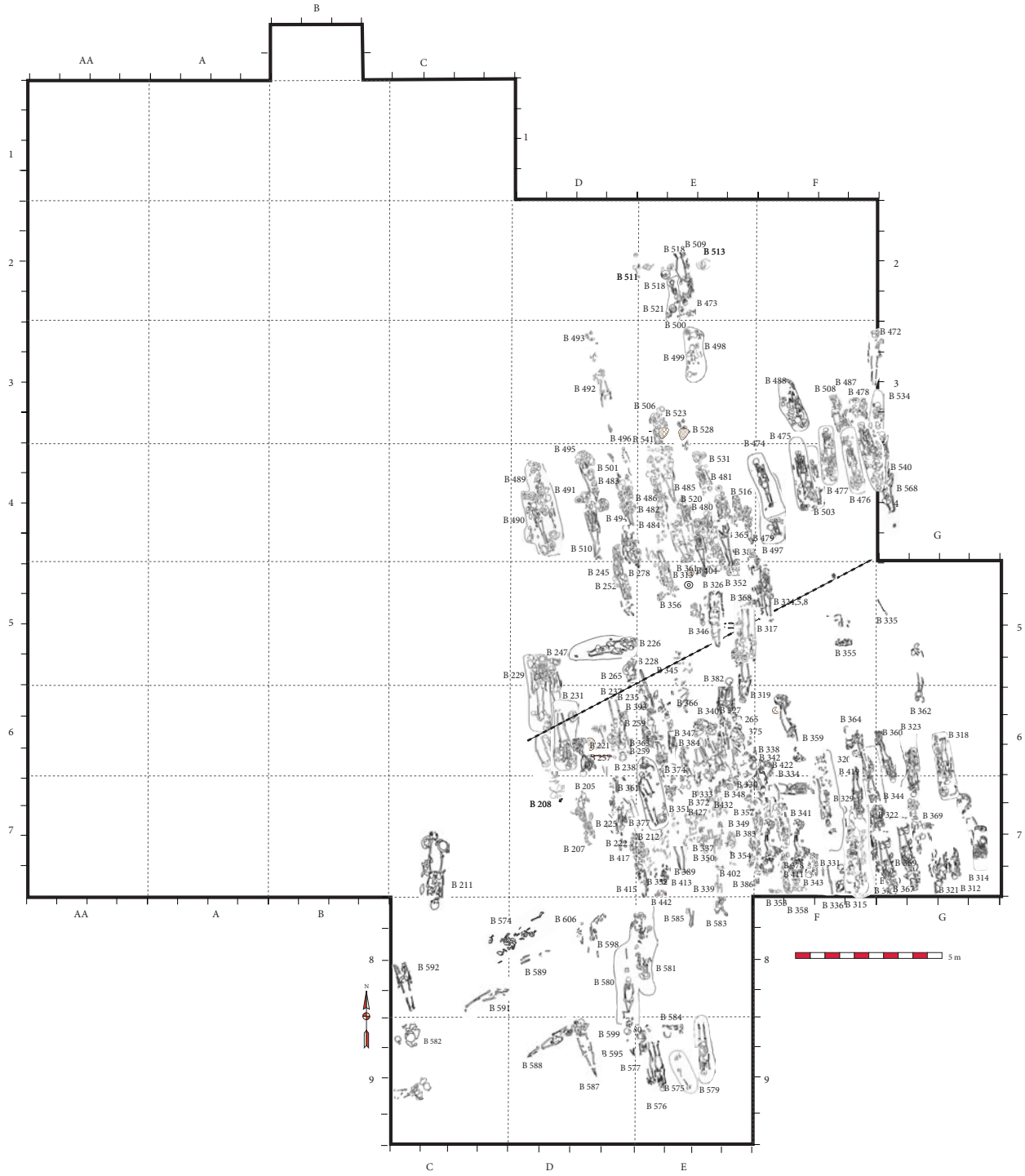


FIG. 14:1 The distribution of Iron Age 1 graves

TABLE 14:1 *The mortuary offerings for Iron Age 1 adult burials, southern group*

burial no.	207	208	225	321	329	334	344	359	360	372	375	382	384	393	422	432	577	581
age	MA	YA	OA	Adol	Adol	A	A	A	MA		A	MOA	YA	A	YA	A	A	A
orientation	160°	170°	N	S	S		160°	S	160°	S	N	N	S	180°	S	S	340°	170°
depth (metres)	1.77	1.75	1.97	1.62	1.86	1.98	1.78	1.96	1.70	1.92	1.94	2.13	2.07	2.15	1.87	2.10	1.61	1.95
n pots	3	0	3	10	7	0	9	7	6	6	6	0	3	8	1	2	4	3
pot form 5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 41	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0	0	0	0
pot form 45	0	0	0	0	2	0	0	1	0	0	1	0	0	1	0	0	2	0
pot form 47	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
pot form 48	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1
pot form 51	2	1	1	5	2	0	3	2	3	2	2	0	1	2	0	0	1	1
pot form 54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pot form 55	0	0	0	3	0	0	3	0	2	0	2	0	1	1	0	0	0	0
pot form 57	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pot form 61	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
pot form 62	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
pot form 63	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bivalve shell	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1
pig bones	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
red ochre	0	0	0	1	3	0	0	2	1	3	12	0	2	0	1	1	0	1
spindle whorl	2	0	1	2	0	0	1	0	0	0	2	0	0	0	0	0	0	2
Bos bone	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
water buffalo bone	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
fish skeleton	0	1	0	12	4	0	4	0	5	6	3	0	0	1	0	3	0	0
dog bone	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
grey clay	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
shell bangle	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0
bronze ring	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bronze bangle	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
bronze arrowhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
bronze anklet	0	0	0	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0
iron bangle	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
iron object	12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
iron knife	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0
iron spear	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
iron chisel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
agate beads	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ivory bangle	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
pellet bow pellet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6

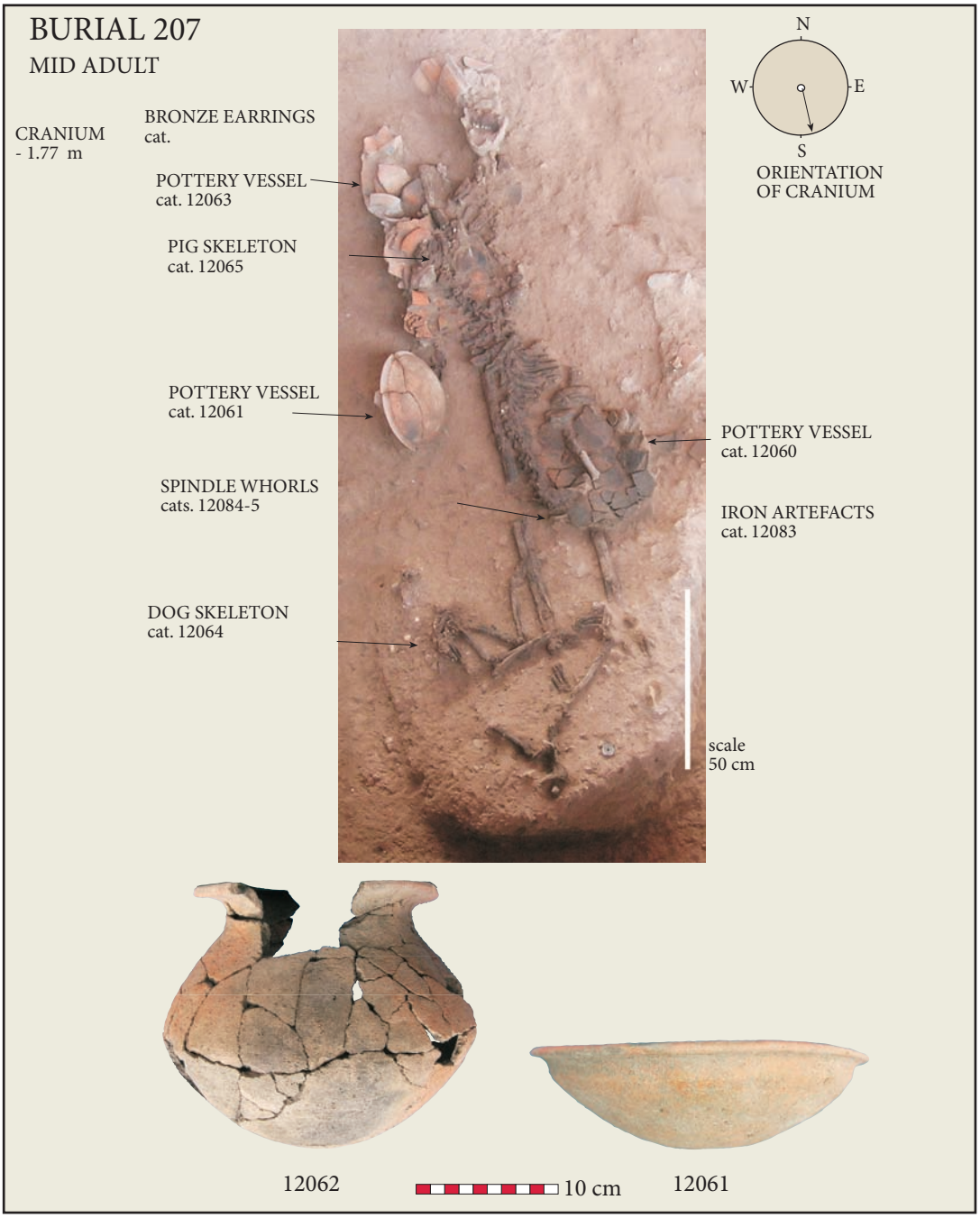


FIG. 14:2 Burial 207

Burial 207 was found at a depth of 1.77 m below datum, with the head orientated 160° from north. It was disturbed in antiquity. This person was interred together with the body of a dog and a pig, the former at the feet and the latter over the right side. There were also three pottery vessels, two of which can be reconstructed for form 51. Two spindle whorls had been placed between the knees. At least 12 iron artefacts were found as a tight cluster over the left knee. These look like points, or perhaps tanged knives/awls and represent a set of tools. They were covered in skeuomorphic fabric. This might have been the bag in which they were contained, or either a shroud or clothing.

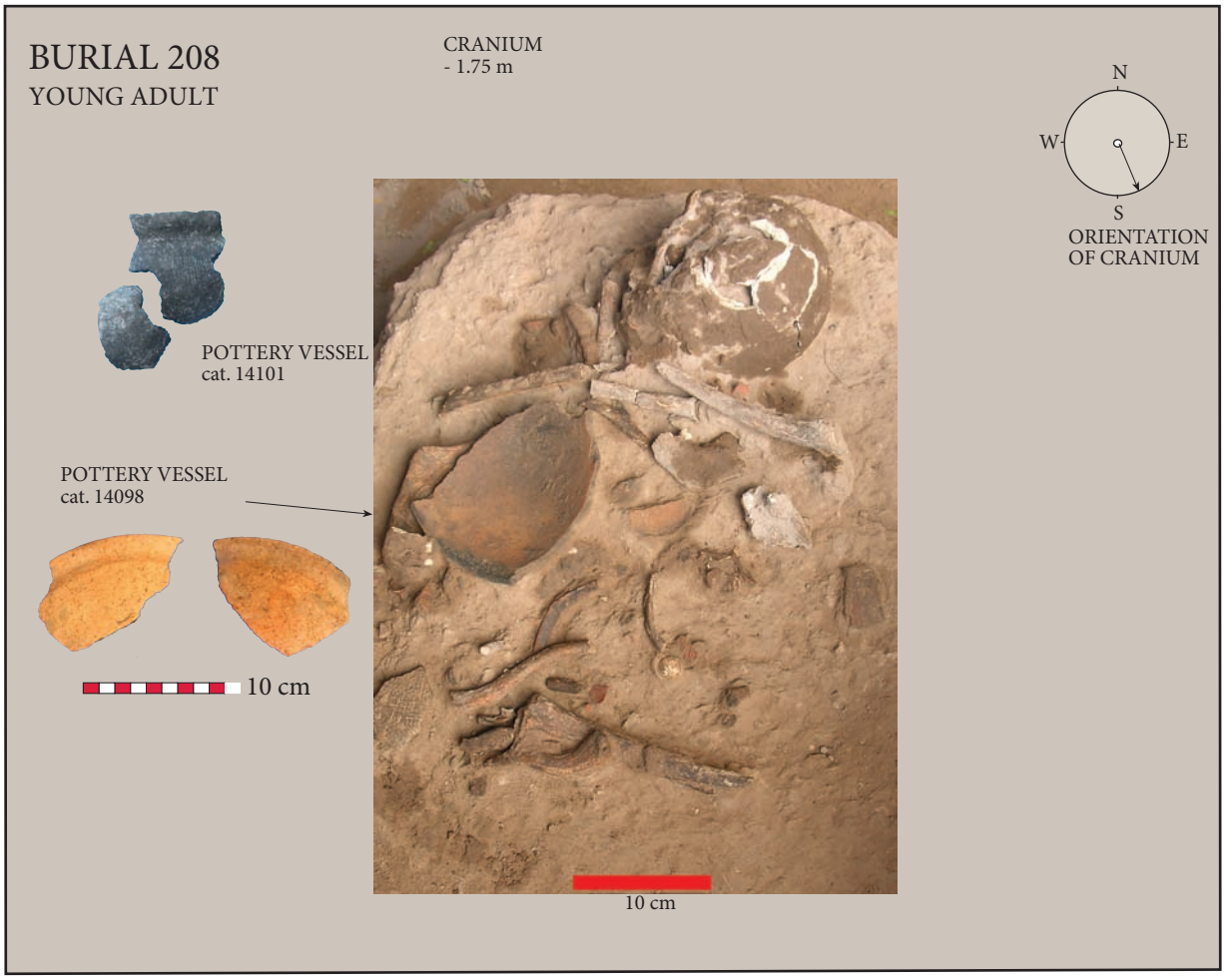


FIG. 14:3 Burial 208

Burial 208 was found at a depth of 1.75 m below datum, oriented with the head directed 160° from north. It was excavated over two seasons. In the first the disturbed region of the upper body was revealed, along the fragrments for a form 51 pot. A year later, the limb bones were found, with a second pot beside the left thigh. While fragmentary, it probably belongs to form 5. Pot cat. 14098 contained one left fin spine from the fish *Clarias* sp. This grave lay parallel with that for 231, and the lower part was disturbed with the interment of burial 229.



FIG. 14:3 Burial 207, showing the dog skeleton. Scale 10 cm

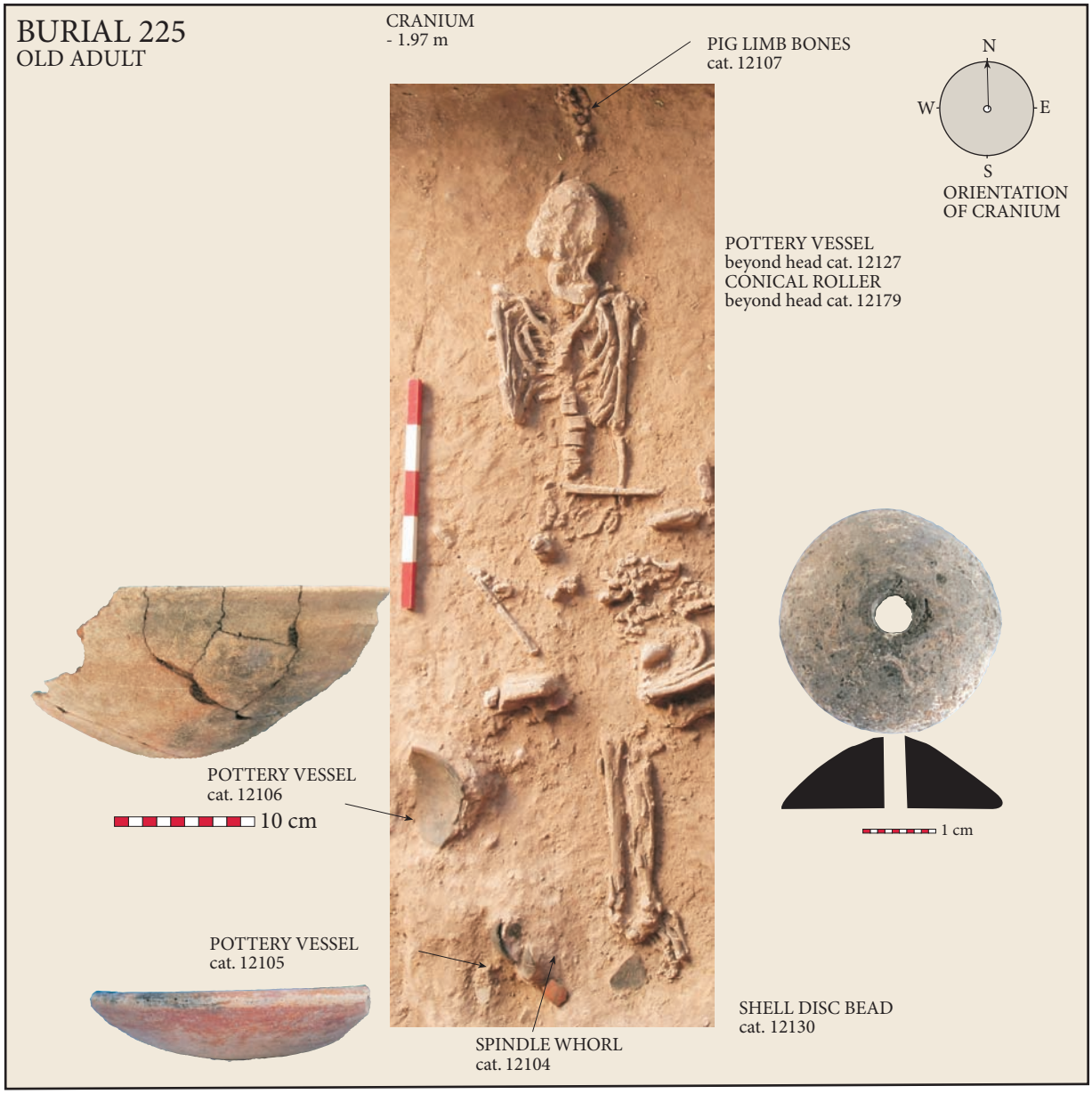


FIG. 14:4 Burial 225

Burial 225 was found at a depth of 1.97 m below datum, in a grave with the head orientated to the north. Three pottery vessels were found, two by the ankles and one beyond the head. One cannot be reconstructed, the other two are of forms 51 and 57. Articulating pig's limb bones were found beyond the head and a spindle whorl lay beyond the ankles. A conical roller and single shell disc bead are probably fortuitously present.

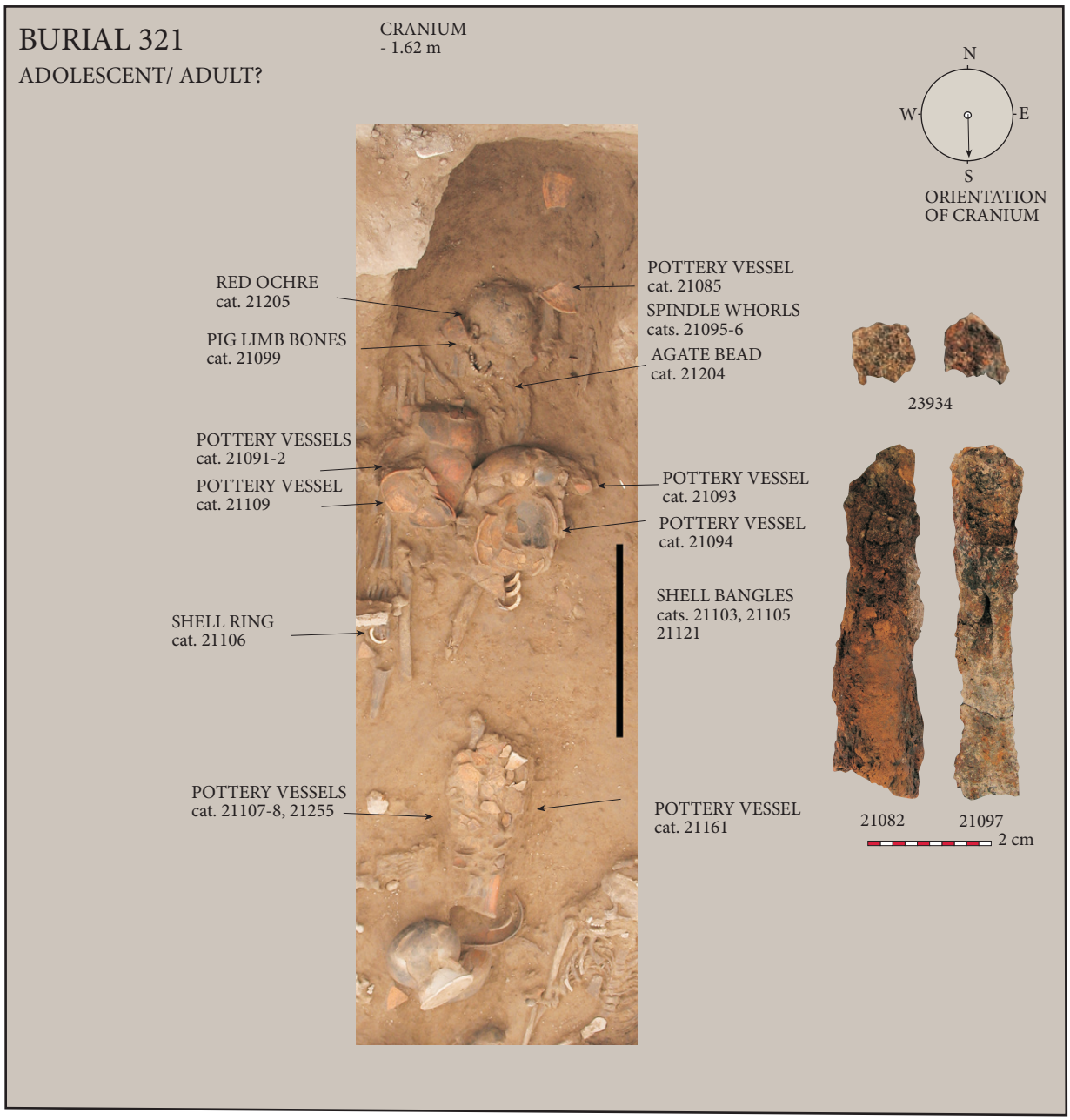


FIG. 14:5 Burial 321

Burial 321 was found at a depth of 1.62 m below datum in a grave oriented with the head to the south. The lower part of the skeleton of an adolescent had been disturbed in antiquity. Ten ceramic vesels were encountered, over the upper body and by the feet. Five are of form 51, and there are three of form 55 and a single form 48. This person wore four shell bangles on the left wrist and one on the right. An agate bead was found in the area of the neck. Two spindle whorls had been placed to the left of the cranium. Pig's bones lay to the right of the head, which also was partially covered in red ochre. Two thin iron artefacts looking like knives were found over the right hand, and another fragment of iron was probable also associated with this individual. The following fish bones were found: contents of pot cat. 21109, cat. 21258 *Clarias* sp. 1L, 2R pectoral fin spine; frontal bone (L+R) with nerve foramen and 2 small fragments of neurocranium, three individuals. *Anabas testudineus* 1R lacrymal. *Channa striata* three whole fish. Contents of pot cat. 21112, *Clarias* sp. 3L, 1 R pectoral fin spine; 1R cleithrum, four individuals. *Hemibagrus/Mystus* 1L pectoral fin spine. *Anabas testudineus* 1L lacrymal. *Channa striata* 1R lower pharyngeal; 1R hyomandibular.

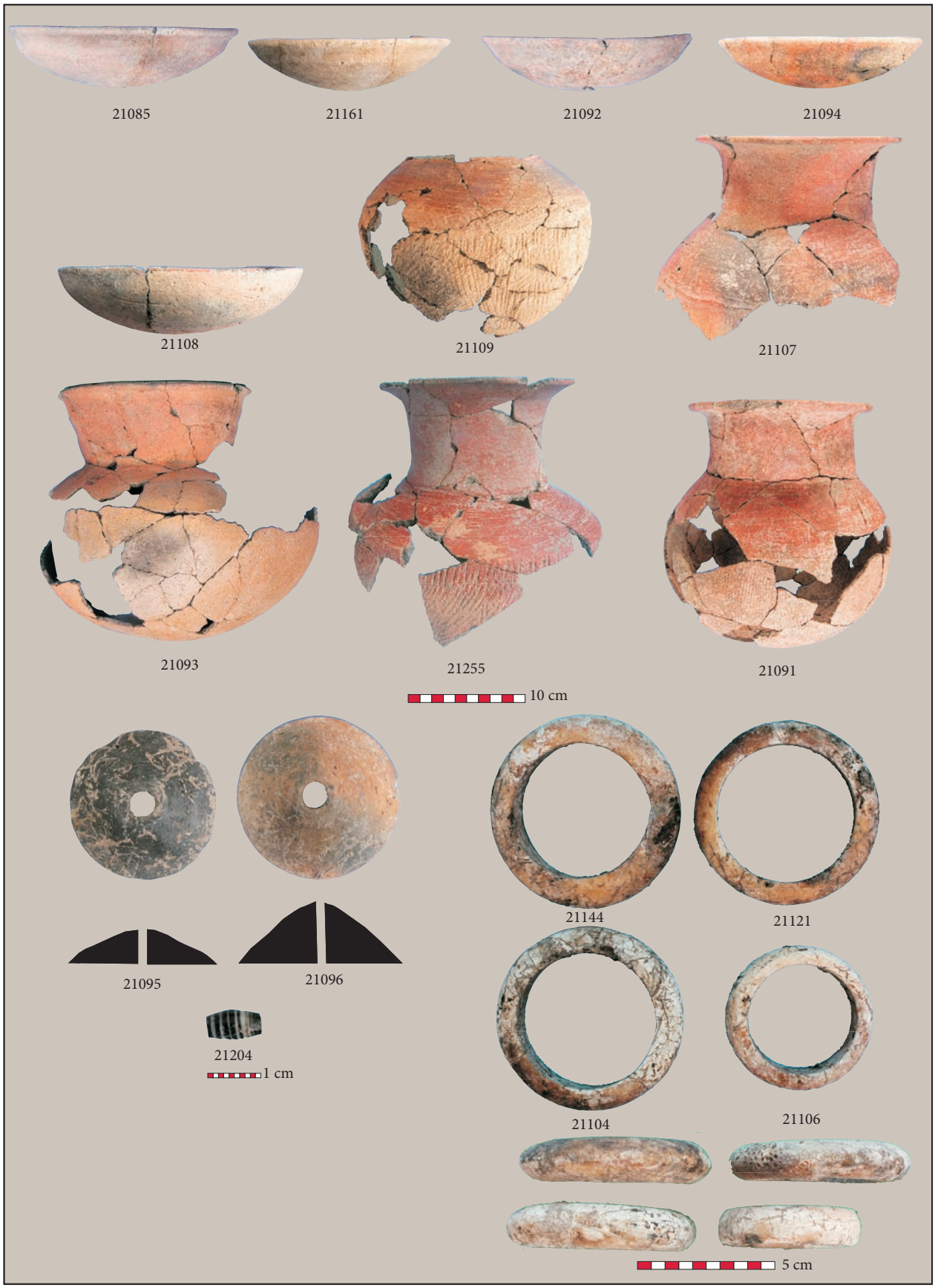


FIG. 14:6 Mortuary offerings with burial 321

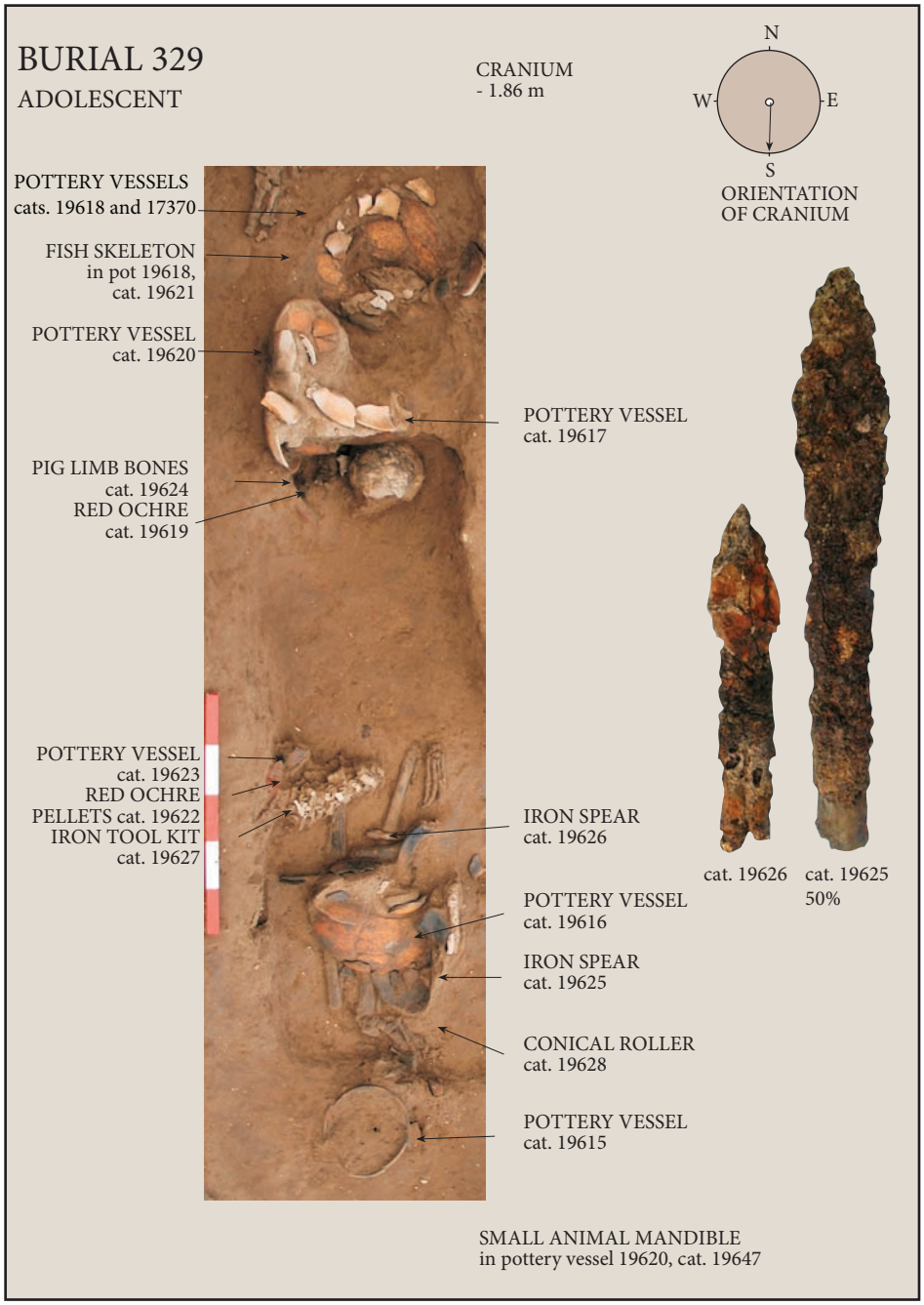


FIG. 14:7 Burial 329

Burial 329 contained the skeleton of an adolescent and was found at a depth of 1.86 m laid out with the head orientated to the south. Seven ceramic vessels were found in association, they may have been more but the central part of the grave was disturbed. The surviving pots were found over the lower legs and beyond the head. The five identifiable pots belong to forms 45 and 51, of which there are two each, and there is one form 41. Pot cat. 19618 contained the remains of four fish, as follows:- *Clarias* sp. 1R pectoral fin spine; *Anabas testudineus* 1R supracleithrum and *Channa striata* two whole skulls. Pig's limb bones were found beside the head and the mandible of a small, unidentified animal was found in pottery vessel 19620. A pellet of red ochre lay in the same area, with two more by the right hand. This person was accompanied by several iron artefacts. A socketed spear lay beside the left tibia and another was found laterally across the left femur. A collection of small and thin iron tools, some of which look like knives, was found beside the right femur.

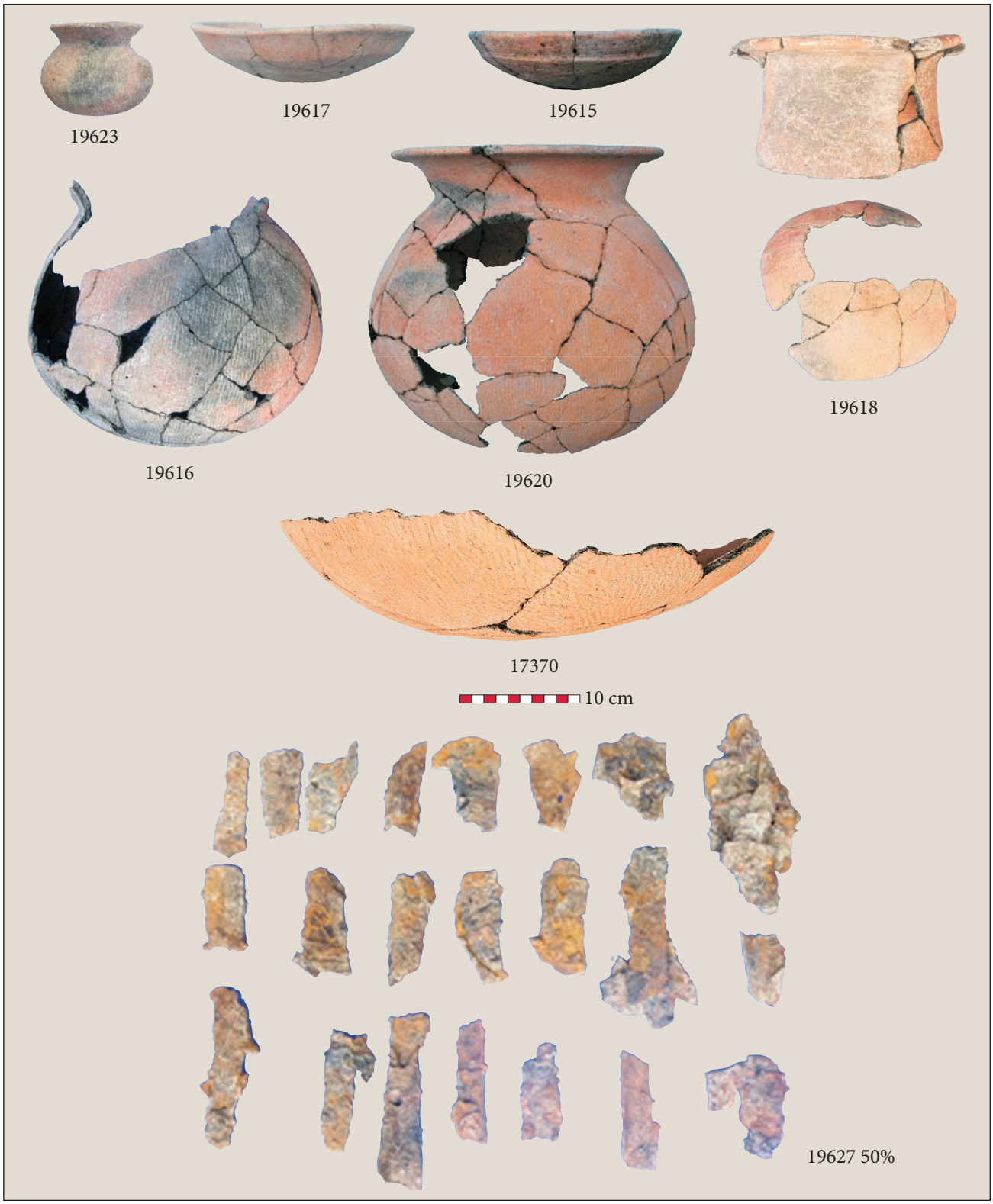


FIG. 14:8 Mortuary offerings from burial 329

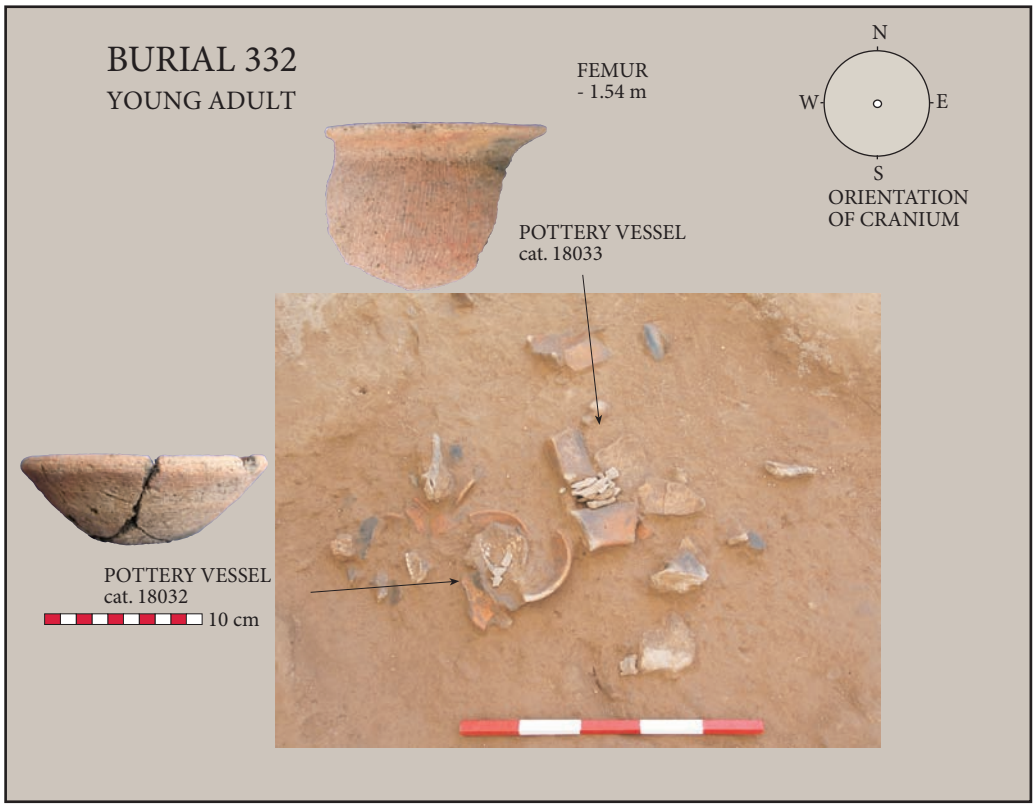


FIG. 14:9 Burial 332

Burial 332 was very badly disturbed. It contained the bones of a young adult, in association with at least two pots. One of these is of form 51. The remains were found at a depth of 1.54 m below datum

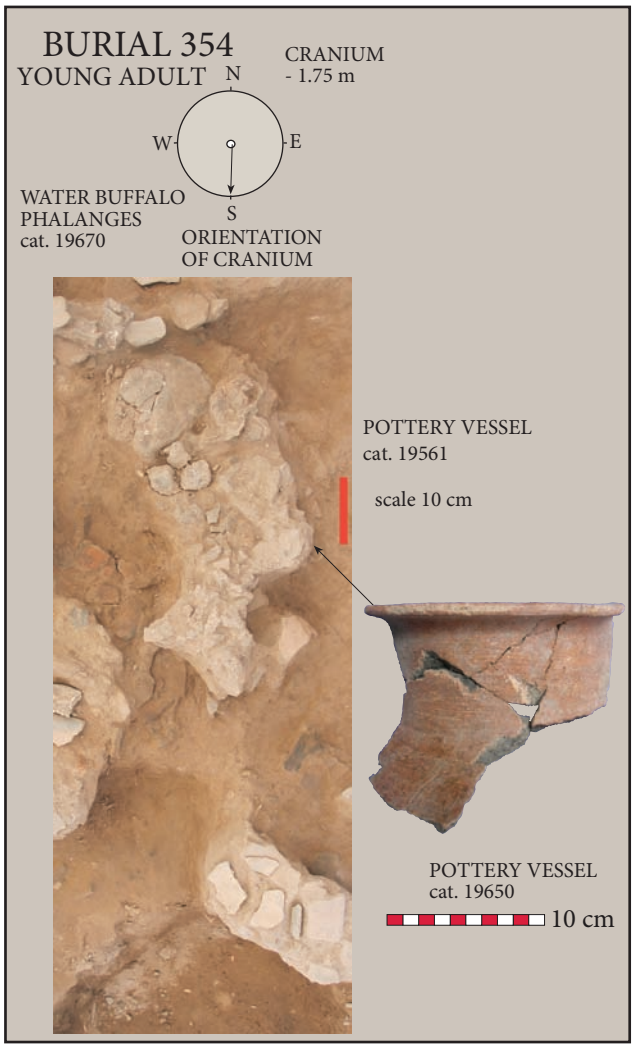


FIG. 14:10 Burial 354

Burial 354 was very badly disturbed and only the fragmentary skull and some finger bones of a young adult have survived. The grave was found at a depth of 1.75 m and was orientated with the head to the south. two fragmentary pots survived, one of which is probably form 55. There were also some water buffalo bones in the area beyond the head

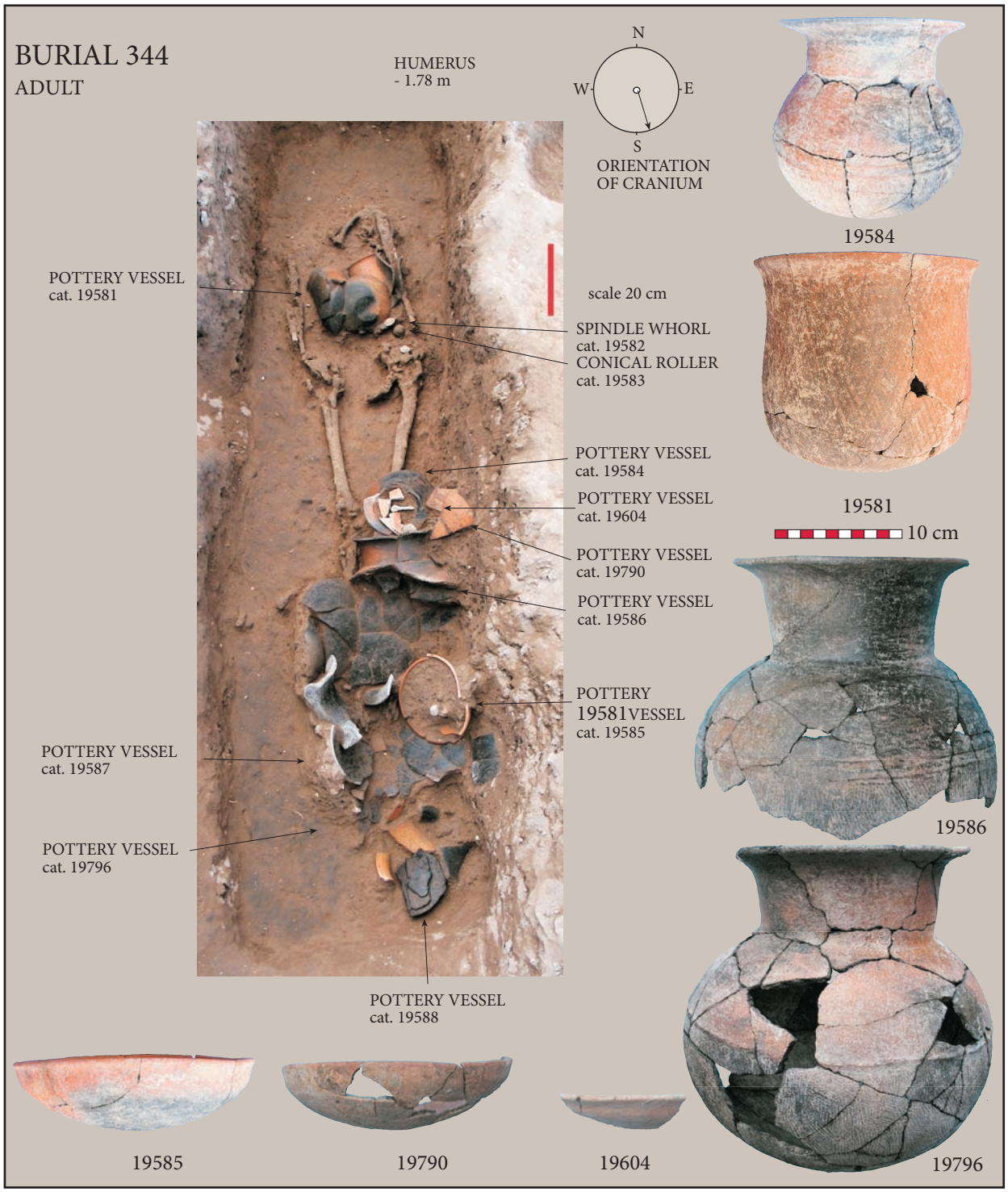


FIG. 14:11 Burial 344

Burial 344 was found as a complete grave with the skeleton 1.78 m below datum. It was orientated with the head directed 160° to the south. Nine ceramic vessels were found in association, one over the chest, and the rest over the lower limbs. The skull, however, is missing. There are no grave goods beyond the head. A spindle whorl was found by the left hand, along with a conical roller. The latter is unlikely to have been a deliberate offering. Pot Cat. 19584 contained *Monopterus albus* 1 urohyal, *Anabas testudineus* one right opercular and *Channa striata* one left (ventral end), and one right (dorsal end)cleithrum. Pot cat. 19586 contained *Clarias* sp. one right pectoral fin spine.

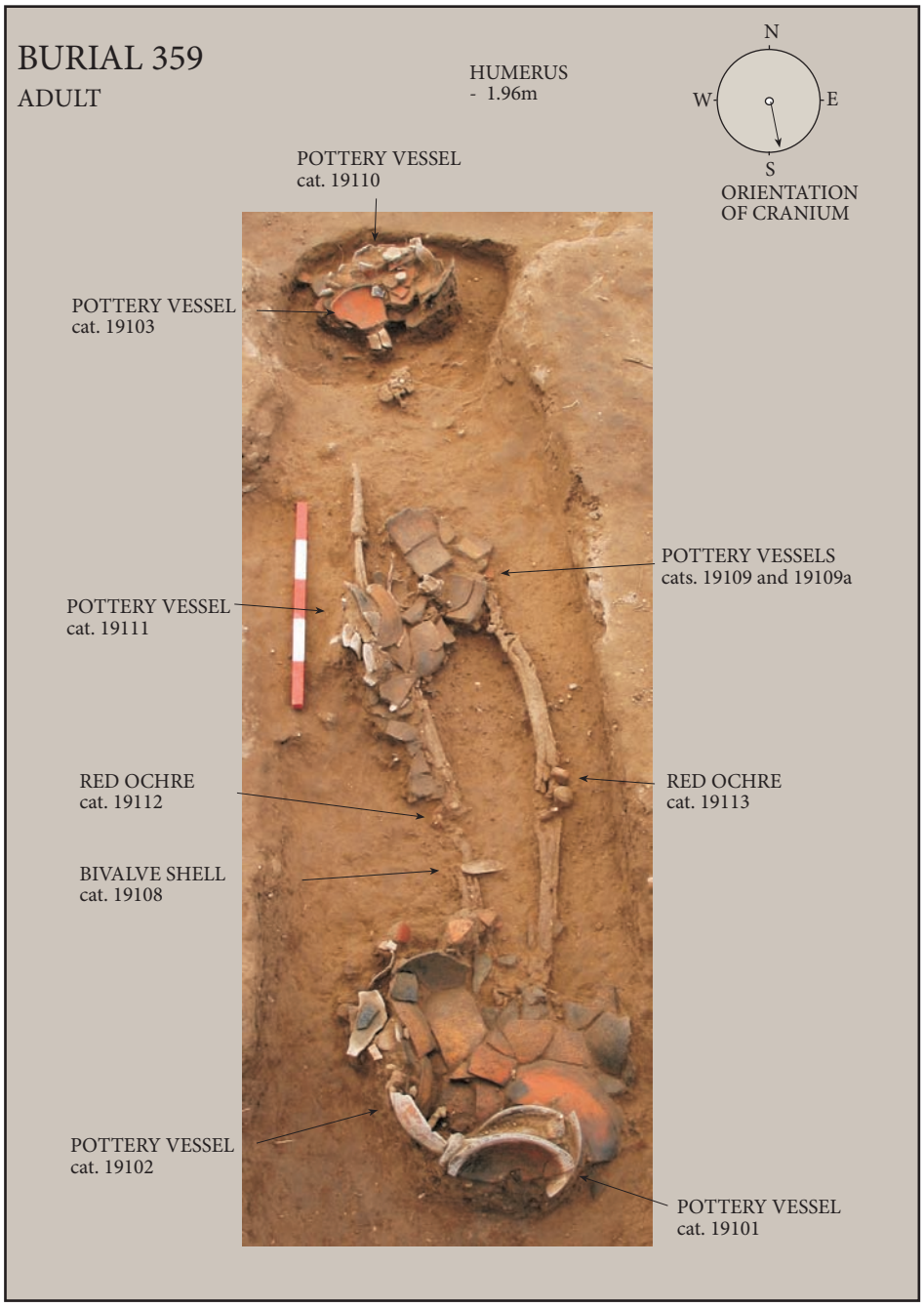


FIG. 14:12 Burial 359

Burial 359 was found at a depth of 1.96 m below datum, orientated with the head to the south. The upper part of the skeleton was largely missing. Two pottery vessels were found beyond the head area, three over the abdomen and the remaining two over the ankles. Two are of form 51 and there is one example of forms 41, 45, 48 and 62. Red ochre was found beside both knees, and a bivalve shell lay over the right lower leg.

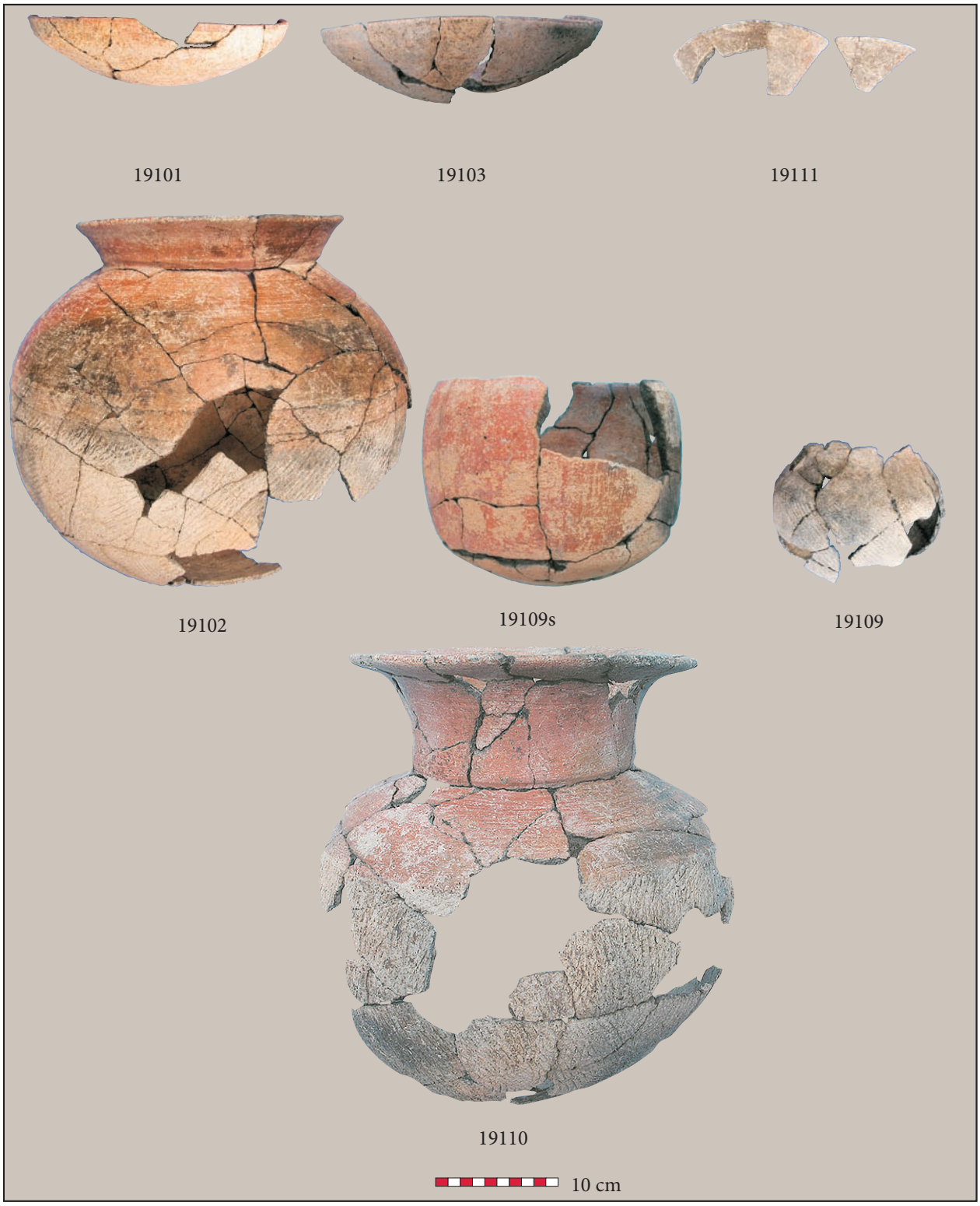


FIG. 14:13 Ceramic vessels from burial 359

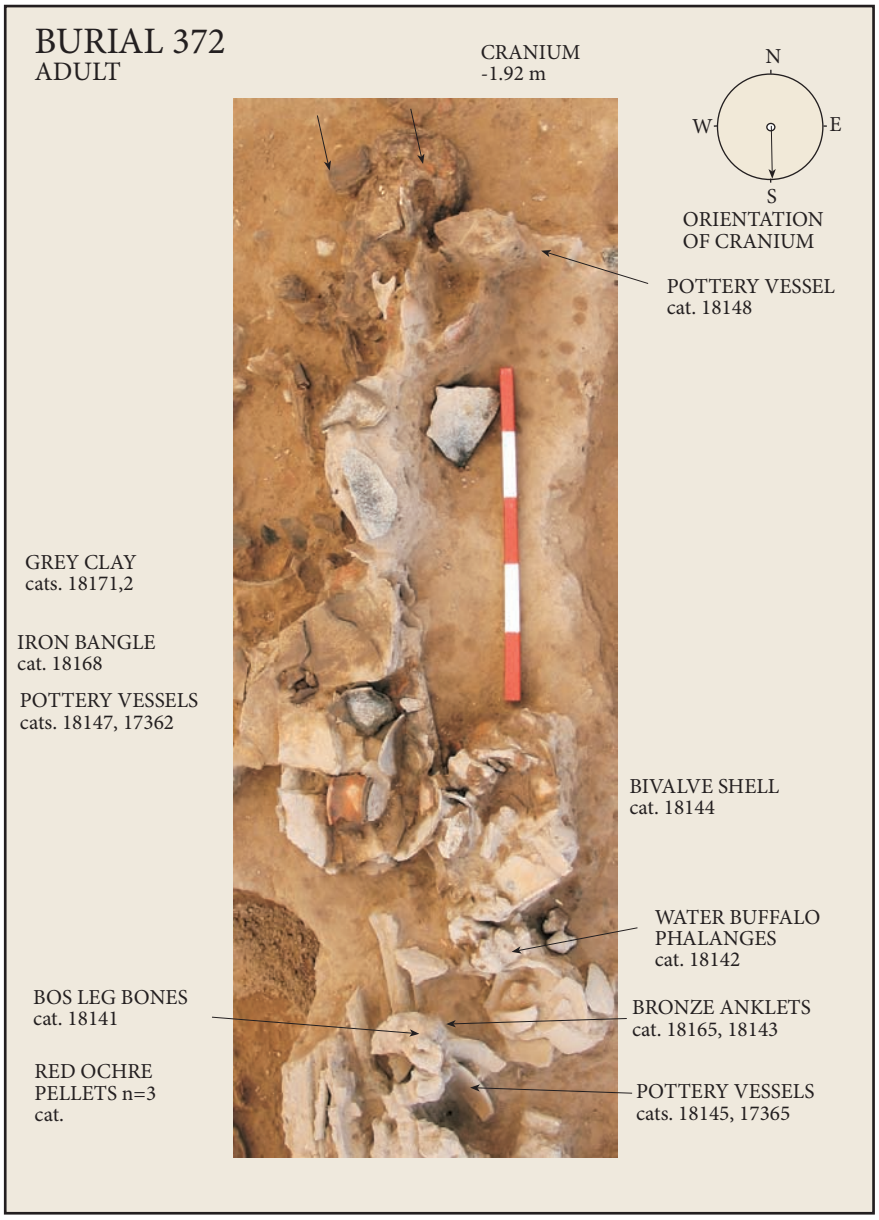


FIG. 14:14 Burial 372

Burial 372 was found at a depth of 1.92 m with the head orientated to the south. It was located in an area of heavily disturbed and concentrated Iron Age graves that proved very difficult to isolate in terms of the associated mortuary offerings. This individual was probably associated with at least six pottery vessels, of which two are of form 51 and one of form 47. Both water buffalo and bovid limb bones were found among the ceramic vessels over the legs. Other mortuary offerings include a bivalve shell and three pellets of red ochre. This person wore ten bronze anklets eaqually placed between the left and right ankles. These were hollow and appear to have been cast as sheets before being converted into anklets, as there is a seam running the entire length of the interior of each.

The following fish bones were found in pot cat. 18146: seven fish vertebrae and *Monopterus albus* 1R articular and *Channa* sp. 1L fragment of supracleithrum. Pot cat. 18148 contained 35 fish vertebrae *Clarias* sp. three small fragments of neurocranium, *Anabas testudineus* 1L lacrymal, *Channa lucius* 1 fragment of R articular and a fragment of R palatine and *Channa striata* 1L hypohyal; 2R ceratohyal; 1L maxilla; 1L palatine and 1R pterotic.

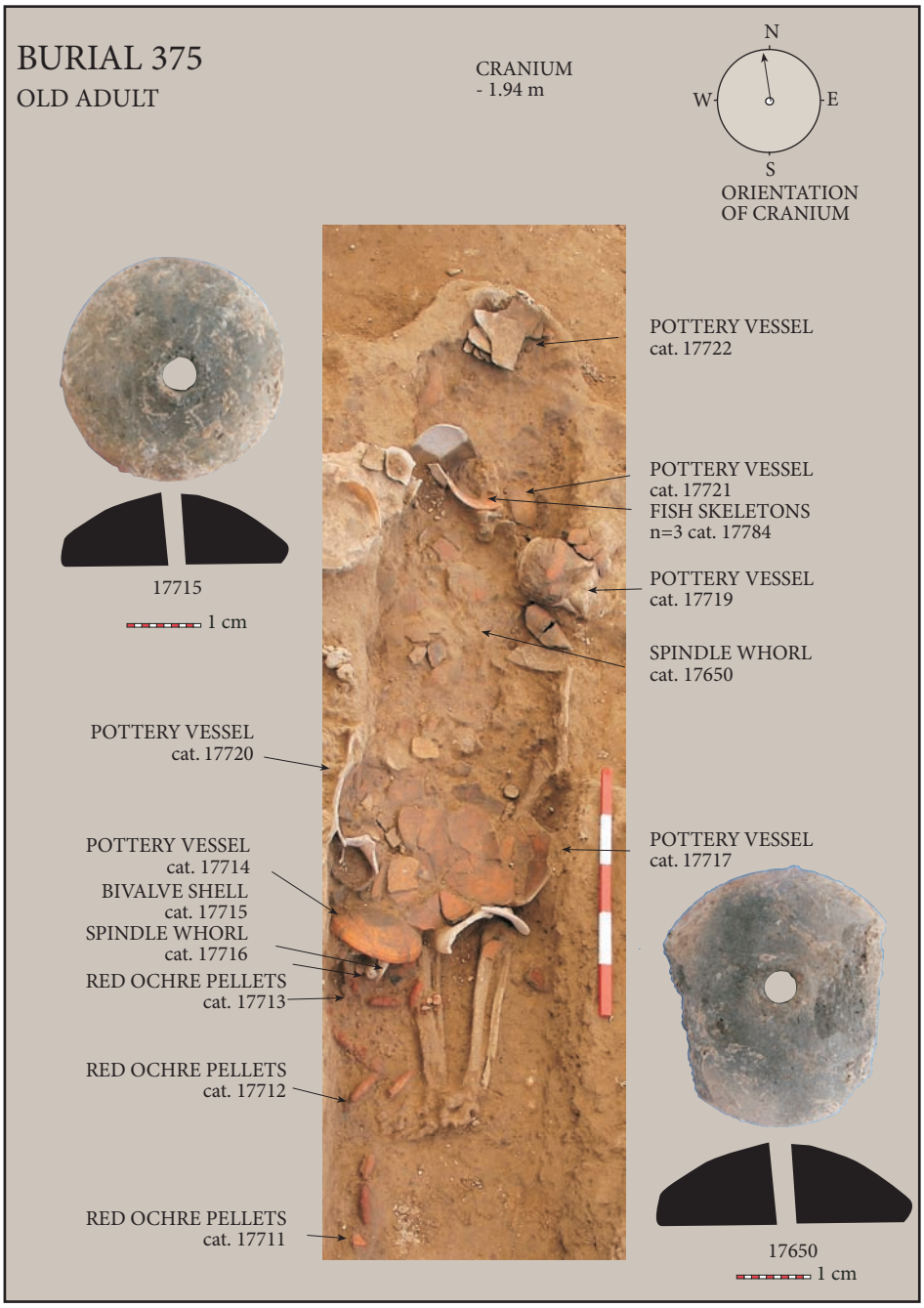


FIG. 14:15 Burial 375

Burial 375, that of an old adult, was found at a depth of 1.94 m below datum, with the head orientated to the north. At least six ceramic vessels were found as mortuary offerings, two of form 51, two form 55 and one of form 45. They were found over the knees and beyond the head. Two spindle whorls had been placed over the chest and to the right of the righ lower leg. There was also a series of 12 red ochre pellets beside the ankles and three skeletons of the fish *Channa striata* in pot cat. 17721.



FIG. 14:16 Burial 382

Burial 382 involved a mid-old adult, lying orientated with the head to the north at a depth of 2.13 m below datum. This grave lies on the northern edge of the southern group, and unlike nearly all of those in this series, was orientated to the north. No pottery vessels were found with this individual. However a most unusual range of bangles were encountered. Ten iron bangles were found, six on the left and four on the right hand. There are also five broad and thin bronze bangles one of which retains pseudomorphic woven fabric on the surface. An ivory bangle was found on the left wrist.

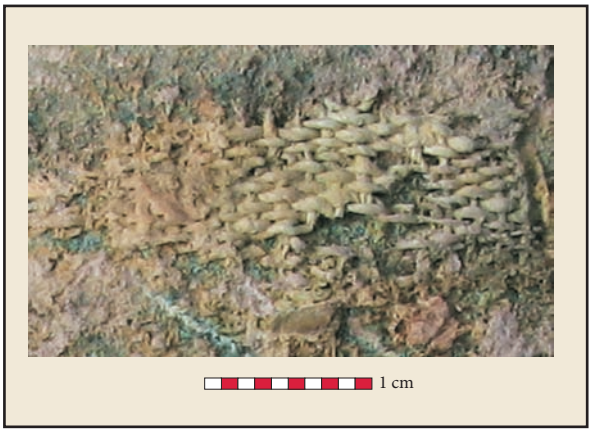


FIG. 14:17 The woven fabric surviving on the surface of the bronze bangle with burial 382

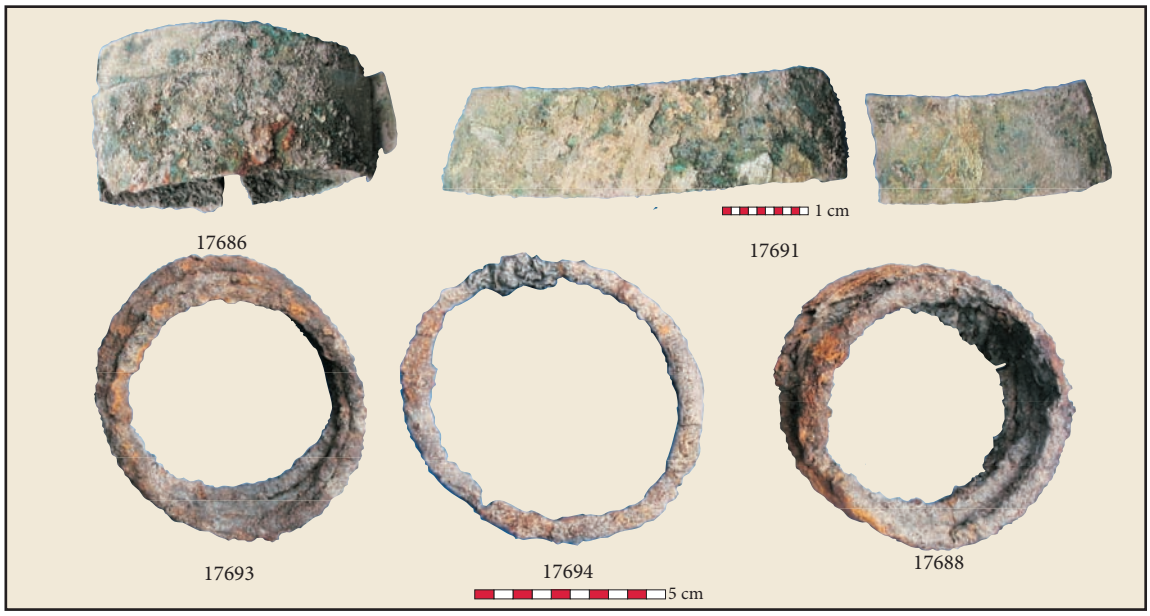


FIG. 14:18 Iron and bronze bangles from burial 382

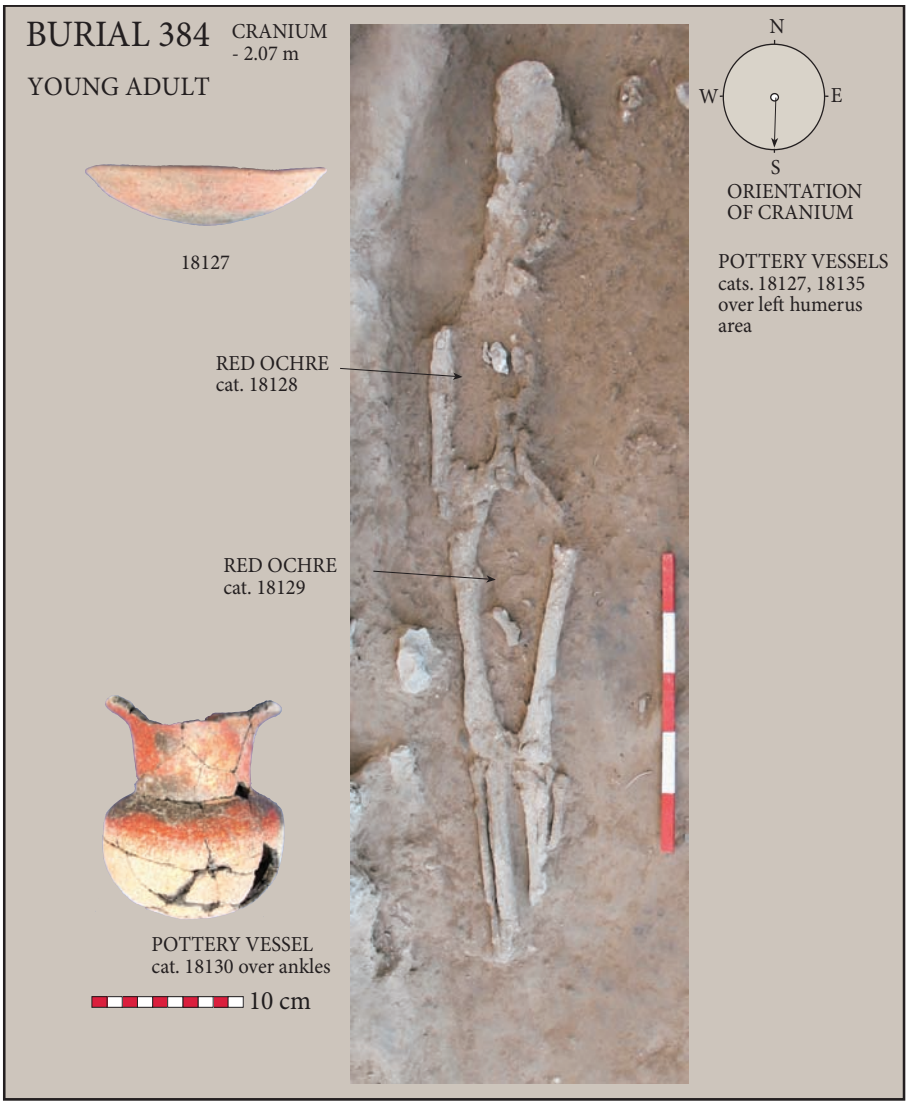


FIG. 14:19 Burial 384

Burial 384, a young adult grave, was found at a depth of 2.07 in a grave with the head directed to the south. Three ceramic vessels were found, although the burial had been disturbed in antiquity. One vessel is of form 55, the other form 51. Two pieces of red ochre were also present,

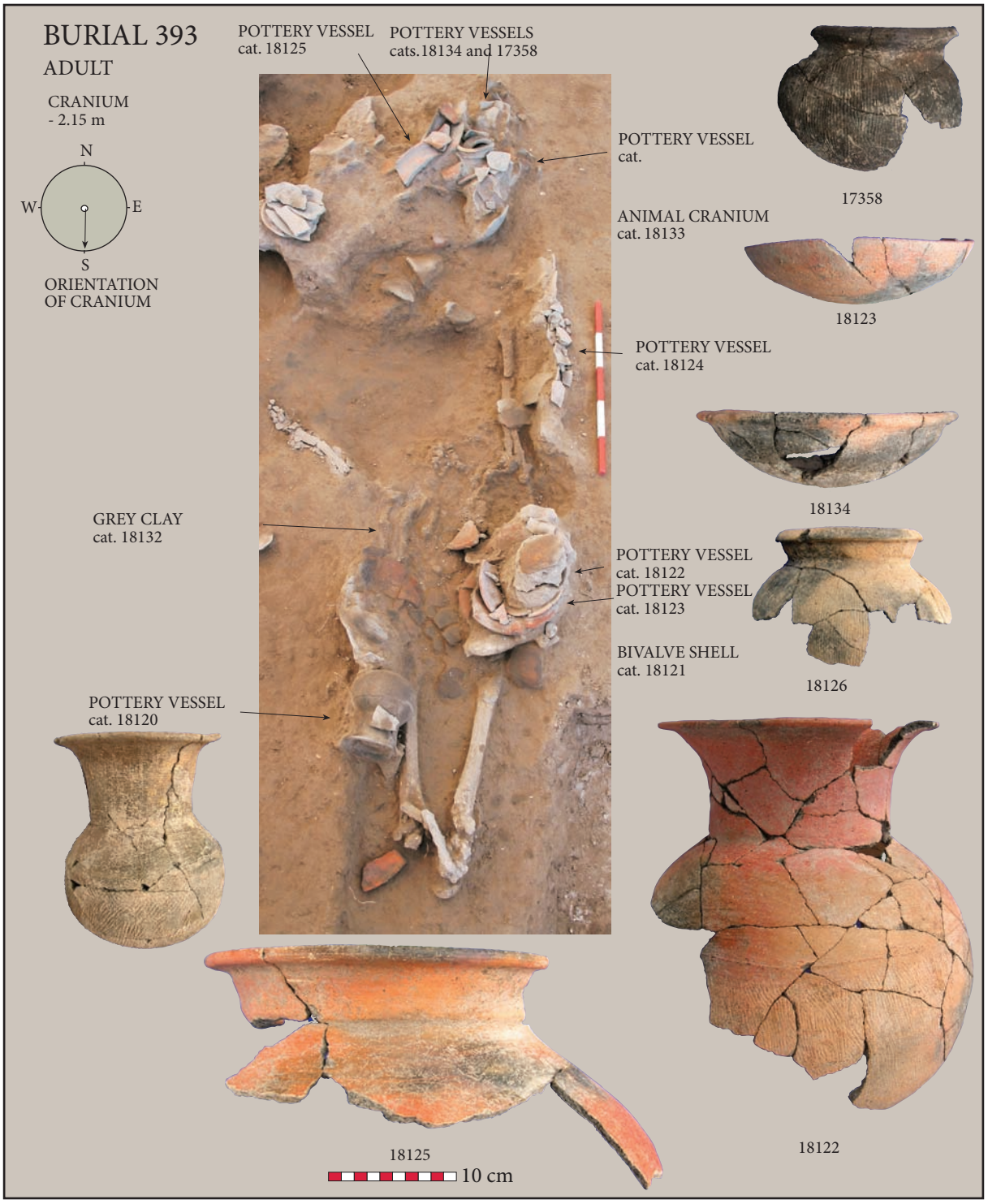


FIG. 14:20 Burial 393

Burial 393 was found at a depth of 2.15 m below datum, with the head of the grave directed to the south. There are eight ceramic vessels in association although the grave had been disturbed in the central part. Seven could be reconstructed, and of these, there are two of forms 41 and 51, and one of forms 45, 48 and 55. A bivalve shell lay over the left knee and there was also a deposit of grey clay in the same area. Part of the cranium of the fish *Channa* sp. was found.

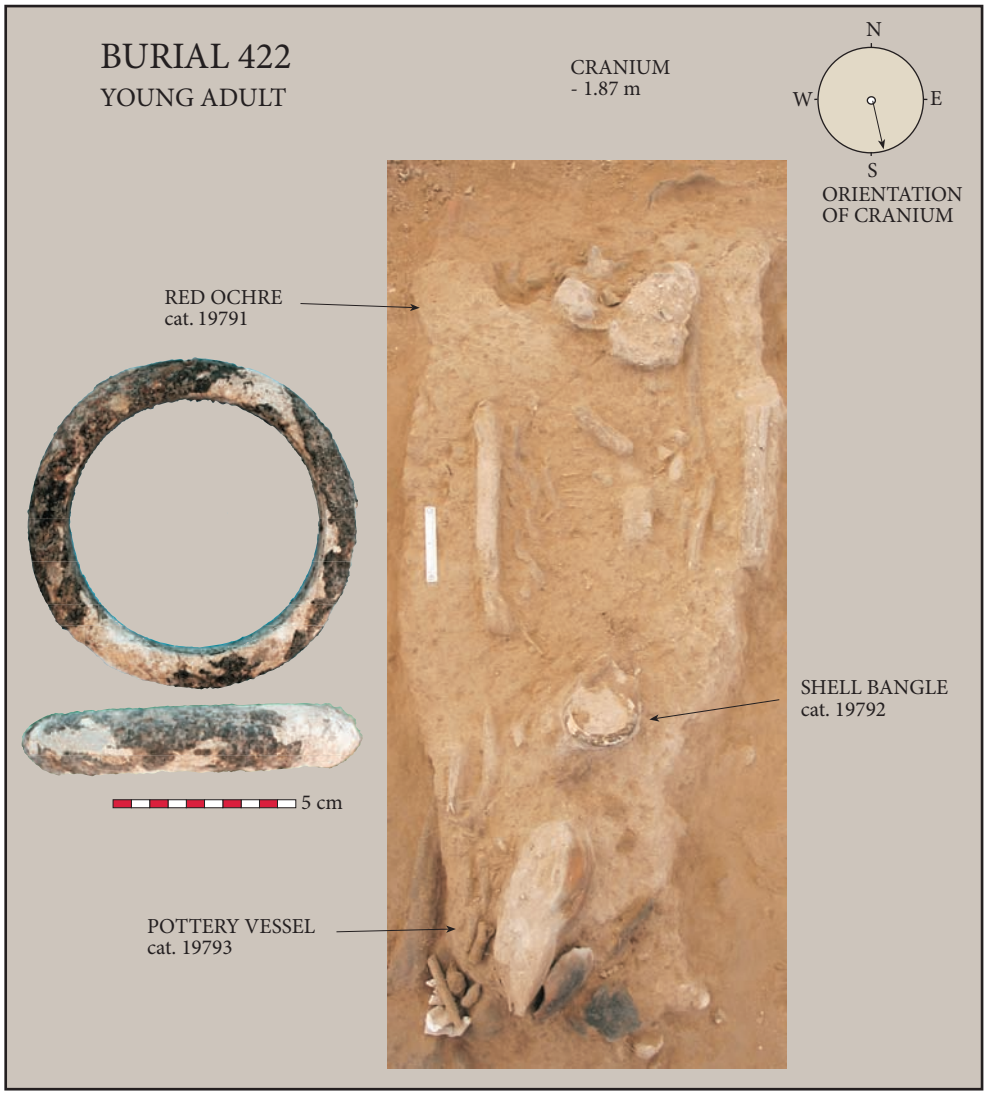


FIG. 14:21 Burial 422

Burial 422, a young adult, was found immediately over burial 338, at a depth of 1.87 m below datum. The grave was orientated with the head to the south. The grave was incomplete. A pot that could not be reconstructed lay in the foot area, and a shell bangle was found int he area of the hands. Red ochre was present beside the head.

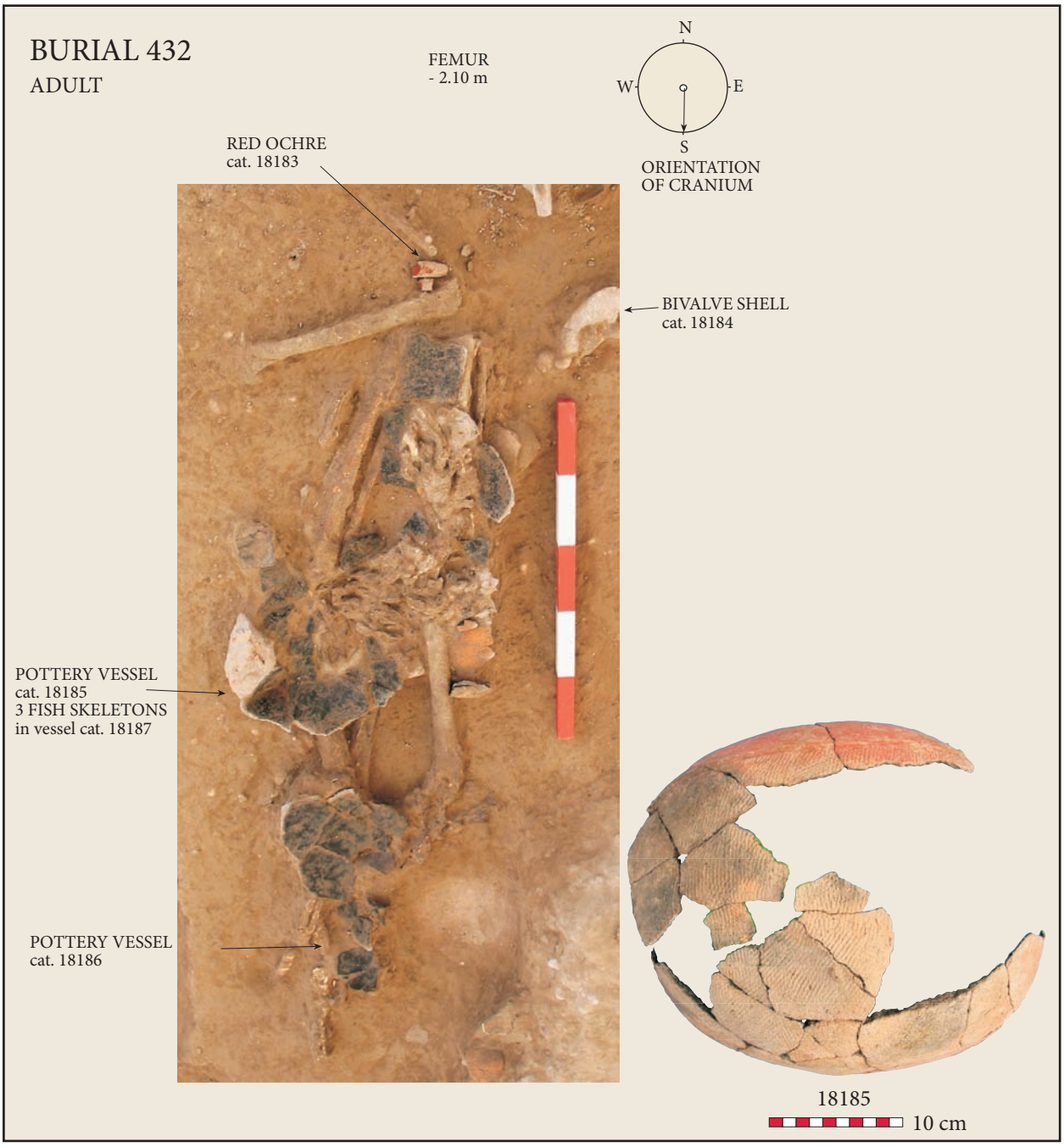


FIG. 14:22 Burial 432

Burial 432 was found in a severely mutilated condition directly under burial 372, at a depth of 2.10 m below datum. The body had been orientated with the head to the south. This individual was accompanied at the very least by two ceramic vessels one of which, cat. 18185, contained three fish skeletons: one *Channa* sp. one *Channa lucius* and one *Channa striata*. Red ochre and a bivalve shell were found in the ankle area.



FIG. 14:23 Burial 575

Little survives of burial 575. It was found at a depth of 1.33 m below datum, with the head orientated 340° from north. Some young pig bones were found by the right arm.



FIG. 14:24 Burial 598

Very little survives of burial 598, which was found at a depth of 1.92 m below datum, with the head orientated to the north. It is not possible to be sure of form of either of the ceramic vessels found with this individual.



FIG. 14:25 Burial 577

Burial 577 was found at a depth of 1.61 m below datum, with the grave orientated with the head 340° from the north. Four pottery vessels were found, beyond the head, the feet, and beside the right hand. Three could be reconstructed, one to form 51 and the others to form 45. A bronze arrowhead was found beyond the head, and there was a deposit of grey clay inside pot cat. 20708. A single clay pellet was on top of pot cat. 20705.

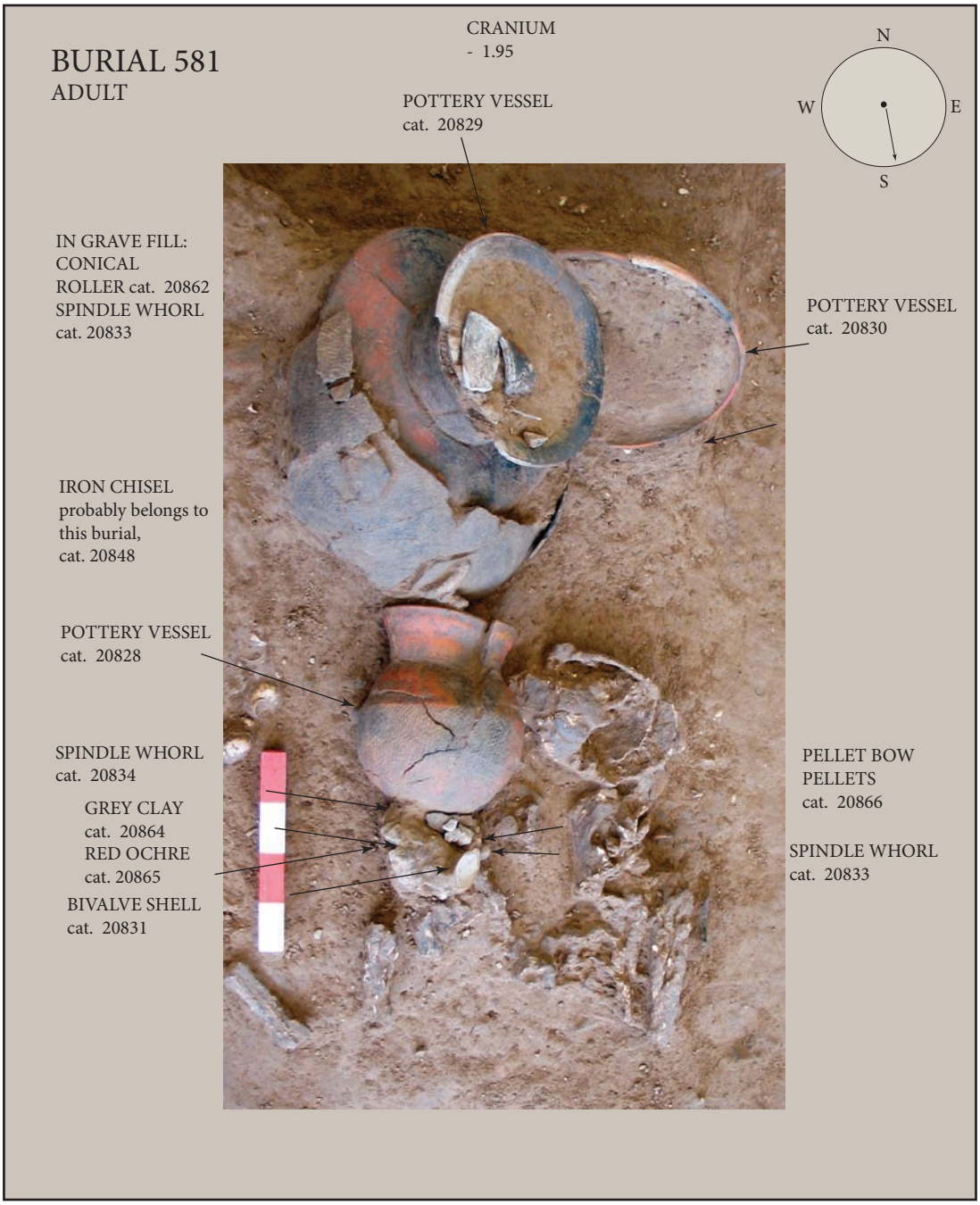


FIG. 14:26 Burial 581

Burial 581 was cut into and badly damaged by burial 578. Only the upper part of the skeleton has survived. The grave lay at a depth of 1.95 m below datum, with the head orientated 170° from the north. The area beyond the head contained as mortuary offerings, three pottery vessels of forms 51, 48 and 54. There were also two spindle whorls, a bivalve shell, grey clay and red ochre. A group of six pellet bow pellets lay beside the cranium, and an iron chisel was also found.

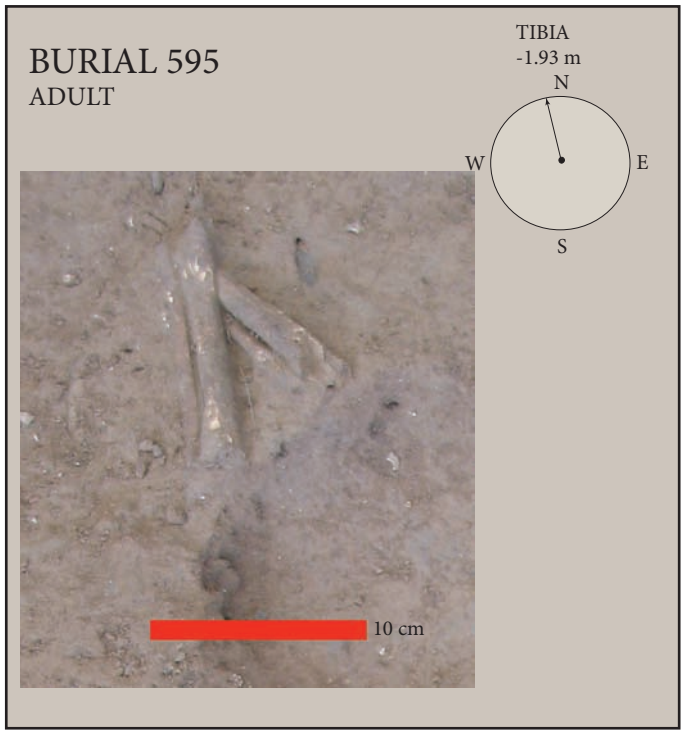


FIG. 14:27 Burial 595

Burial 595 comprises just the tibiae and fibulae, at a dept of 1.93 m below datum. The orientation of the bones indicates that the head was directed to the north.

XV THE INFANT BURIALS OF IRON AGE PERIOD 1, SOUTHERN GROUP

C.F.W. HIGHAM

There are relatively few infants or children in the southern group of early Iron Age burials. There are no neonates and no jar burials. There are two remarkable bronzes among the mortuary offerings: a pair of decorated bangles, and a pair of anklets containing clay balls to resonate.

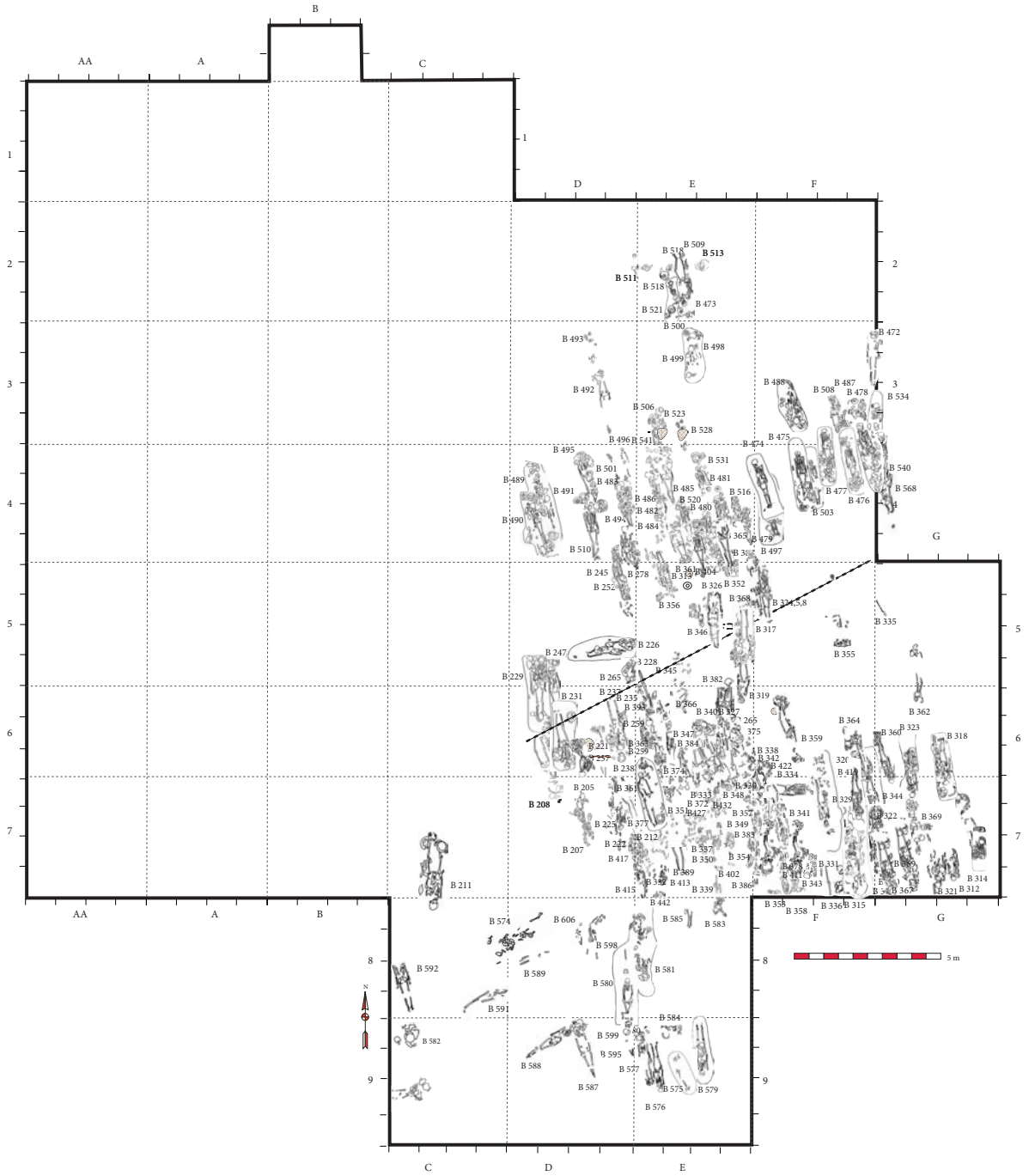


FIG. 15:1 The distribution of Iron Age 1 graves

TABLE 15:1 *The mortuary offerings for Iron Age 1 infant and child burials in the southern group*

burial no.	221	235	314	331	342	343	369	415	584
age	10 y	10 y	9 m	2 y	15 y	9 m	8 m	8 y	3 y
orientation	160°	S	180°	180°	160°	S	S	N	E
depth (metres)	1.48	1.85	1.62	1.71	1.81	1.84	1.80	1.94	1.78
n pots	4	4	5	4	3	7	2	0	1
pot form 5	0	1	0	0	0	0	0	0	0
pot form 45	0	0	1	1	1	0	0	0	0
pot form 48	0	0	0	0	0	1	0	0	0
pot form 51	1	2	2	1	1	2	0	0	0
pot form 55	0	0	2	0	1	1	1	0	0
pot form 59	0	0	0	0	0	0	1	0	0
pot form 71	0	1	0	0	0	0	0	0	0
bivalve shell	0	2	1	2	1	0	0	0	0
pig bones	1	1	0	1	0	1	1	0	0
Bos bone	0	0	0	1	0	0	0	0	0
fish skeleton	0	0	2	0	9	3	0	0	0
red ochre	0	0	4	0	2	8	1	0	0
spindle whorl	0	4	0	1	1	0	0	0	0
grey clay	0	0	1	0	1	1	0	0	0
shell bangle	0	0	1	2	0	0	0	0	0
ivory bangle	0	0	0	0	0	7	0	0	0
ear plug	0	0	0	1	0	0	0	0	0
bronze anklet	0	0	2	0	0	0	0	0	0
bronze bangle	0	0	0	0	0	2	0	0	0
glass earring/bead	0	3	0	0	0	1	0	0	0
agate bead	0	0	0	0	0	1	0	0	0
iron artefacts	0	2	0	0	0	5	0	0	0
clay cylinder	0	0	1	0	0	0	0	0	0



FIG. 15:2 Burial 221, showing the complete pig skeleton overlying the body

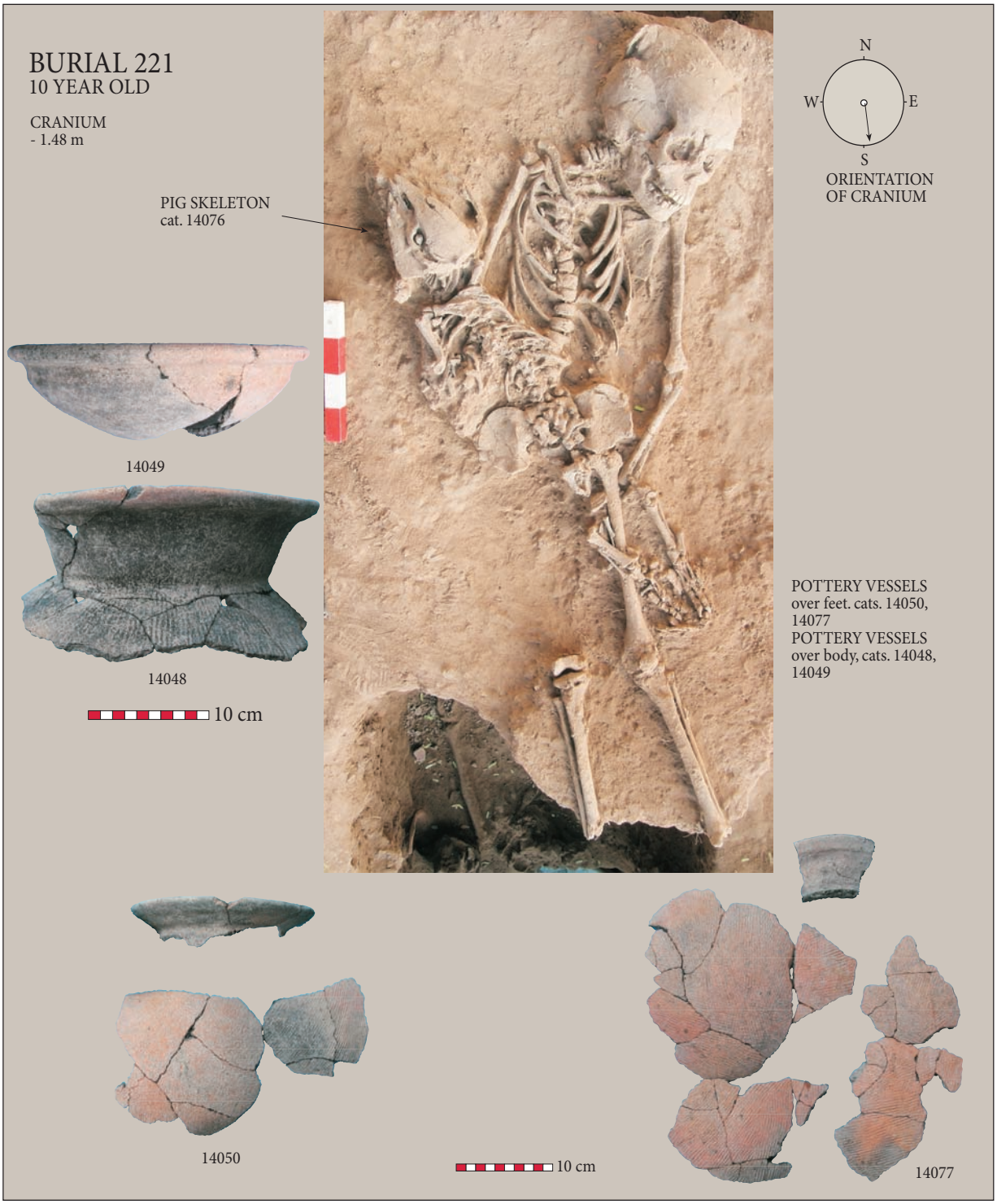


FIG. 15:3 Burial 221

Burial 221 contained the skeleton of a 10-year-old, interred at a depth of 1.48 m below datum and orientated with the head 160° from north. Four pottery vessels lay over the body, three being fragmentary, the fourth being of form 51. The complete skeleton of a young pig partially covered the body.

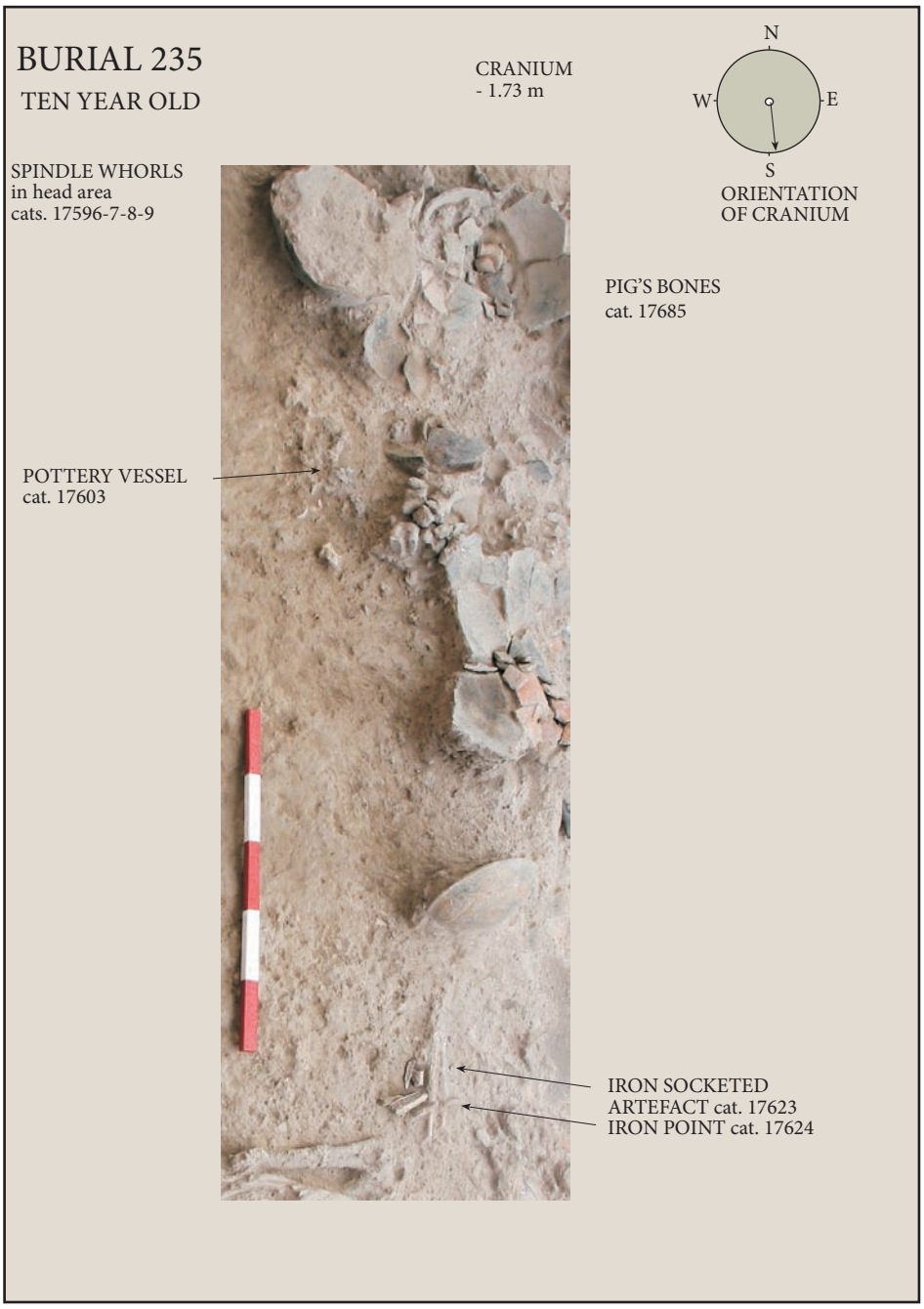


FIG. 15:4 Burial 235 before full exposure

Burial 235 contained a child aged about 10 years at death. It was interred at a depth of 1.73 m below datum, with the head orientated to the south. The child was found in a disturbed condition. Four ceramic vessels were probably associated, two of form 51, one form 5 and one form 71 a large ovoid jar on a flat base. Four spindle whorls lay beyond the head area, but some or all might belong to neighbouring burial 363. Two iron artefacts, a point and a socketed item, were placed beyond the feet. There were also the left fore limb bones of a pig by the shoulder, and two bivalve shells.

Burial 314 is a complete Iron Age 1 infant burial. The 9-month old was found at a depth of 1.63 m below datum, with the body orientated with the head to the south. One pottery vessel covered the chest area, four others were placed to the left of the head and upper body. Two are of form 51, two of form 55 and one of form 45. The infant wore two large bronze anklets that contained small clay balls that would have acted as a bell when the infant moved. The infant also wore a shell bangle on the right wrist. Grey clay and three pieces of red ochre were found beside the right knee. A bivalve shell had been placed beyond the head. A



FIG. 15:5 Burial 235



FIG. 15:6 Burial 314, after the removal of the pottery vessels

most unusual cylinder of clay was also found in the area of the head. Pot cat. 21038 contained cat. 21070: *Channa striata* two whole fish skulls (broken pieces) with 4 vertebrae.

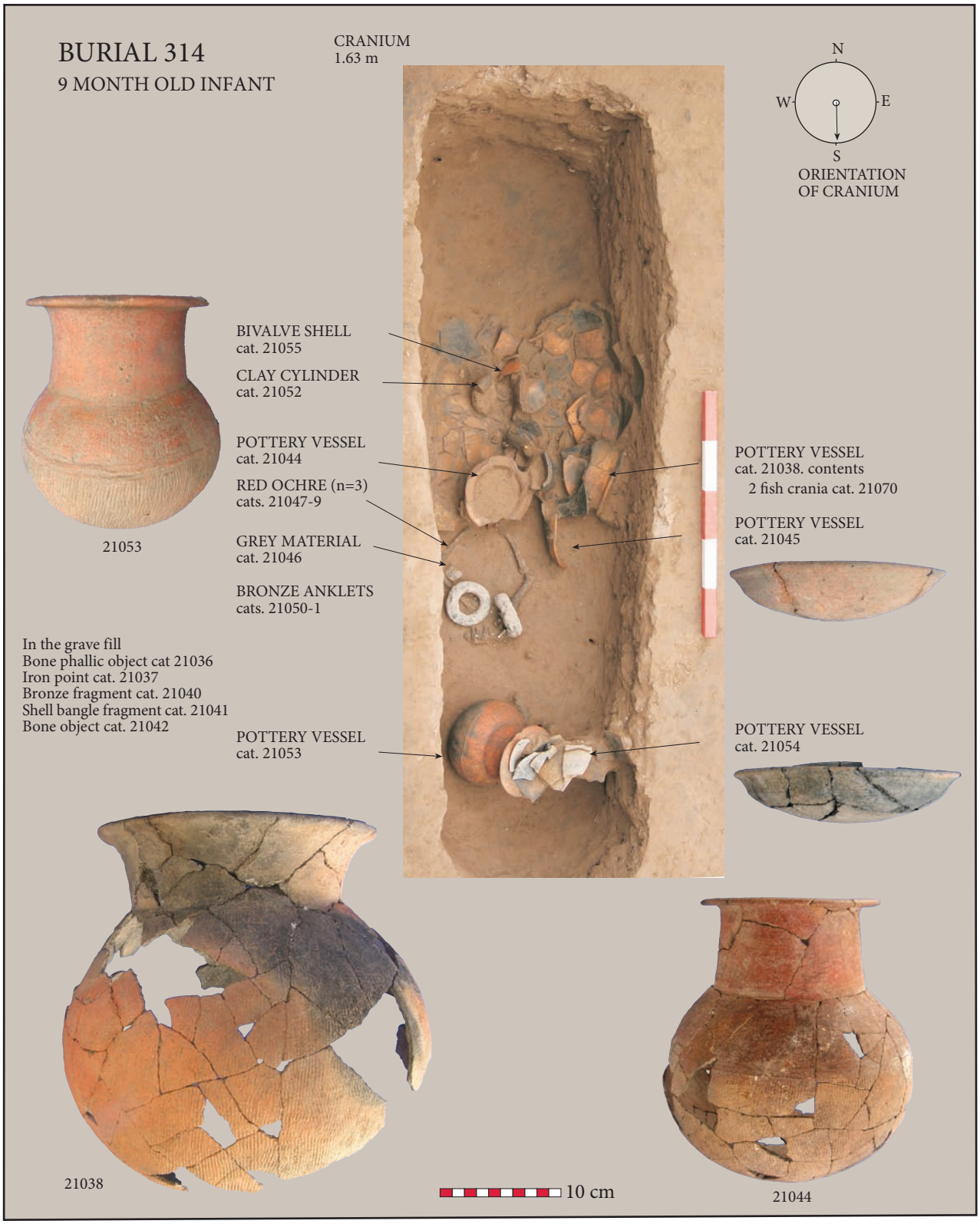


FIG. 15:7 Burial 314

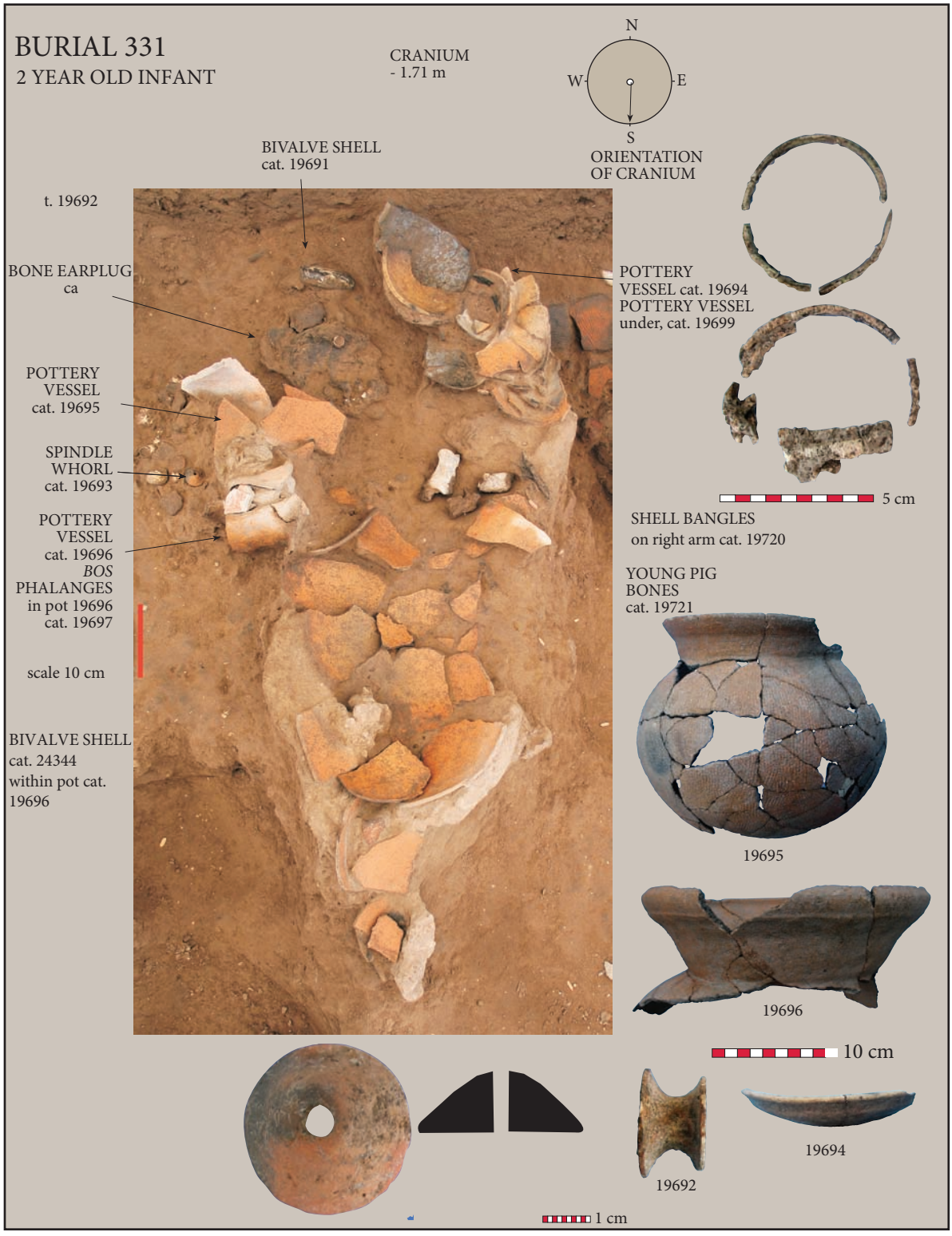


FIG. 15:8 Burial 331

Burial 331 contained the skeleton of a two-year-old infant, interred at a depth of 1.71 m below datum, with the head orientated to the south. Four ceramic vessels were associated, two of which are hard to place in terms of form due to their fragmentary condition. There is one of form 51, another of form 45. A bone earplug was identified in the head area. Other grave goods comprise two bivalve shells placed beyond the head and in pot 19696, a spindle whorl at the right shoulder, two shell bangles on the right arm, the second phalanges of a young pig and the rear first and second phalanges of a cow.

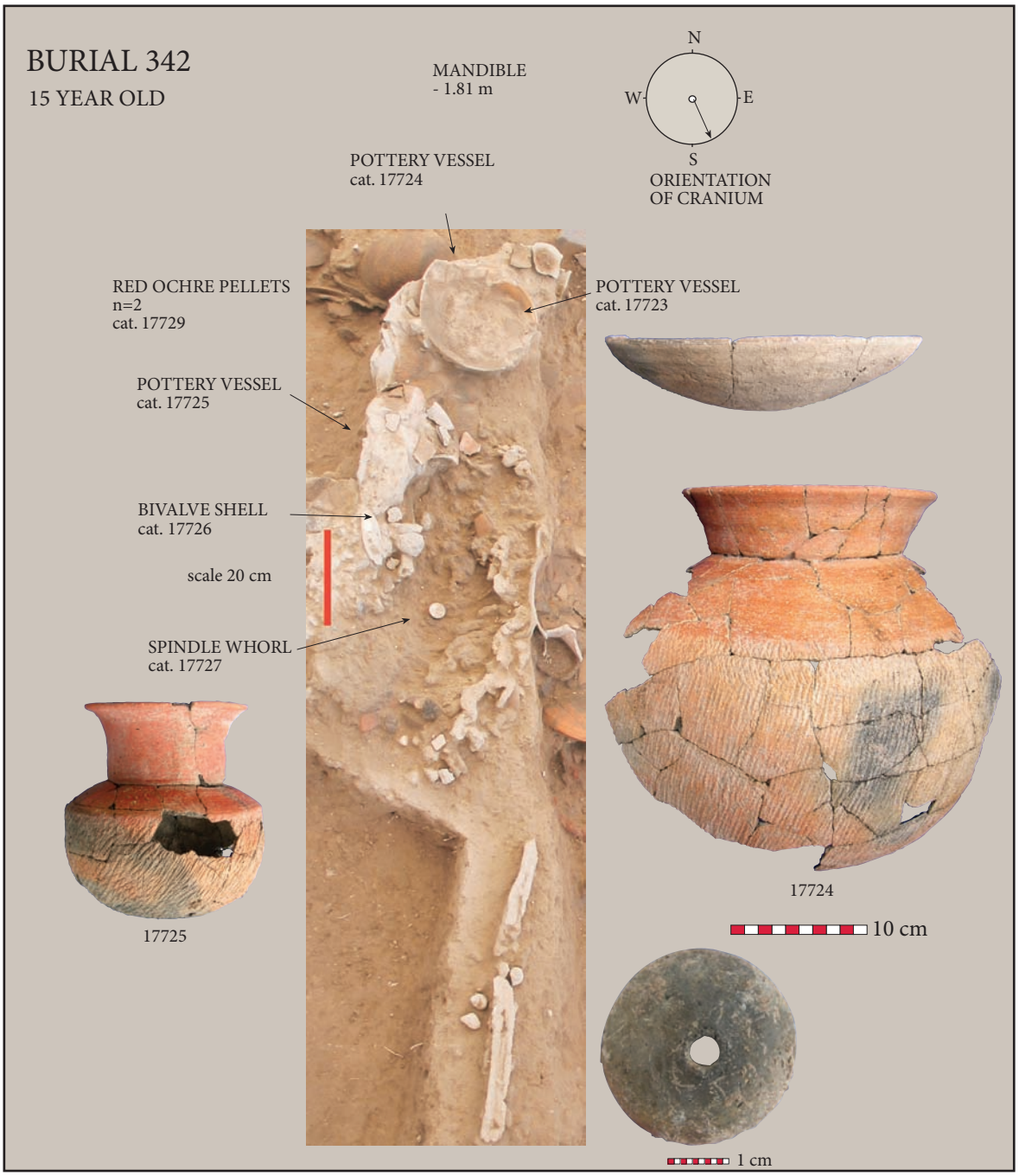


FIG. 15:9 Burial 342

Burial 342 contains the skeleton of a 15-year-old. The grave was found at a depth of 1.81 m below datum, orientated with the head 160° from north. Three pots were found, one beyond and two beside the head. They are of forms 45, 51 and 55. Pot cat. 25292 contained approximately 50 fish vertebrae (possibly from *Channa striata*) as well as *Clarias* sp. 2R pectoral fin spines, *Hemibagrus nemurus* 1L dentary, *Hemibagrus*/*Mystus* 1L, 2R pectoral fin spine, *Anabas testudineus* 1L articular; 1L fragment of cleithrum; 1R dentary and *Channa striata* 1L, 2 R maxilla; 1R pre-maxilla; 1L palatine; 1L, 1R quadrate. Two pellets of red ochre had been placed to the right of the head. A bivalve shell and a spindle whorl lay over the right shoulder.



FIG. 15:10 Burial 343

Burial 343 contained the skeleton of a 9-month-old infant, interred at a depth of 1.84 m and orientated with the head to the south. Of the seven pots associated, four could be reconstructed. There are two of form 51, one form 48 and one form 55. The form 48 vessel contained fish bones. This infant wore two very large bronze bangles, one on each wrist. Four ivory bangles were found on the right wrist and three more on the left. There was also an agate bead and one very fragmentary glass bead in the area of the head, together with a shell pendant. An iron artefact was present, by the right wrist and a set of thin iron items probably knives, were located by the right arm. Pig's limb bones were found beyond the head. Pot cat. 19655 contained fish remains, cat. 18847: *Channa striata* 1 large whole fish and cat. 19668: two whole skulls of *Channa striata*. Finally, seven pellets of red ochre were found beyond the feet, and another by the right arm.

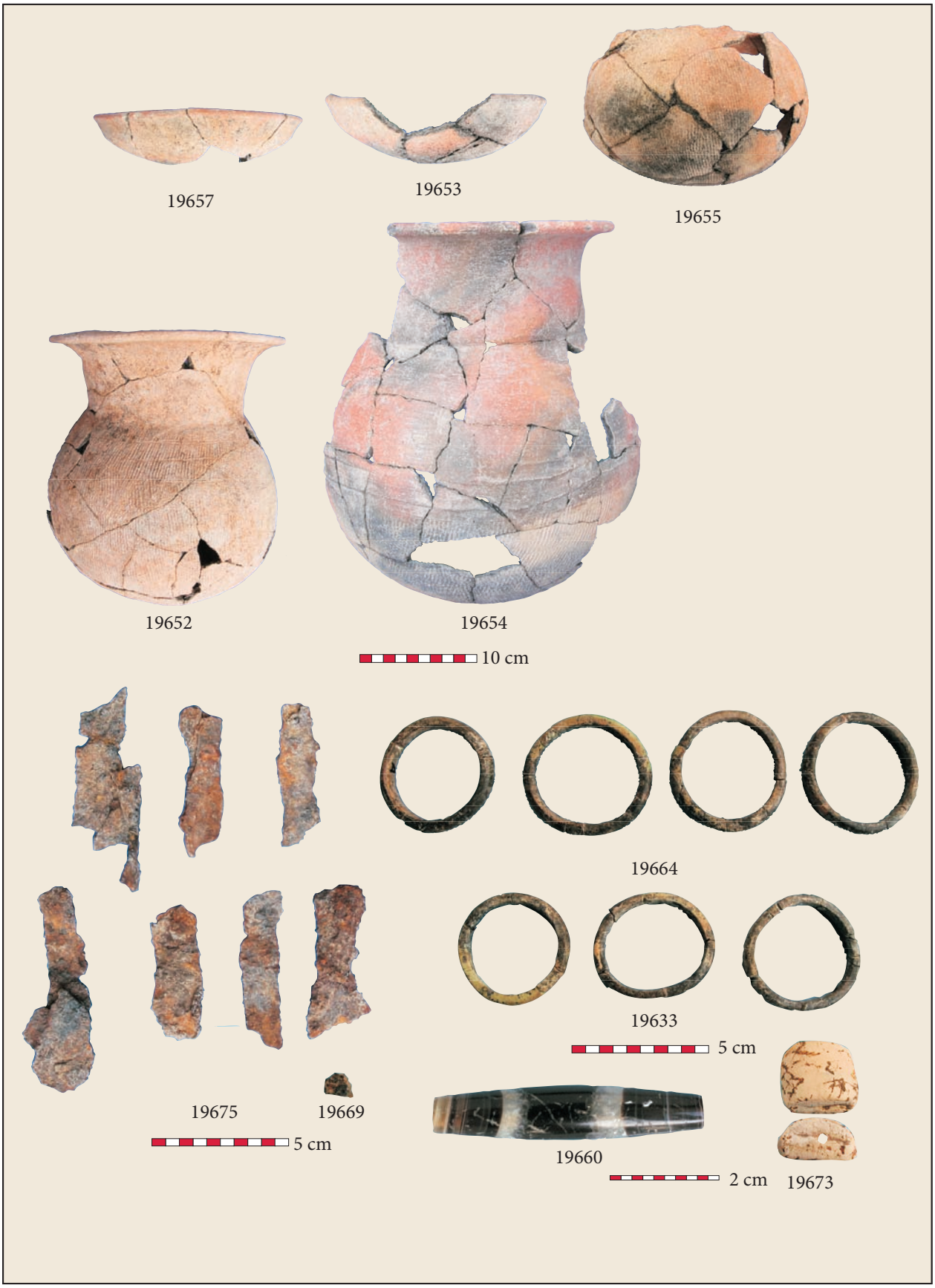


FIG. 15:11 Mortuary offerings with burial 343



FIG. 15:12 The bronze bangles from burial 343

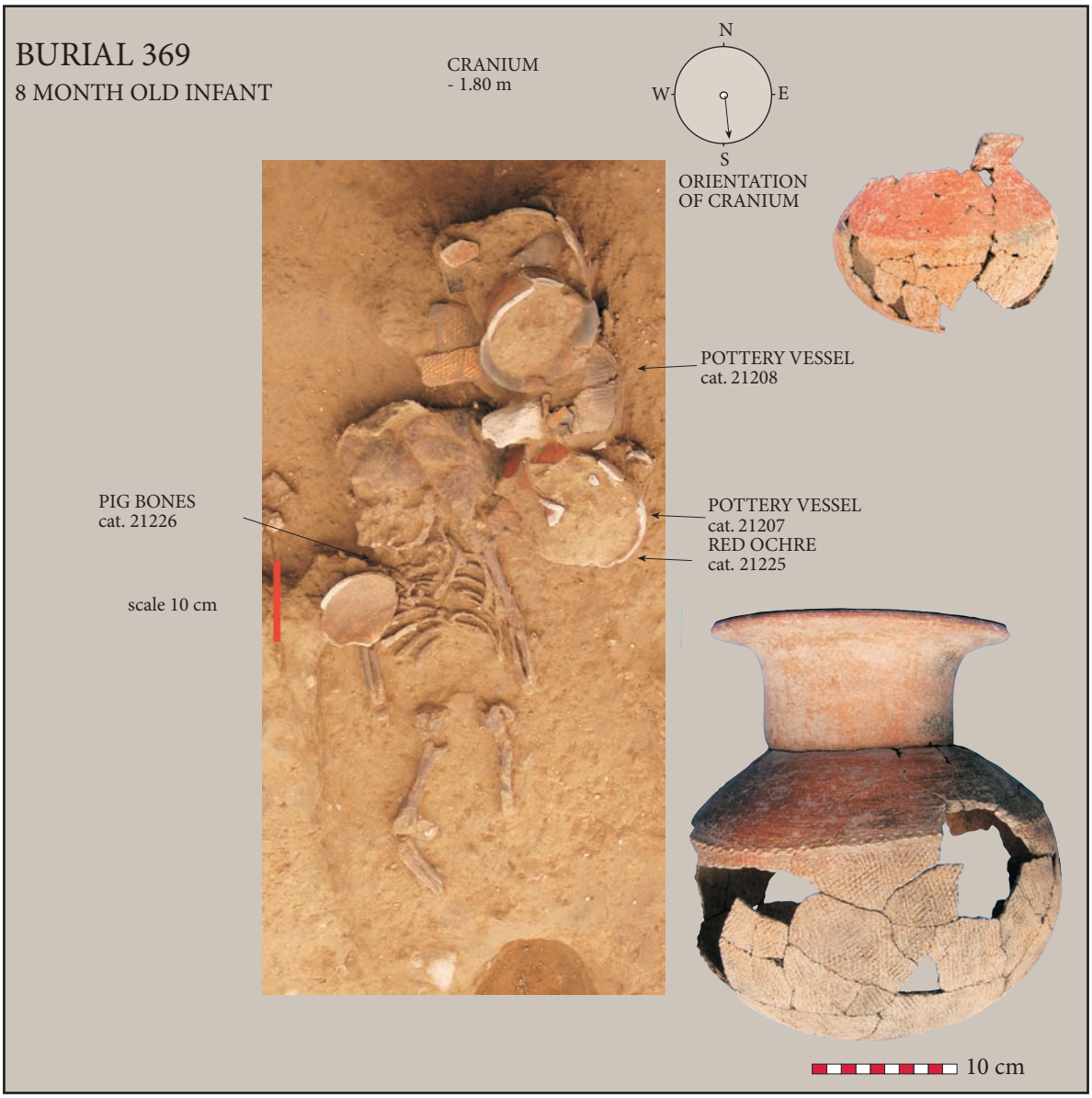


FIG. 15:13 Burial 369

Burial 369 contained the skeleton of an eight-month-old infant, interred at a depth of 1.80 m below datum, and orientated with the head to the south. Two pots were found to the left of the skull, one of form 55 and the other of form 59. Red ochre was identified under vessel cat. 21207, and the foot bones of a young pig were present at the right shoulder.

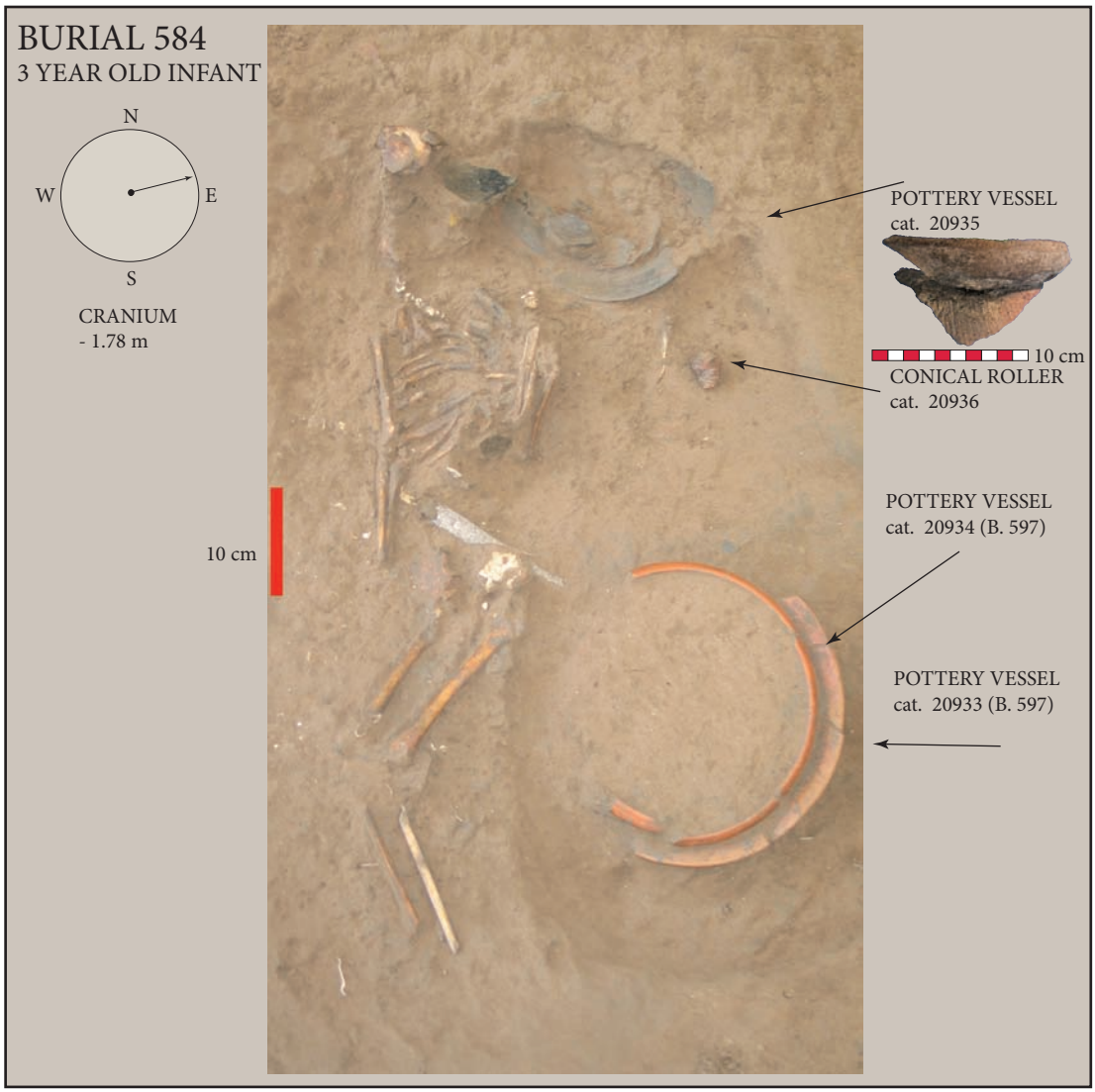


FIG. 15:14 Burial 584

Burial 584 contains the skeleton of a 3-year-old infant at a depth of 1.78 m below datum. The grave was orientated with the head to the east. This infant lay beside the grave of burial 597. Part of a ceramic vessel was found beside the head. The conical roller 20 cm to the left of the body may not be an *in situ* offering.

Burial 415 contains most of the skeleton of a child who died when aged about eight years. The grave was found at a depth of 1.94 m and its orientation has the head directed to the north. No grave goods were encountered.

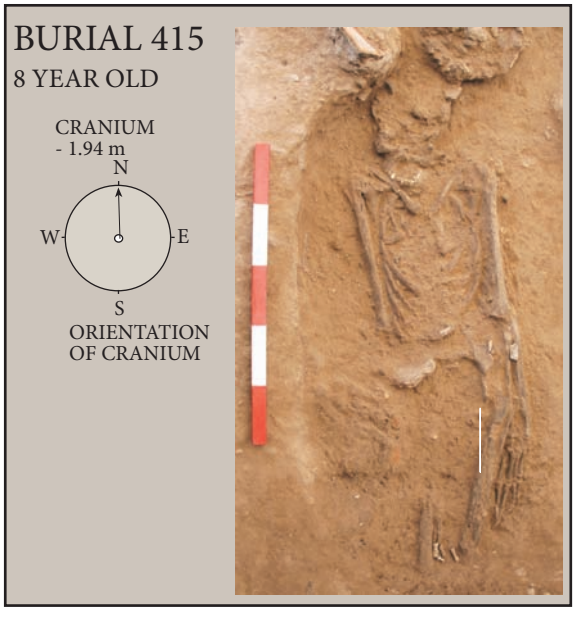


FIG. 15:15 Burial 415

XVI THE BURIALS OF IRON AGE PERIOD 2

C.F.W. HIGHAM

The Iron Age 2 burials were found in the main square. Most are infant jar burials, and their predominance is interesting, in that it seems that infants were interred during this period in a designated area. This has parallels at Noen U-Loke during the same period, where cluster 3B contained only adults, and cluster 3A only had one infant jar burial.

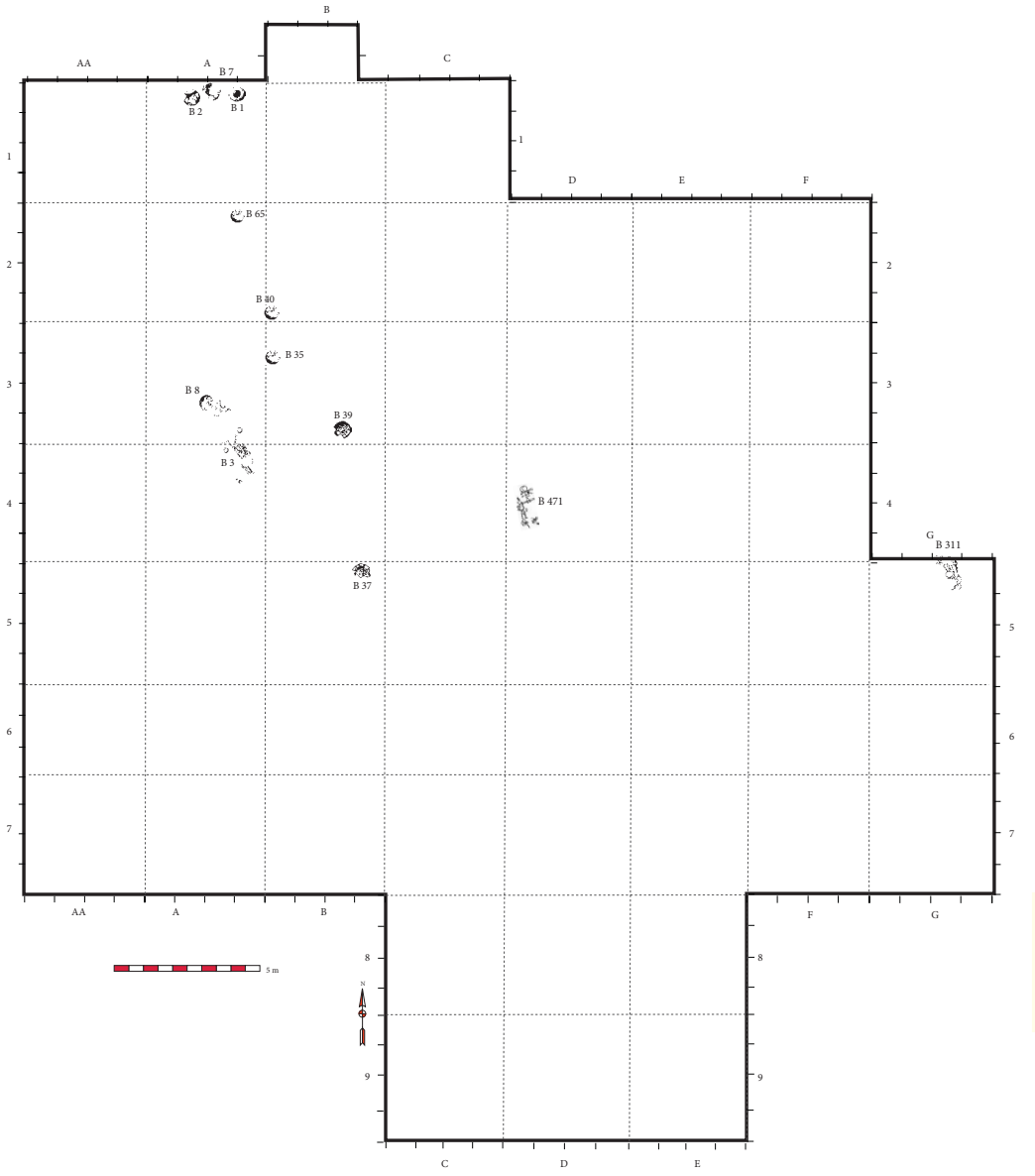


FIG. 16:1 The distribution of Iron Age 2 graves

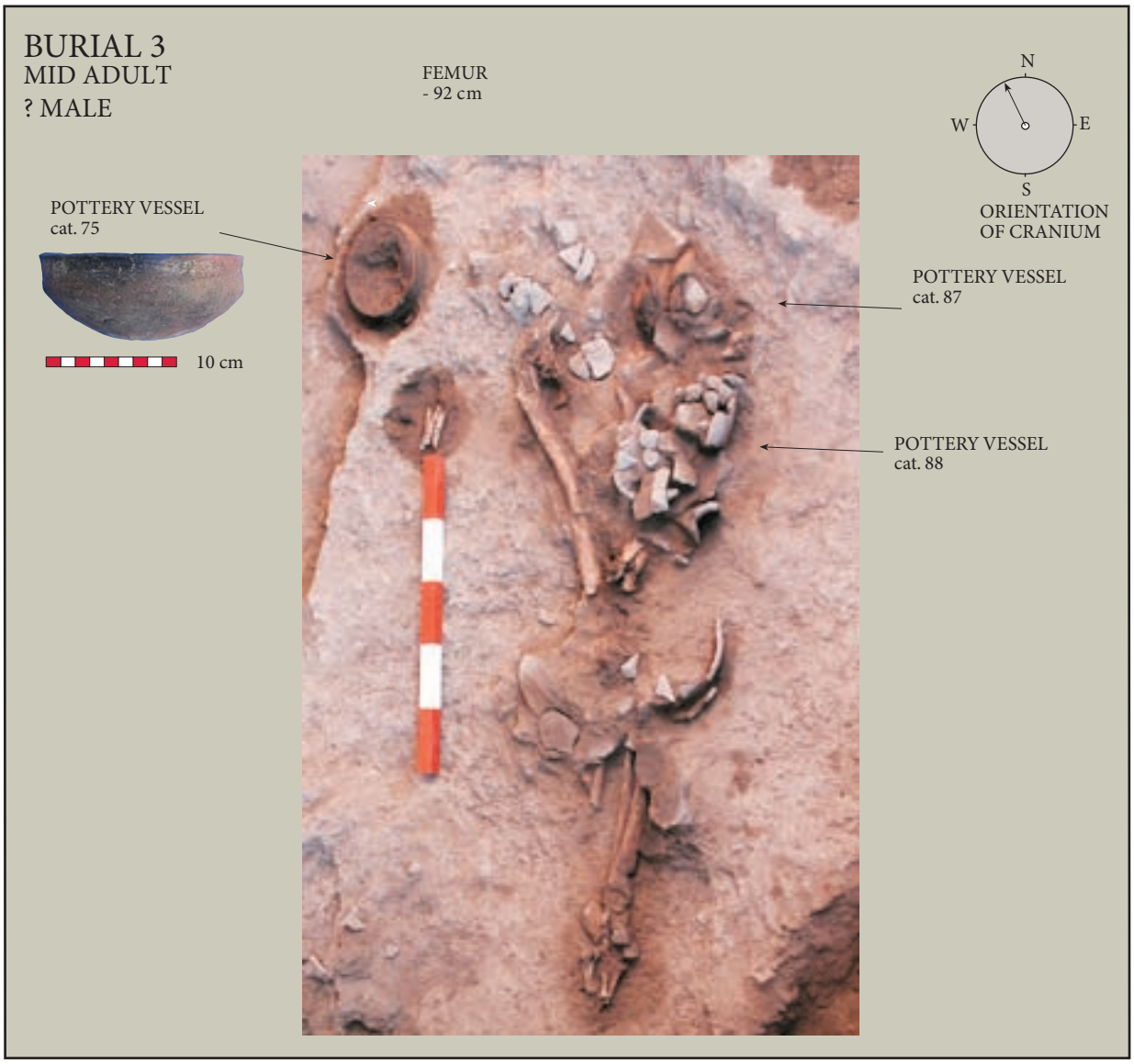


FIG. 16:2 Burial 3

Burial 3 was found at a depth of 92 cm below datum. The badly disturbed skeleton of a mid adult probably male was found, orientated with the head to 350° from north. Only one of the three pottery vessels found in association could be assigned a form. It is form 58.

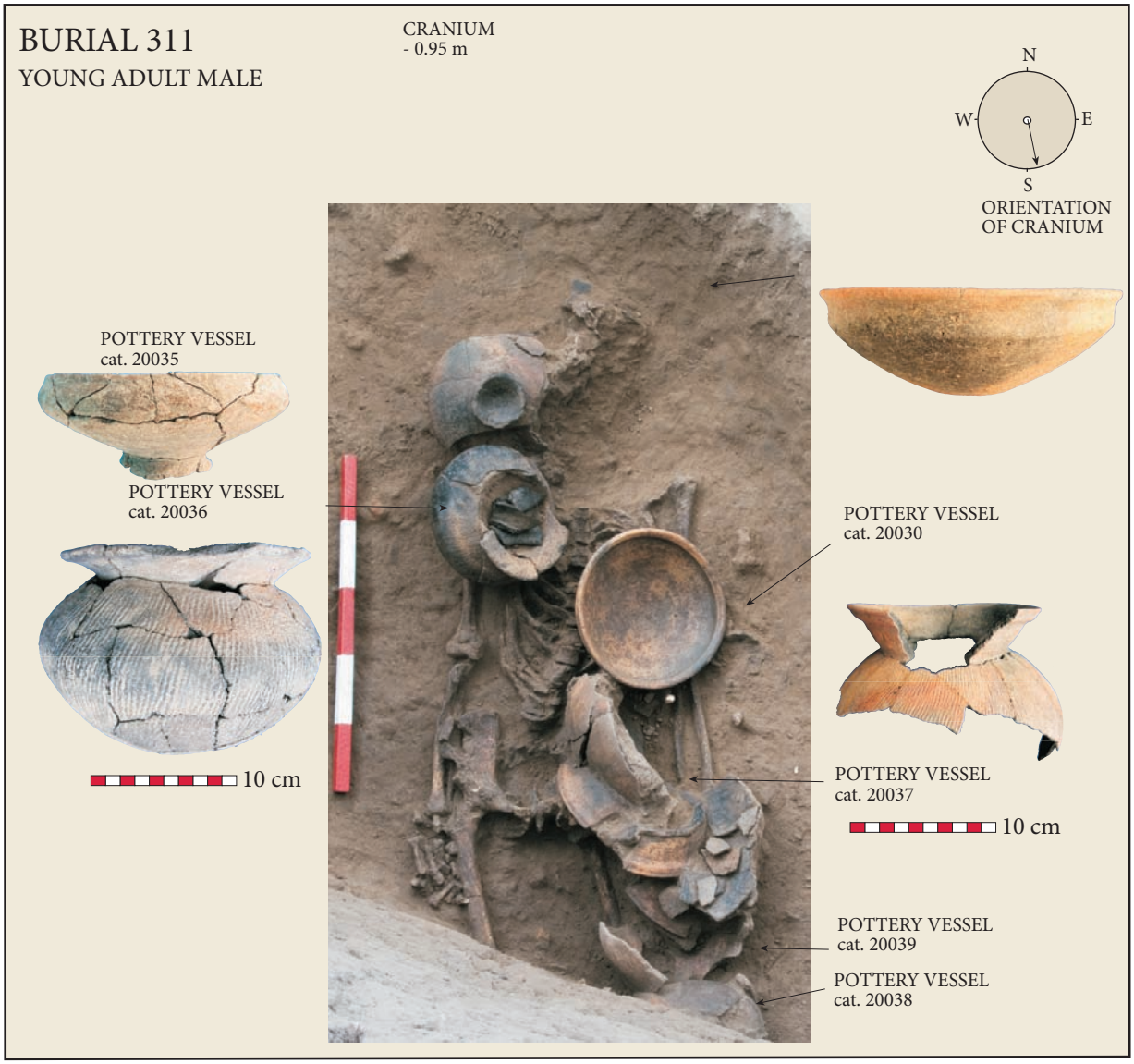


FIG. 16:3 Burial 311

The adult in burial 311 was found at a depth of 95 cm below datum, orientated 170° from north. Only the upper part of the grave was present in the excavated area and the cranium was missing. Four of the six ceramic vessels could be reconstructed Two are of form 56, one is form 58 and the last is form 67.

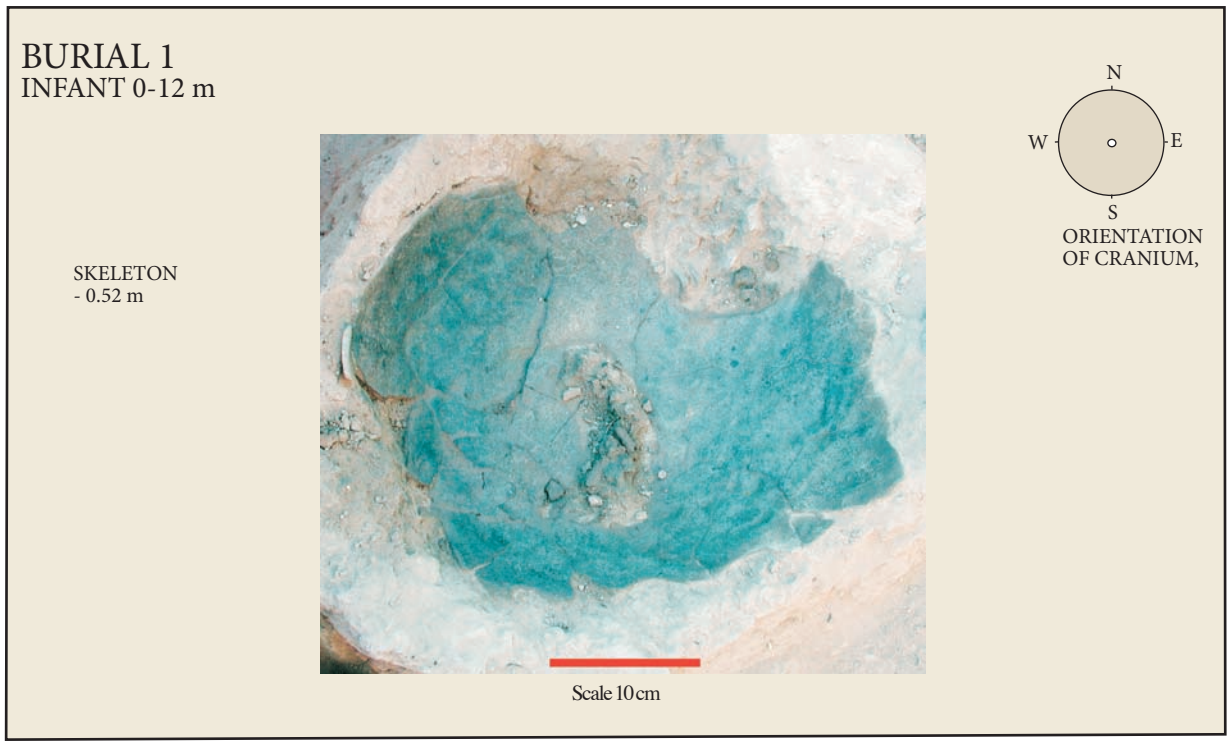


FIG. 16:4 Burial 1

Burial 1, an infant jar burial, was found at a depth of 52 cm below datum. It comprises a few bones of an infant who died when under a year of age, within the base of a pottery vessel that was streak burnished in the style of Phimai Black ceramics.

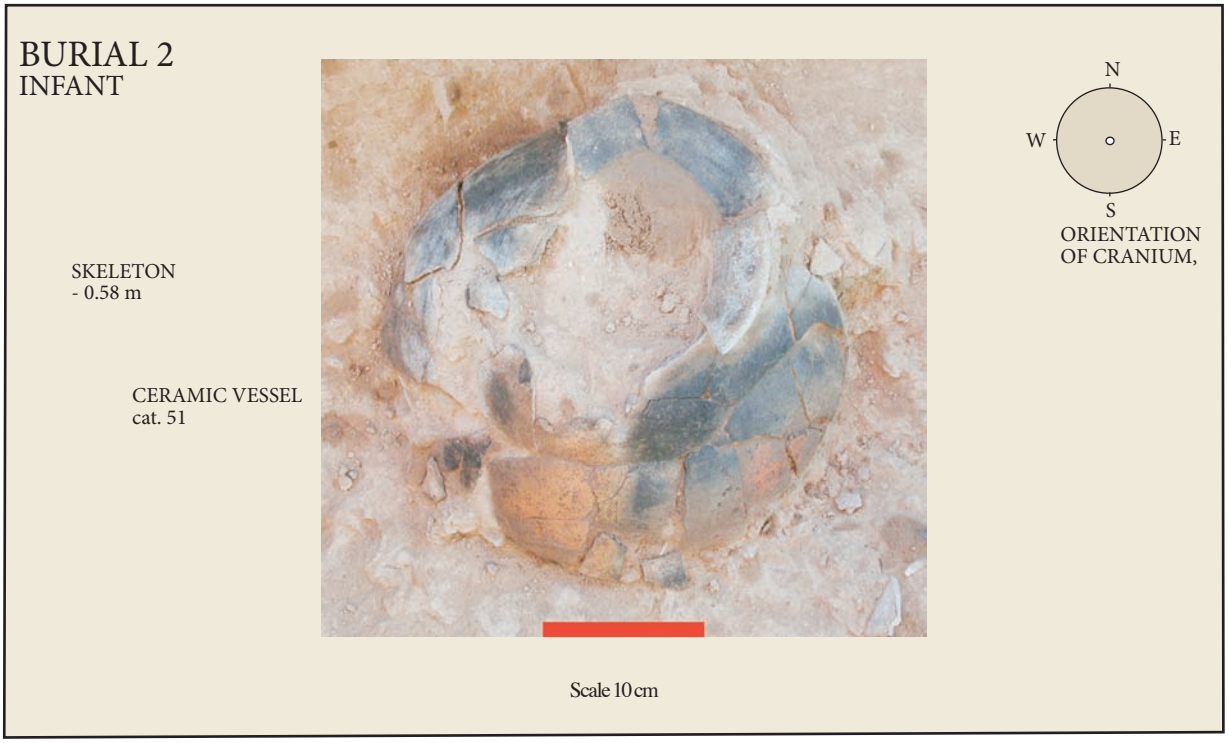


FIG. 16:5 Burial 2

Burial 2, found at a depth of 58 cm, comprises some fragmentary infant bones in a mortuary vessel.

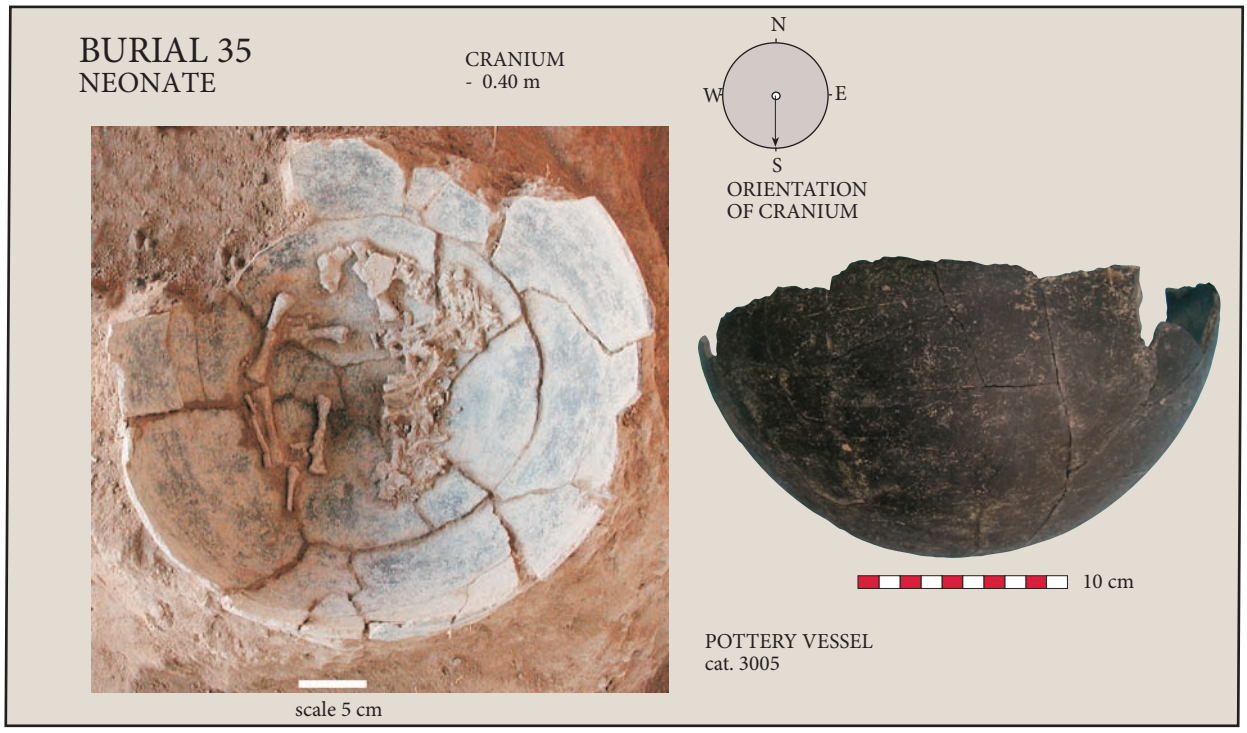


FIG. 16:6 Burial 35

Burial 35 is a jar burial for a neonate, found at a depth of 40 cm below datum. Only the base of the pot has survived. The infant seems to have been placed with the head facing south.

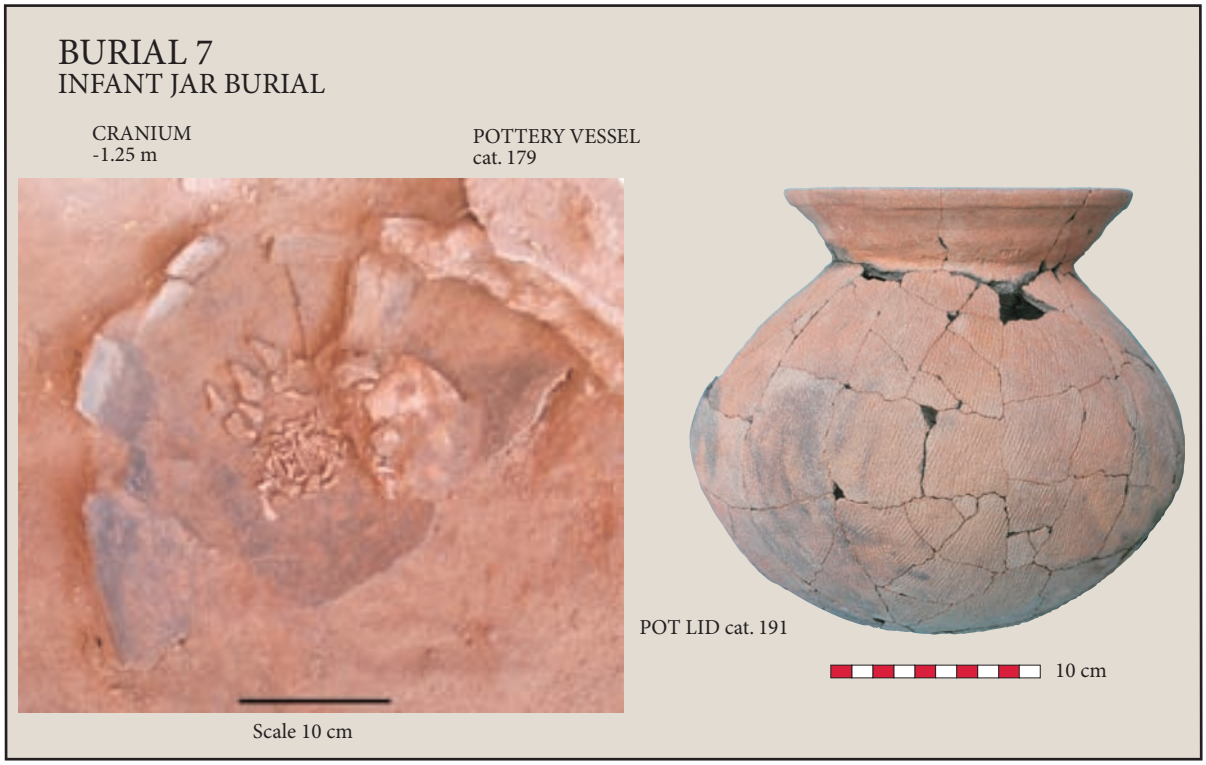


FIG. 16:7 Burial 7

Burial 7 comprised an infant jar burial found at a depth of 1.25m below datum. On the basis of bone size, the infant was newly born. The pottery vessel containing the remains is of form 70. The lid was not reconstructed.

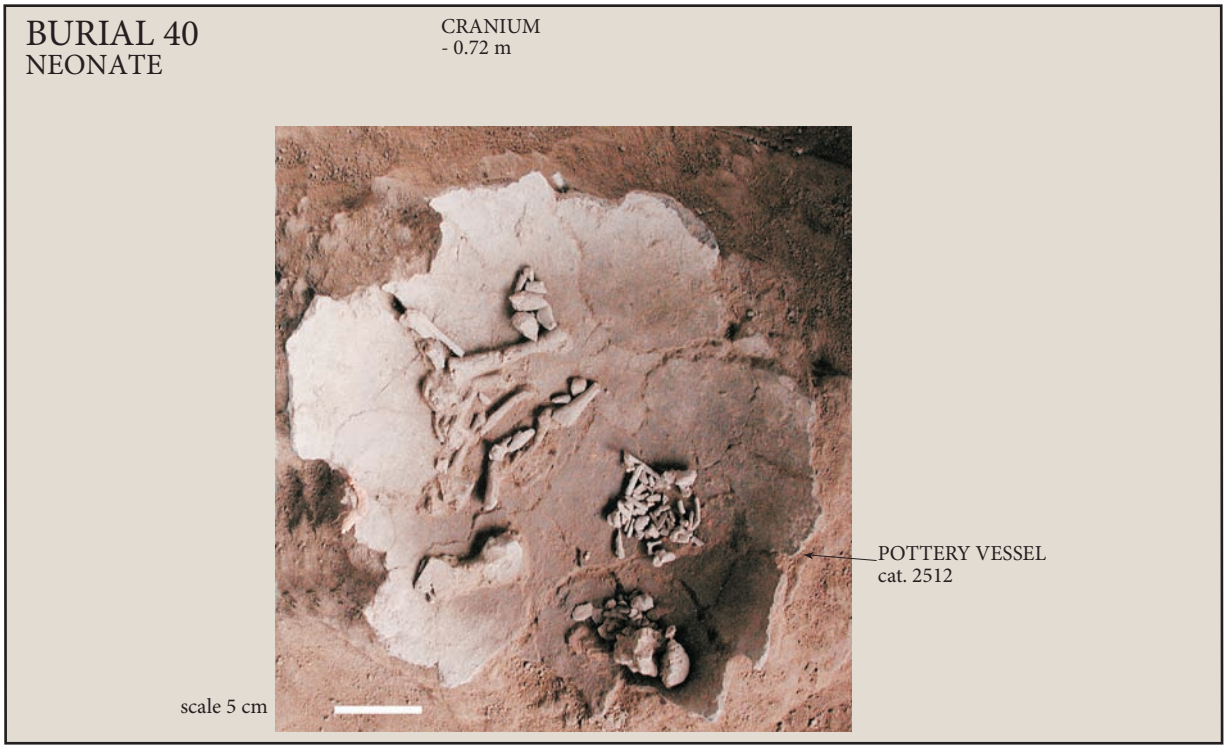


FIG. 16:8 Burial 40

Burial 40 is a jar burial for a neonate, found at a depth of 72 cm below datum. Only the base of the pot has survived.

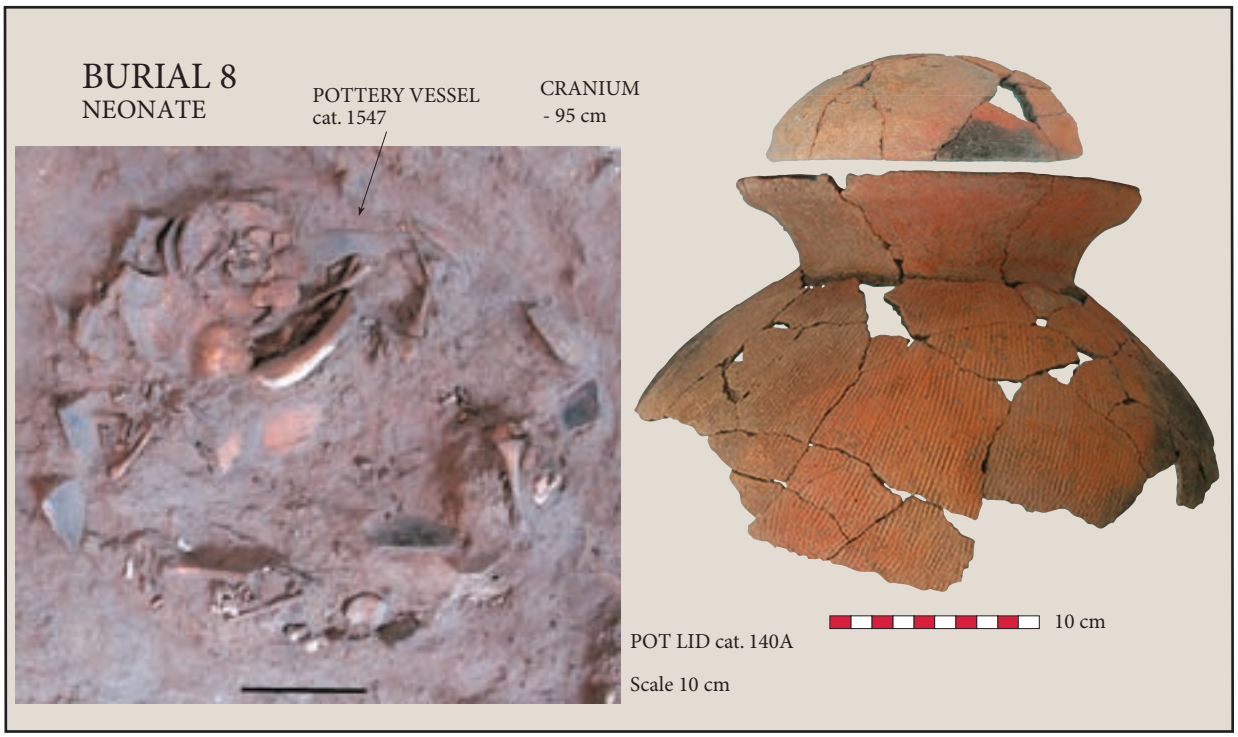


FIG. 16:9 Burial 8

Burial 8 is a jar burial for a neonate, found at a depth of 95 cm below datum. The mortuary vessel is of form 70. The lid is an open bowl of form 42.

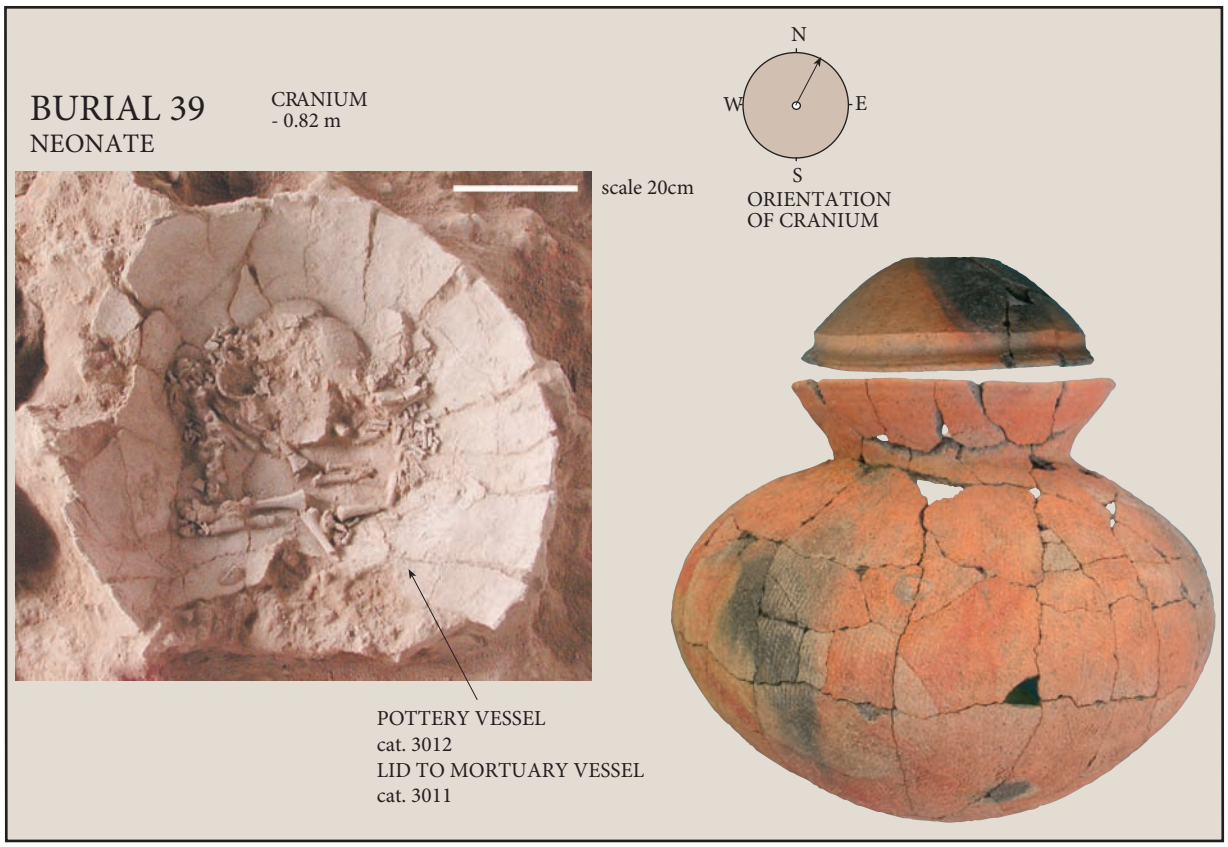


FIG. 16:10 Burial 39

Burial 39 comprised an infant jar burial found at a depth of 82 cm below datum. On the basis of bone size, the infant was newly born. The pottery vessel containing the remains is of form 70. The lid was form 58.

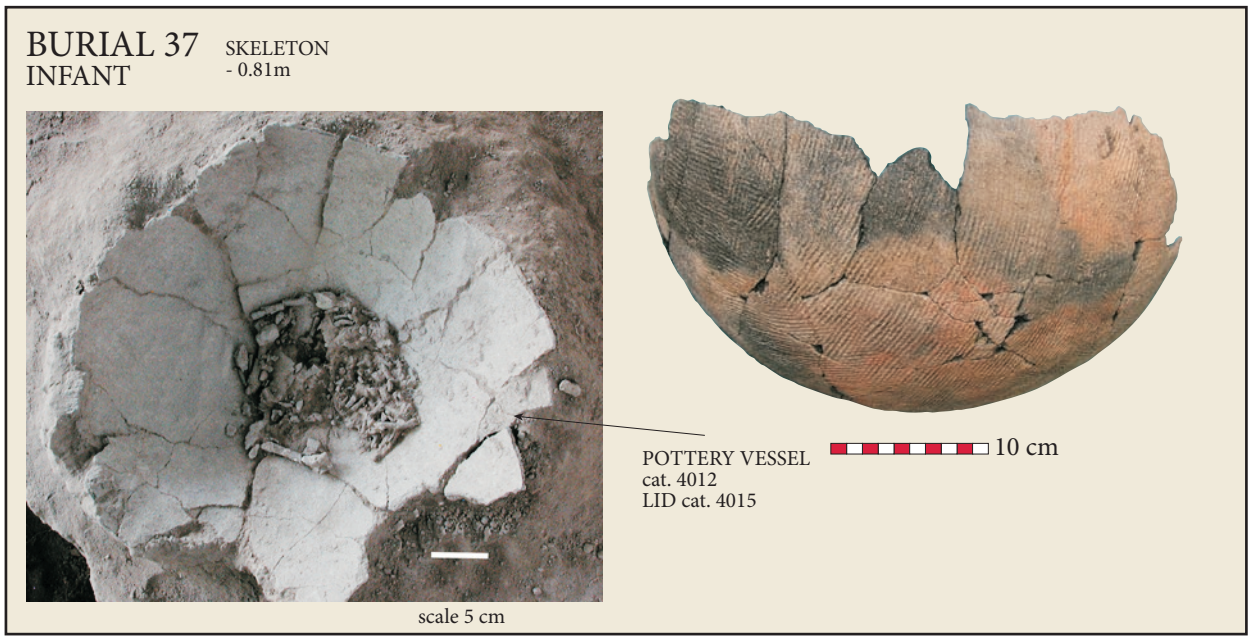


FIG. 16:11 Burial 37

Burial 37 comprised the jar burial of a neonate, found at a depth of 81 cm below datum. The ceramic vessel is of form 70.



FIG. 16:12 Artefacts associated with Burial 471

Burial 471 comprised some heavily disturbed human bones, associated with a series of offerings, including a pot of form 70 and two of form 58. There was also an iron tanged knife in the form of a sickle and a strip of bronze that might have been a bangle. A spindle whorl of rare biconical form was present also. This person wore a golden earring, and at least one agate bead.

XVII THE BURIALS OF IRON AGE PERIOD 4

C.F.W. HIGHAM

The Iron Age 4 burials were found in the main square and in squares X and Y. Those in the main square, were generally found in a very disturbed condition with barely one of them surviving completely. It is a characteristic of this period in the Iron Age sequence that the quantity of bronze ornaments greatly increased, while ornaments of glass, carnelian and agate were also found regularly. If there is a pattern to the layout of Iron Age 3 graves in the main square, it is that there are infant jar burials in proximity to the graves of adults.

There are several burials so disturbed that they are not illustrated. Burial 119, found 67 cm below datum, is an adult individual represented by fragments of skull and some lower limbs. Clearly this person had worn many bronze ornaments since the area of the bones contained three toe rings, possible earrings since they were found in the area of the skull, seven other bronze rings and a fragment of bangle. Burial 202 comprised just the maxilla bone associated with 221 orange and eight blue glass beads. It was found at a depth of 1.06 m below datum. Burial 204 was very disturbed and only a scattered tibia, fibula, humerus and part of the jaw survived at a depth of 1.08 m below datum. Burial 206 at a depth of 1.11 was represented only by a humerus, clavicle and fragment of a probable femur.

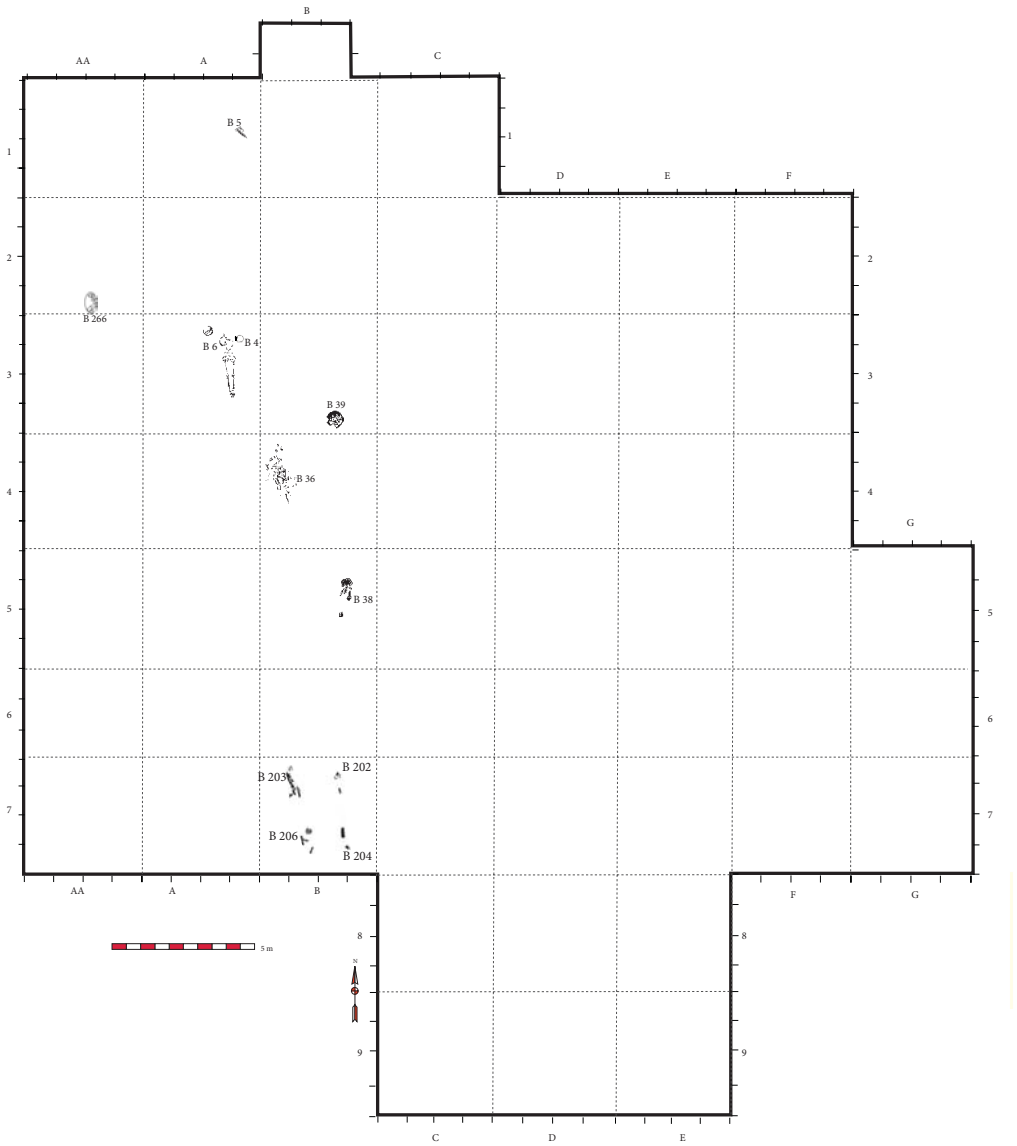


FIG. 17:1 The distribution of Iron Age 4 graves



FIG. 17:2 Burial 6

Burial 6 was found at a depth of 2.02 m below datum, orientated with the head to the north. Thue upper part of the body was disturbed. A pottery vessel lay beside the head. It is the base of a Phimai Black style bowl. Two carnelian beads of the long form found at Noen U-Loke during mortuary phase 3 (IA2)lay beside the skeleton. This young woman also was buried with glass beads in the area of the pelvis, that might have been part of a belt.

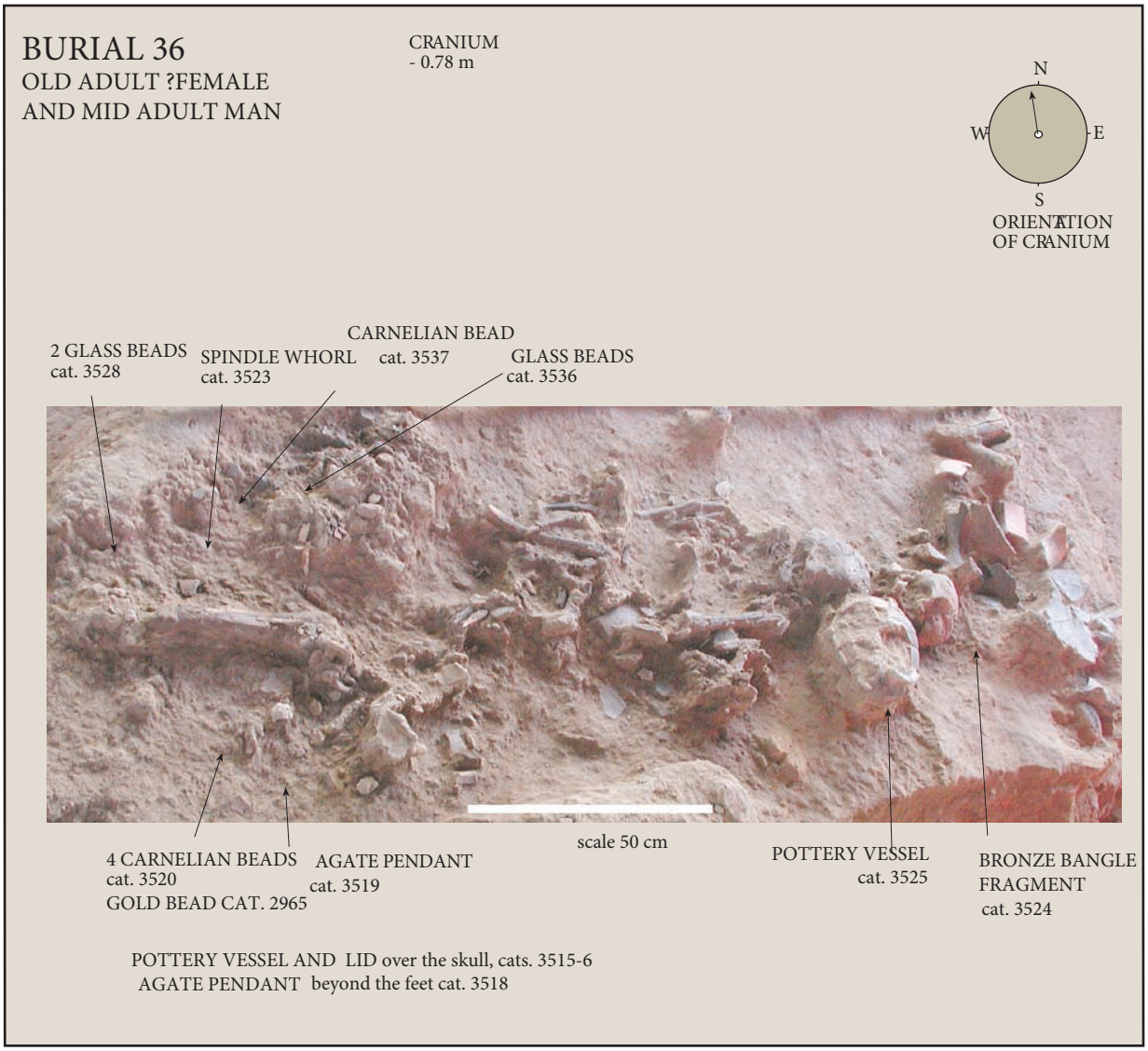


FIG. 17:3 Burial 36

Burial 36 was found in a very badly disturbed state. The grave contains the remains of two adults. One was a mid adult probably female, and the other a mid to old adult male. Two pottery vessels are of forms that almost invariably contain an infant burial, and their fragmented state probably means that the infant bones were dispersed. A gold bead and some orange glass beads were found in the area of the broken potsherds representing form 57 and 68 vessels. A third pot of form 69 was found in the area of the skull. These adults was associated with a range of ornaments. Two agate pendants were found beyond the feet, and four long carnelian beads lay by the left of the lower legs. A fifth bead was present in the area of the pelvis. Orange and red glass beads were recovered from the area of the body. Finally, these individuals were interred with a spindle whorl.

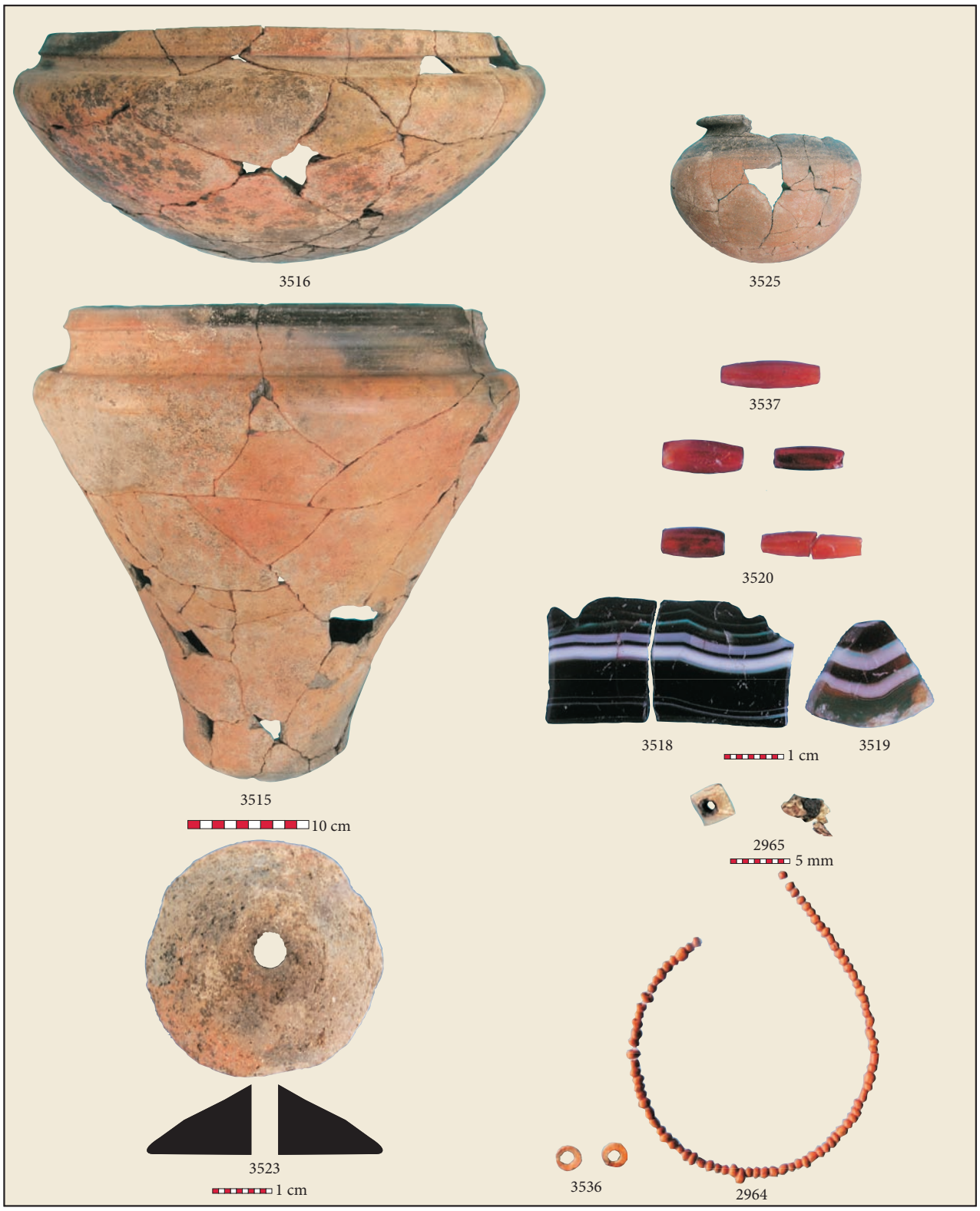


FIG. 17:4 Offerings found with burial 36



FIG. 17:5 Burial 174

The young adult in burial 174 was found at a depth of 95 cm, orientated with the head to the south. Only the left femur, tibia and fibula and the right fibula survived, together with the left finger bones. Three bronze finger rings were found there. A complete water buffalo horn core may have been associated with this burial.



FIG. 17:6 Burial 203

Burial 203, that of a young adult, was found at a depth of 1.11 m below datum, orientated with the head 350° from north. Only part of the cranium and the right hand part of the upper body have survived later disturbance. This person wore a necklace of agate beads and and two agate pendants. Twenty-four orange and 33 orange and two green glass beads probably formed part of this or a separate necklace. Bronze ornaments include two earrings, 11 bangles and six finger rings. Ninety-two orange, one blue and one green glass bead were found in the area of the right wrist, and further blue glass bead was found nearby.



FIG. 17:7 Burial 266

Burial 266 comprises two large form 68 pots placed face to face, containing the remains of a foetal infant. It was found at a depth of 47 cm below datum. The infant was accompanied by a small ceramic vessel of form 49. Ornaments, it is hard to believe that they were ever worn by the infant, comprised an agate pendant and set of yellow, blue, red and orange glass beads A bronze ring and eight small bronze bangles were also recovered.

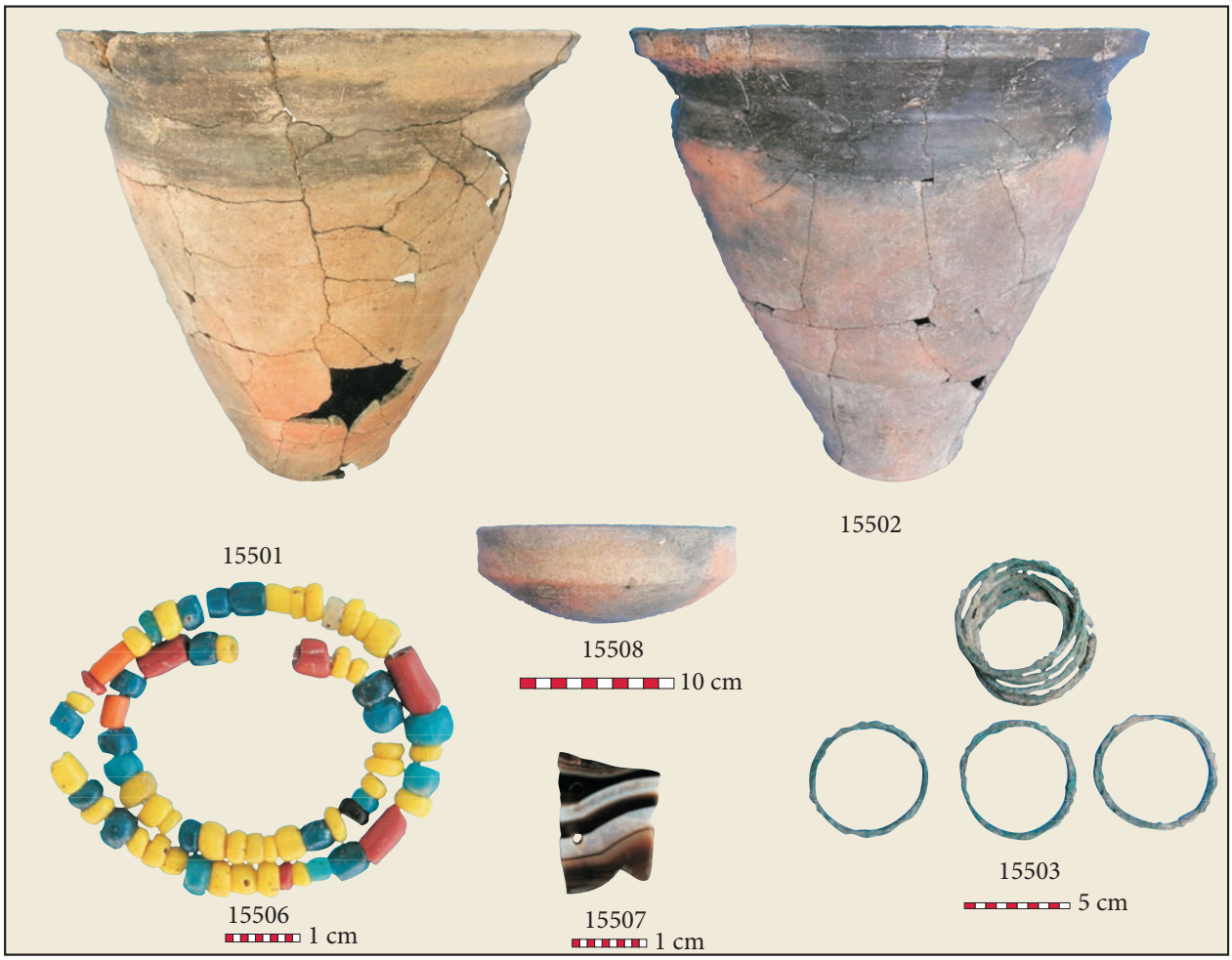


FIG. 17:8 The mortuary offerings with burial 266

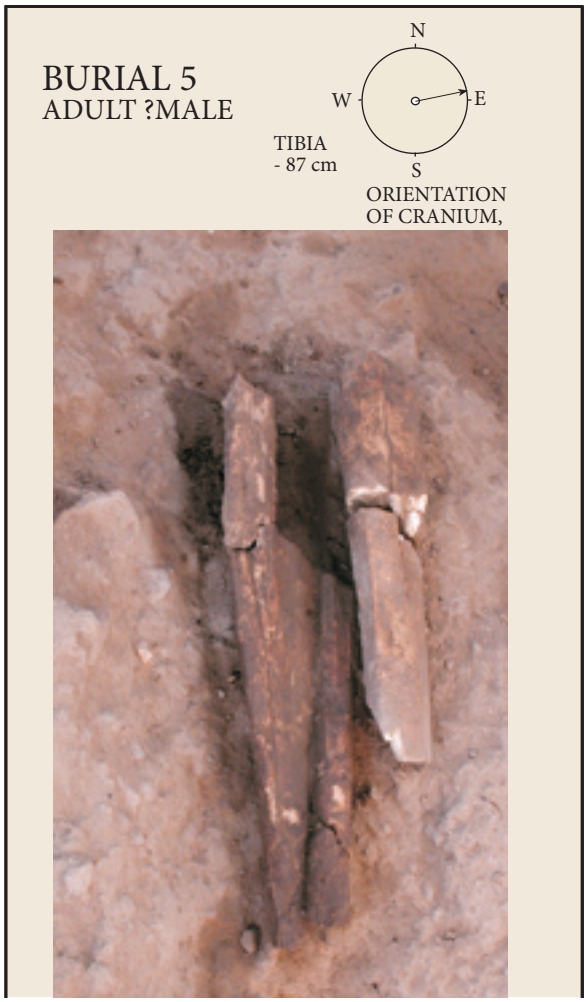


FIG. 17:9 Burial 5

Only the tibiae of an adult probably male survive in burial 5. The person had beem interred at a depth of 87 cm below datum on an orientation with the head to the east.



FIG. 17:10 The bronze ornaments from burial 38

Burial 38 contained the skeleton of an infant who died when about a year of age. It was found at a depth of 94 cm below datum, with the head orientated to the north. A possible stone marker lay beside the head. This infant wore six bronze bangles on the left wrist, and 18 bronze anklets on the right ankle. The right wrist and left ankle were disturbed in antiquity and are missing A small socketed iron axe was also found, located by the right leg.

XVIII THE IRON AGE: SYNTHESIS

C.F.W. HIGHAM

INTRODUCTION

The Iron Age mortuary remains at Ban Non Wat fall into three phases, identified as Iron Age 1, 2 and 4 in the upper Mun Valley cultural sequence. The first has by far the most burials, and itself may be divided into two groups of graves. One of these has the dead person laid out with the head pointing to the north (Fig. 18:1). The second has the head pointing to the south. Each contains the remains of men, women, infants and children. Both are located east of the late Bronze Age cemetery, and there seems to have been a continuity, a horizontal stratigraphy, between both. The dead were interred in wooden coffins which, to judge from the configuration of broken ceramic vessels, were hollowed tree trunks. The rituals of interring the dead included placing offerings within the coffin, the corpse often wearing personal ornaments.

IRON AGE 1: THE NORTHERN GROUP

Pottery vessels were the most common mortuary offerings with adults of this group. The number varies between

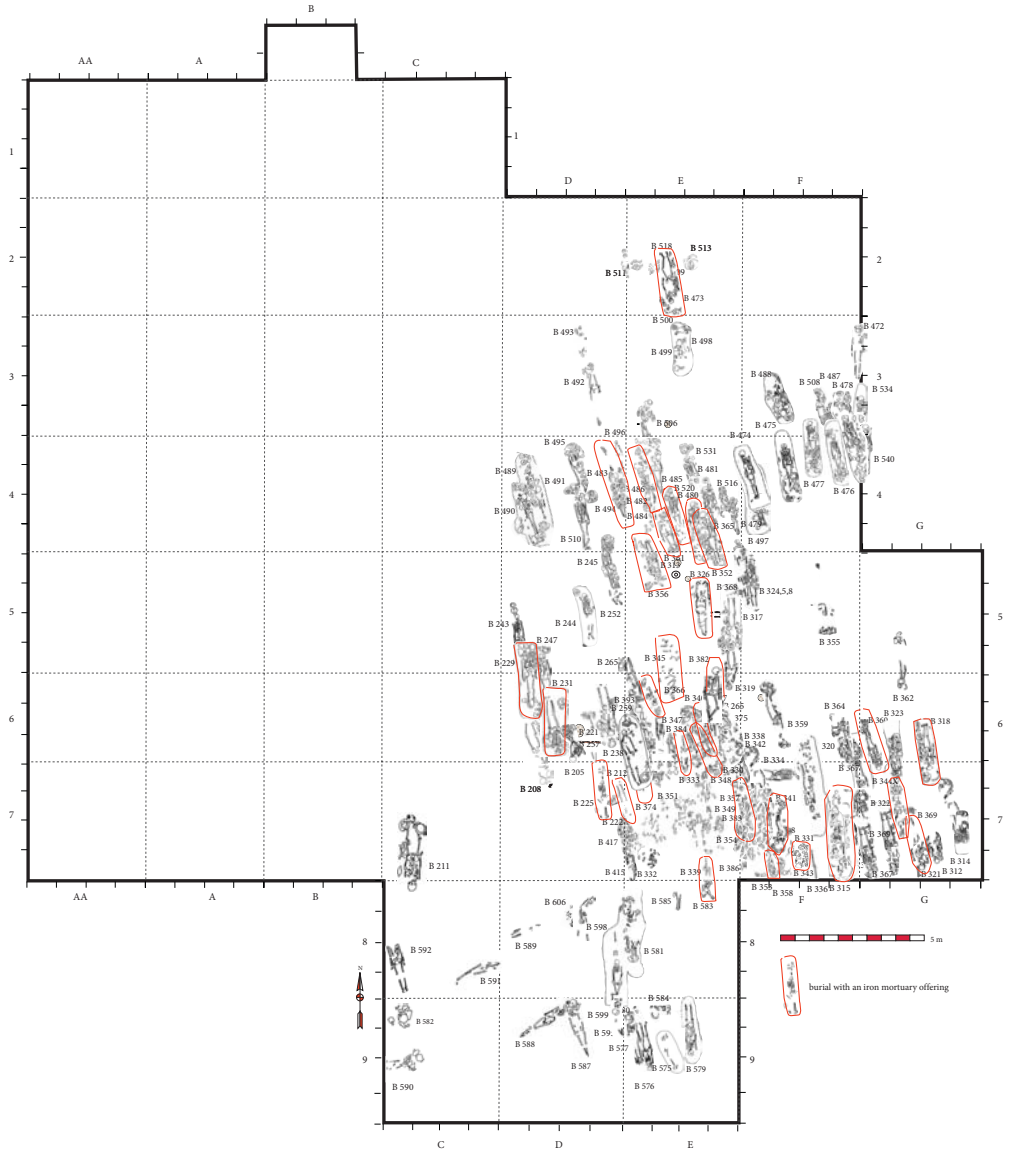


Fig. 18:1 The distribution of Iron Age 1 burials containing iron offerings

none and 18. There are three principal forms. The round-based cord-marked pots with an everted rim are similar in form to those used today as food containers. There are also platters, on which food might have been served, and large vessels again with a round base, cord marked on the lower part, red slipped on the upper with a cylindrical neck. These were found often to contain up to 12 complete fish skeletons. The assemblage as a whole seems to reflect food serving and eating. This attention to food is supported by the presence in the graves of articulating limb bones of pigs, cattle and water buffaloes. Pigs are most frequently found among the mammalian remains, cattle and water buffaloes less so.

There are two items which might well reflect a ritual component to the mortuary protocol. The bivalve shells continued in a long tradition at this site stretching back to the original settlement over a millennium earlier. They might well represent fertility and rebirth. Red ochre also has a long tradition. In the early Bronze Age, one finds it as a powder spread round the corpse, but by the early Iron Age, red ochre was placed in the form of oval pellets. During the late Bronze Age, spindle whorls and caches of grey clay were placed in some graves, and this, too, continued into the early Iron Age. The 18 females identified were associated with 11 whorls, while six were found with 16 men.

Bronze artefacts were very rare during this mortuary phase. There are 32 bangles, 27 with one individual. There is also one bronze ring. This contrasts with the abundance of such rings during IA 3-4. Burial 482 included two thin socketed bronze implements that are closely matched by examples cast in the Khao Wong Prachan Valley in Central Thailand. Shell jewellery all but disappeared from view particularly when compared with its frequency during the early Bronze Age, when over 160,000 shell beads were found in the 48 burials of Bronze Age 2 and 3A. One person wore a shell bangle, and another had five earrings.

What these people made of iron is particularly interesting, given that they were probably among the first to forge items in this part of the Mun Valley. Those of the northern group were found with ornaments, tools and weaponry. Overall, iron was quite rare. Two of the 16 men were accompanied by a socketed spear, and there were two socketed tools that looks like a hoe. There are 13 blades or knives shared between four people and four iron bangles. In the early Iron Age cemetery as a whole, there are 73 iron objects in 93 relatively intact adult graves, a figure which discounts the number of iron items difficult to disaggregate and count in toolkits. It was clearly a relatively rare commodity, or at least one chosen not to be placed regularly with the dead. There are also some whetstones which were presumably used to sharpen the iron cutting implements.

It is particularly interesting to note that these early Iron Age burials also include glass, agate and carnelian ornaments. Burial 356 is the only burial in the northern group and has one of each. It is traditional to source the inspiration for all three through exchange contacts with India. Their presence with earliest iron in this site supports the possibility that knowledge of iron smelting and forging also came to Northeast Thailand through the initiation of a maritime exchange with India and in due course, settlement at least in the coastal tracts by Indian crafts people.

There are 24 graves containing infants or children in the northern group, accounting for 38% of the total. There is a basic similarity in the treatment of adults and those who died young, but fewer offerings and a more limited range in the graves of the latter. Thus, pottery vessels were of the same forms, and up to 11 fish skeletons were present in one of these. Pig bones were present in some graves but there were no bones from bovids. Nor was there any metal, either bronze or iron, other than a single bronze bangle. However, red ochre and bivalve shells were found, and one infant wore eight ivory bangles. Grey clay and spindle whorls were present but only found together in one of the burials. Two burnishing stones were found in one grave, and a cache of 10 pellet bow pellets in another.



FIG. 18:2 The ceramic vessels that are unique to one or the other of the Iron Age 1 groups. Upper row, found in the southern group, lower row, found in the northern group

THE SOUTHERN GROUP

The southern group of burials contains at least 73 graves of adults. Of these, 16 have been identified as female or probably female and 35 as male or probably so. There might be more burials, but such was the concentration of human remains in the western part of the southern group that it was on occasion impossible to disentangle them. Apart from the orientation of the body, the burial rituals are virtually identical with those of the northern

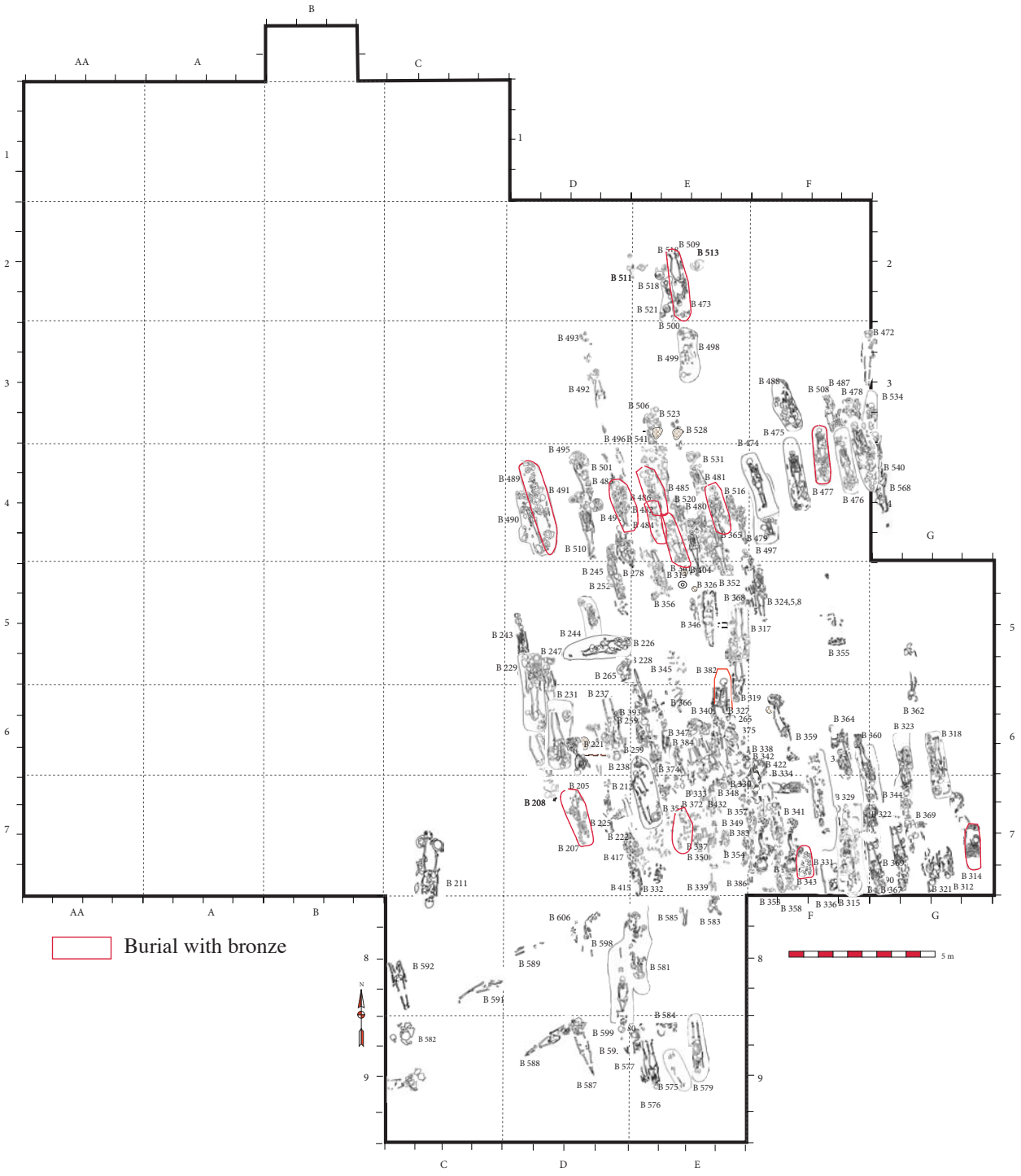


Fig. 18:3 The distribution of Iron Age 1 burials containing bronze artefacts

group. Pottery vessels were placed beyond the head and feet, and some were found broken over the body. The disposition of these broken pots suggests that the dead in this group were also interred in circular coffins presumably fashioned by hollowing trees. The majority of the pottery vessels themselves conform to the same forms as those in the northern group. However, there are some forms unique to the southern graves (Fig. 18:2). Apart from form 57, there is only one specimen of each of these.

There is a wider range of iron artefacts in the southern than the northern group (Fig. 18:1). Most unusually, there are three bimetallic spears, weapons which have a bronze haft and iron blade. These are often seen as early in the Iron Age sequence and are very rare: two have been reported from Ban Chiang. There are also 9 socketed iron spears, 7 of which was found with men, and none with women. The only other possible iron weapon is the point, of which there are three. These might have been

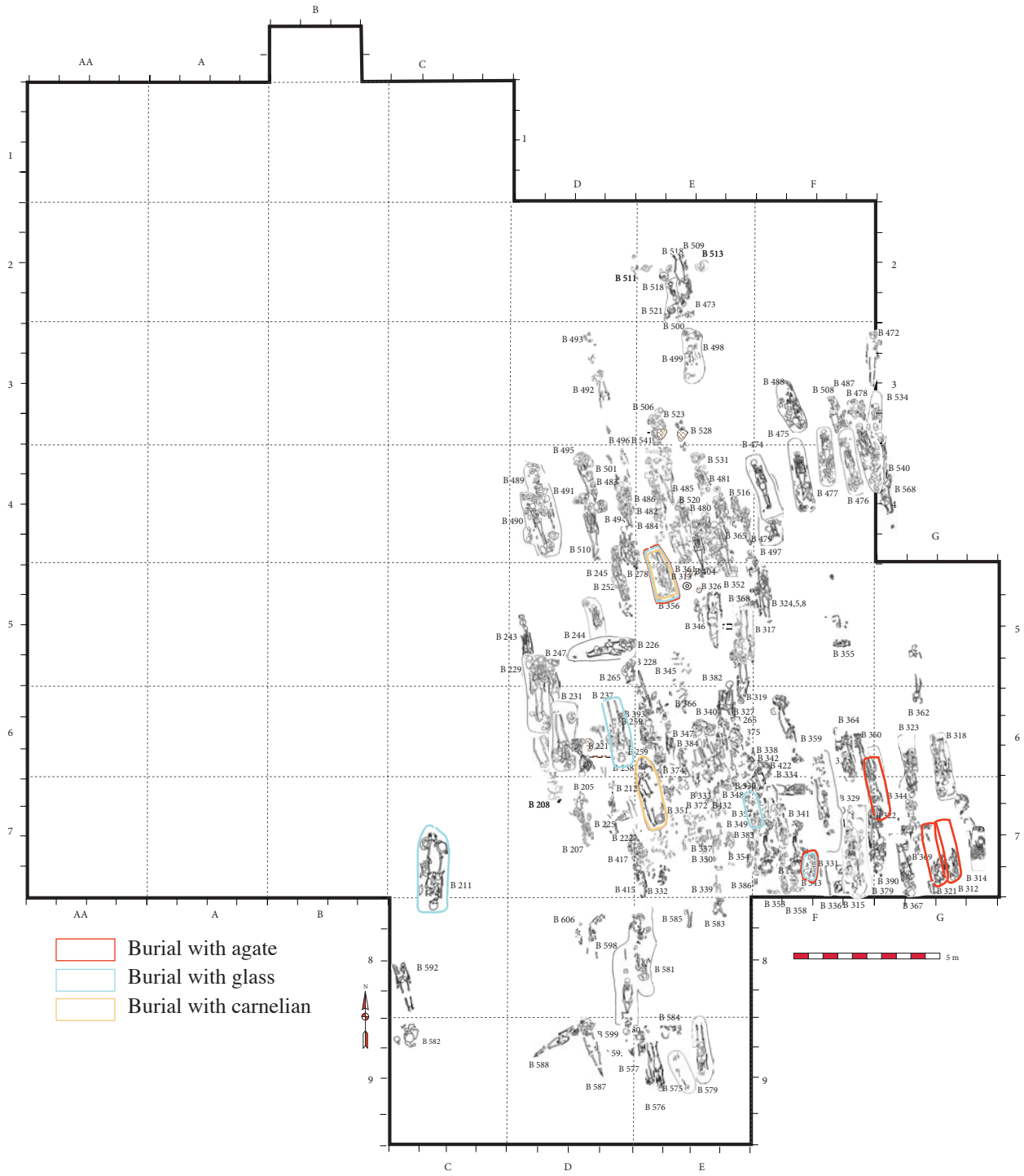


Fig. 18:4 The distribution of glass, agate and carnelian ornaments in the Iron Age 1 cemetery

used as arrowheads. The application of iron to tilling the soil or other agricultural use is seen in the presence of a socketed hoe, and one possible billhook. Ten iron bangles were found, all with one individual. Perhaps the most intriguing of the iron remains comprises kits of small implements that are often so cemented together that it is hard to disentangle, count and identify forms. There are, however, clearly small bladed knives, and awls. The presence of pseudomorphic fabric on the surface of some of these artefacts suggests that the tools were interred within a woven container, unless the fabric in fact represents clothing or a shroud.

Compared with the profusion of bronze ornaments found in later stages of the Iron Age at nearby Noen

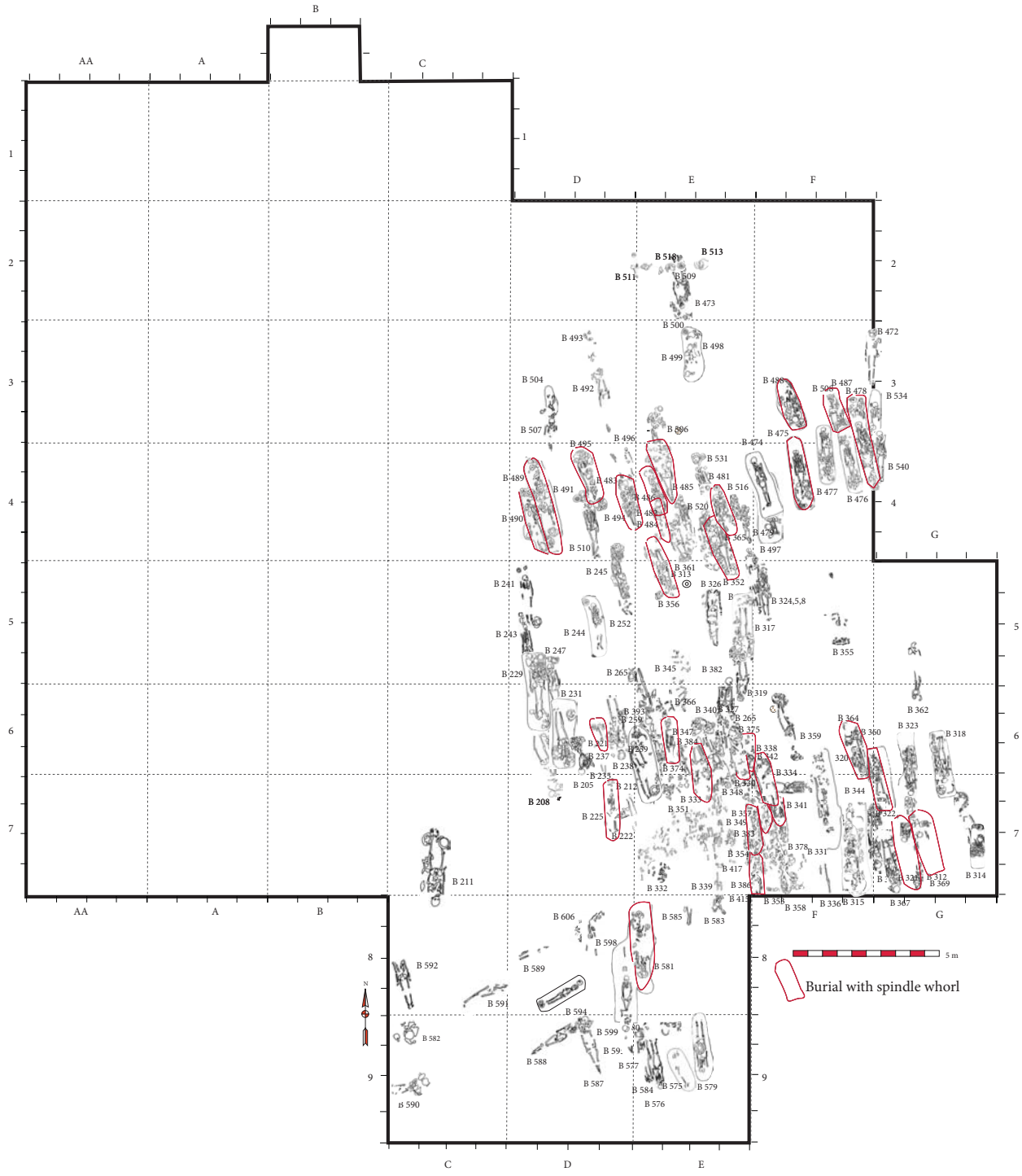


Fig. 18:5 The distribution of Iron Age 1 burials containing spindle whorls

U-Loke, bronzes were rare in the southern group (Fig. 18:3). The assemblage is dominated by ornaments. There are three rings, 25 bangles and 12 anklets. Ten of the anklets were worn by one individual, while the 23 bangles were found on just four people. The only other bronze was a tanged arrowhead. One probable male was accompanied by a complete crucible. This finding, in conjunction with the presence of a bronze founder interred with 29 moulds in the preceding phase, makes the rarity of bronzes all the more surprising.

Lead was also imported into the site. Many clay artefacts in the form of axes were found in non-mortuary contexts. Two of these accompanied burial 340 and they were covered in a thin layer of lead. It is conceivable that these were used as the socket moulds for casting axes by employing a lost lead technique. Two other artefacts of

lead take the form of socketed bladed implements, but their possible use is conjectural.

Placing the remains of animals with the deceased continued a long tradition of incorporating food in mortuary rituals. During the early Iron Age, fish dominated with at least 126 individuals, the most with any individual being 16. Complete fish were placed within large pottery vessels. There are also the bones of pigs, cattle and water buffalo. Pigs dominated among the mammals, being found with 10 individuals, followed by cattle and water buffalo. There are also a few dog bones. The presence of cattle and water buffalo should be considered in relation to the discovery at the edge of the site, of what may well have been a pen for domestic animals, for the Iron Age surface was covered with bovid hoof prints.

Red ochre and bivalve shells again had a long tradition of involvement in mortuary rituals at this site. The ochre was moulded into oval pellets, and placed as caches, with 30 individuals. One person had 13 items. Bivalve shells were found in 23 burials.

Ornaments of exotic origin and worn by the dead dominated the mortuary assemblages of the early Bronze Age at Ban Non Wat, with a particular emphasis on marine shell and marble. Both declined to negligible amounts with the early Iron Age. Just seven shell bangles were found from four individuals, and two shell ear plugs, possibly for insertion into the ear lobes were encountered. One bangle probably of ivory was also present. It is most intriguing, however, to find the presence of glass, agate and carnelian jewellery in what is considered to be an initial Iron Age cemetery.

There are three globular carnelian beads with burial 259 (Fig. 18:4). Similar beads were found at the coastal site of Nong Nor. Three agate beads were recovered from burials 312, 321 and 322. These graves were grouped together in the eastern end of the excavated area and if there was a progressive extension of the cemetery in that direction, they might be later in the Iron Age 1 sequence. Glass ornaments were found with burials 211, 357 and 237 (Fig. 18:4). They were earrings and in the case of burial 237, a further ring and a spike located in the ankle area.

As with the northern group, spindle whorls and grey clay were incorporated into the burial practice (Fig. 18:5). Certainly the former, and probably the latter, were involved in the production of fabric. Four of the women and seven of the men were associated with whorls. Beyond these, a further 6 people were buried with them. Twelve people were found with grey clay, including three women and nine men.

South Group infants

There are surprisingly few infants or children in this group, particularly given the number in the corresponding series to the north. Four of the nine were aged 8-10 years of age at death, and there were no neonates nor jar burials. The pottery vessels correspond in form to those with adults, except for a single specimen each of forms 59 and 71. Seven is the most found in any of the nine graves.

Only two burials contained iron. Burial 235, a 10-year old, was associated with an iron point and what looks like a chisel. Bronzes were found with two individuals. One nine-month old wore two decorated anklets which were hollow and contained small balls of clay to act as a rattle when the infant walked. Another nine-month old wore two large decorated bangles, one on each wrist.

Bivalve shells accompanied four infants, and four were associated with red ochre. As with the adults cattle, pigs and fish played their part in the burial procedure. One infant was accompanied by nine fish skeletons. A two, 10 and 15-year old were buried with spindle whorls, and three infants with grey clay. The 10-year old in burial 235 wore glass earrings, and glass beads were found in the neck area, presumably once a necklace.

IRON AGE 2

Iron Age 2 burials have been isolated on three grounds. They are restricted to the northwestern part of the excavated area, where there is a remarkable concentration of lidded jar burials containing the remains of newly-born infants Indeed, at least six of the eight infant burials are neonates. These graves are found higher than the Iron Age 1 graves, and the vessels containing the infants are similar in form to those from IA2 at nearby Noen U-Loke, but none of the pots found with the infants, or the three adults, is of the Phimai Black tradition which characterises IA3-4

Other than the pottery vessels themselves, no offerings were included in the infant graves. One adult, however, and all were found in a disturbed or partial condition, was relatively wealthy, with a gold and an agate bead, and an iron sickle.

IRON AGE 4

It is unfortunate that as yet we have not identified the cemetery at Ban Non Wat that corresponds to IA3 at Noen U-Loke. Individuals in the latter were interred in graves filled with rice, with considerable wealth in terms of bronze, glass, agate and iron offerings together the Phimai black ceramics. A small number of IA4 graves at Ban Non Wat are found in the western part of the main square, with a group in the small opening in square X and one or two in square Y. These have in common, a form of infant jar burial that is found at IA4 Noen U-Loke. There are eight adult burials in the main square, five of which are fragmentary, and three while disturbed, were still associated with a range of interesting mortuary offerings.

Burial 36 was so badly disturbed that there were virtually no articulating bones left. However, an interesting set of artefacts was found among them, and they are typical of IA4. There are also two agate pendants and five carnelian

beads. The complete golden bead is similar in form to those from burial 69 at Noen U-Loke. There are also orange glass beads and a spindle whorl. A pot is of the form used for infant jar burials, and indeed, it might have once contained a corpse.

Only the upper right part of the skeleton of burial 203 has survived, so the ornaments found represent only a partial set of what was once there. There are 11 bronze bangles and six finger rings, two agate pendants, 15 agate beads, two bronze earrings and orange, green and blue glass beads. This is a typical assemblage of the later Iron Age in the upper Mun Valley.

Burial 266 comprises a double jar burial, containing the remains of a foetal infant. This tiny individual was accompanied by an agate pendant, small bronze rings or bangles and yellow, blue red and orange glass beads.

There are five adult and five infant IA4 burials in square X. Relative to the late Iron Age burials at Noen U-Loke, they were poor. Perhaps being at the edge of Ban Non Wat accounts for this. The combined total of mortuary offerings in the five infant burial jars comes to ten bimetallic (iron and bronze) rings, a bronze ring and one bronze bangle. One adult was relatively complete and this person was interred wearing 29 bronze finger rings, three bangles and a bimetallic ring. Burial 107 was disturbed, and was associated with two of the bimetallic rings, while burial 111 had three bronze rings, a bronze bangle and a bronze earring.

COMPARISON WITH NOEN U-LOKE

Noen U-Loke is a moated site located only 1.8 km to the west of Ban Non Wat. Our excavations there uncovered a habitation and mortuary sequence that covers the duration of the Iron Age in the upper Mun Valley. It is therefore a key site in the overall objective of our research programme, which is to identify and explain the prehistoric cultural sequence that led to the transition into early states. This will therefore be summarised below.

Iron Age 1 420 - 150 BC

The initial Iron Age is documented by six burials at Noen U-Loke and 145 at Ban Non Wat (Figs. 18:6-7). The dead were normally interred in a supine position accompanied by a variable range of mortuary offerings. At the former site, two men were found buried alongside each other but in opposite directions. They were undisturbed and illustrate a complex mortuary ritual. Each lay in a supine position with the hands by the side. Pottery vessels closely matched in form at the corresponding phase at Ban Non Wat contained food remains: complete fish skeletons, pig and turtle bones. The severed foot bones of pigs were

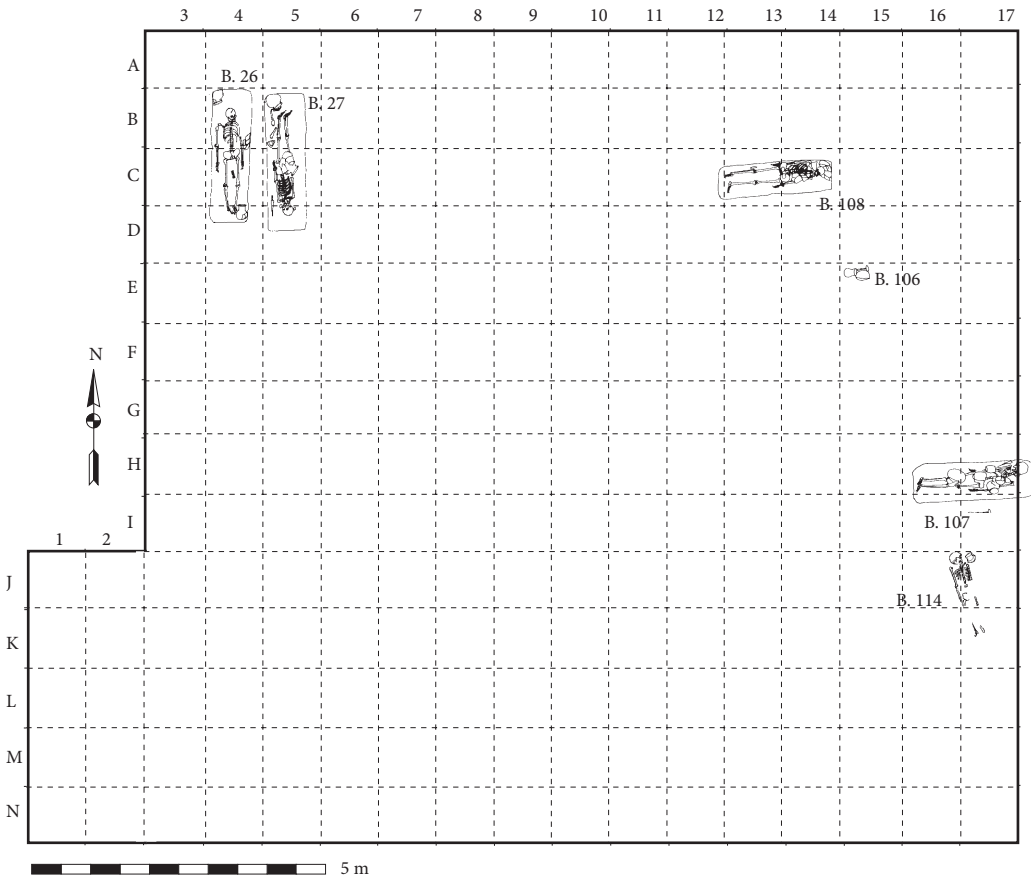


Fig. 18:6 The layout of graves belonging to Noen U-Loke Iron Age 1



Fig. 18:7 Iron artefacts placed with the dead during Iron Age 1. A. Ban Non Wat burial 348 socketed chisel, B. burial 341 socketed hoe, C. burial 390 bimetallic spear, D. burial 341 point, E. burial 356 bangles, F. Noen U-Loke burial 108 torc or neckring, G. burial 108 bangles, H. burial 27 socketed spear, I. Ban Non Wat burial 374 socketed spear

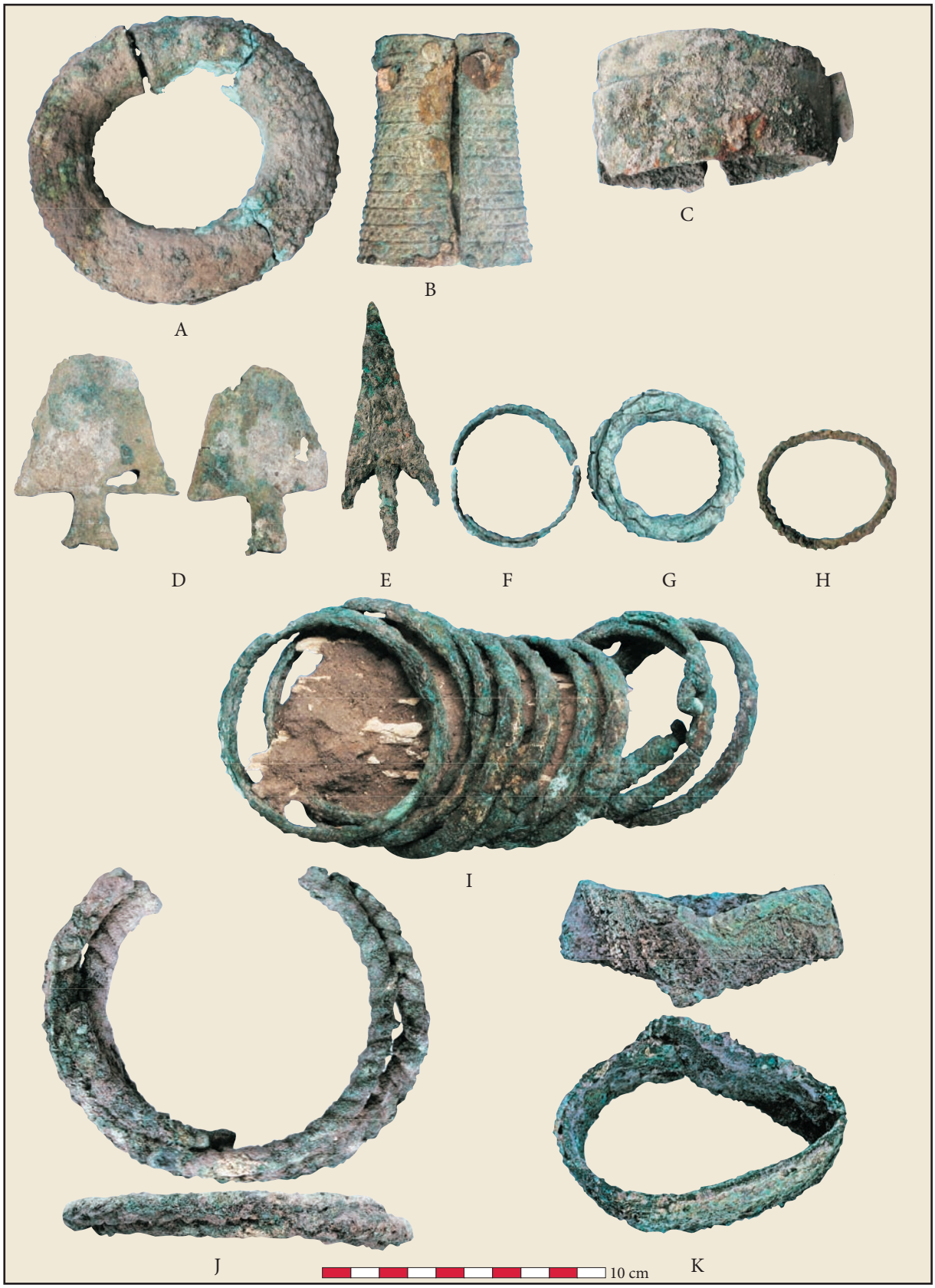


Fig. 18:8. Bronze artefacts from Iron Age 1 burials. Ban Non Wat A Burial 314 anklet, B. burial 343 bangle, C. burial 382 bangle, D. burial 482 socketed implements, E. burial 477 arrowhead, F. burial 345 bangle, G. burial 489 bangle, H. burial 481 bangle, I. burial 485 bangles. J. Noen U-Loke burial 27 left, three torcs, and K. bangle

placed with each man. One man was accompanied by a large socketed iron spear (Fig. 18:7H) and an iron hoe. He also wore shell discs probably inserted into distended ear lobes and four tiger's canines bored for suspension round the neck. The second man wore two similarly bored pig's tusks. An old woman of this same phase wore two iron bangles on each wrist, and a neck ring of iron (Fig. 18: 7F,G). Bronze was used for ornaments: bangles and neck rings (Fig. 18:8J,K), as well as for socketed spears.

It is not possible to offer a precise correlation between Ban Non Wat IA1 graves and those of IA1 at Noen U-Loke, and there are some important distinctions between the two sites which might be chronological or alternatively, due to the small sample size for the latter site. Common features include the provision of large pottery vessels containing complete fish skeletons, as well as the severed limbs of pigs. At Ban Non Wat, water buffalo and cattle bones were also found on occasion. There are similarities, and some differences, in the iron artefacts found. Spears and bangles are present at both sites, but at Ban Non Wat, there were also kits of thin-bladed knives, awls and possibly other small tools, formerly contained in cloth bags to judge from pseudomorphic fabric remains. Bronzes were relatively rare. There were plain bangles (Fig. 18:8I) and in the case of two infants, technically demanding anklets and bangles bearing decoration cast through the lost wax procedure (Fig. 18:8A,B). Three men were accompanied by spears with a bronze socketed haft and an iron blade (Fig. 18:7C). There were also two thin socketed bladed artefacts of unknown use, but which are precisely matched in moulds from the Khao Wong Prachan Valley in Central Thailand (Fig. 18:8D), and an arrowhead (Fig. 18:8E).

Glass in Southeast Asia is usually seen as a signal for the commencement of maritime exchange with India. The early Iron Age phase at Ban Non Wat included a handful of individuals wearing glass ear ornaments. Burial 356 also wore a necklace containing a glass, carnelian and an agate bead. Many people were also accompanied by spindle whorls and caches of grey clay. The former were used for processing yarn, while clay is used to this day for dyeing

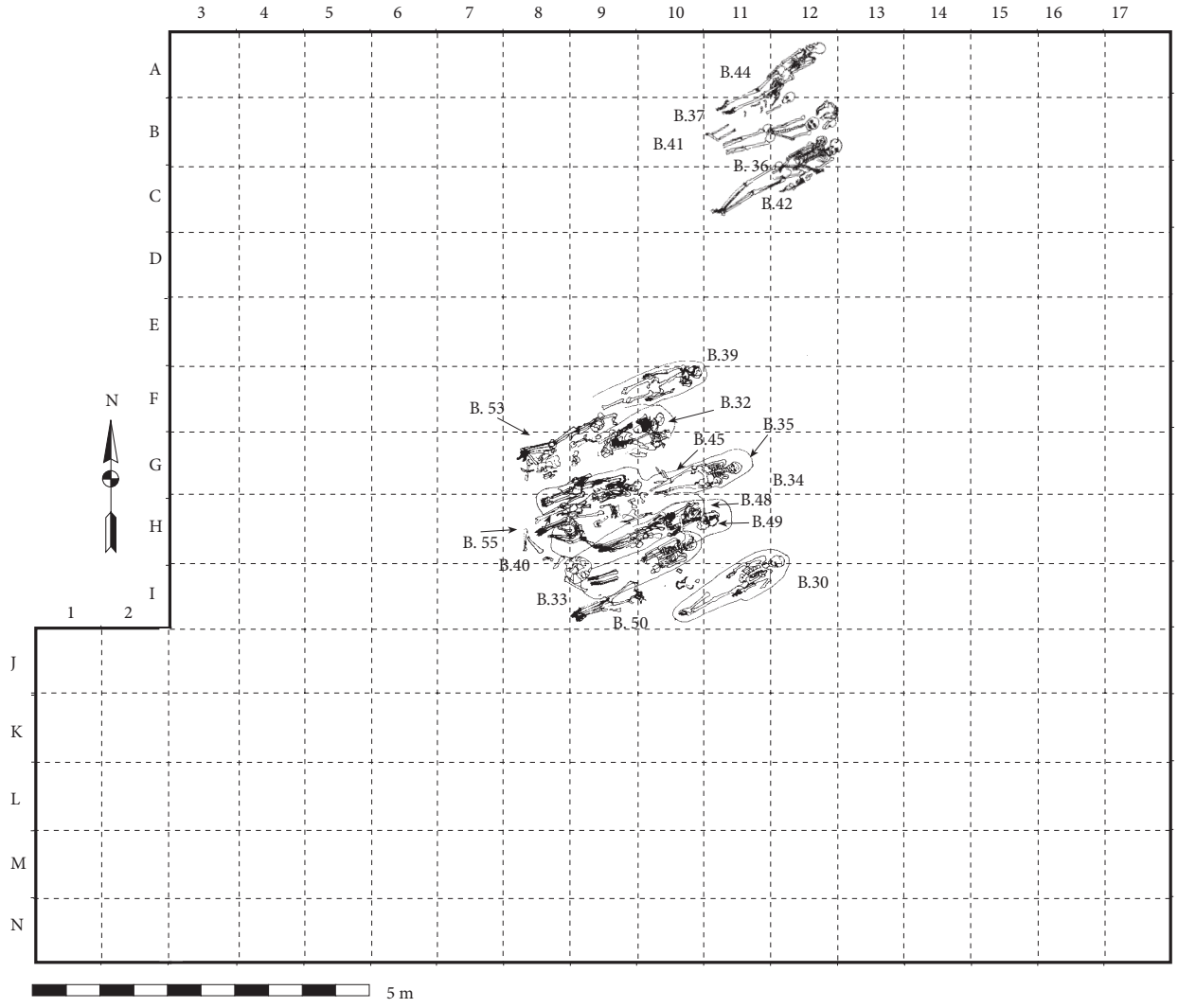


Fig. 18:9 The layout of graves belonging to Noen U-Loke Iron Age 2

cloth. Clearly, the production of fabric was being undertaking by the occupants of Ban Non Wat.

Iron Age 2 150 BC- AD 200

The second phase of the Iron Age is represented by two tightly clustered groups of burials at Noen U-Loke (Fig. 18:9). The earlier group comprised the graves of two men, two women, a child and an infant. They wore the first glass beads to be found at this site, as well as an agate pendant, some beads of shell and bronze finger rings. Two people were interred with complete pig's skeletons. The later and larger group lay just to the south, and in it, we find a number of singular changes, particularly the rice bed burials. This technique involved placing the corpse in a grave filled with white, burnt rice husks, referred to below as silicified rice. The bones, when encountered, were covered in rice. Long, facetted carnelian beads were restricted to this cluster (Fig. 18:10H,I). Other jewellery included strings of glass beads (Fig. 18:10 A-C), agate beads and pendants (Fig. 10D-G, J), and bronze toe and finger rings (Fig. 18:10 M,N). A bronze spiral ornament was found on the head of a young man (Fig. 18:10K). There were no iron offerings, and very few pottery vessels.

Iron Age 3 AD 200-400

The structure of the Iron Age 3 cemetery at Noen U-Loke again comprised tight groups of graves each containing the remains of men, women, infants and children (Fig. 18:11, Table 18:3). The ceramic vessels now belonged to the Phimai Black tradition. This was a period when the inhabitants of Noen U-Loke were active participants in a growing exchange network for exotic goods. These groups



Fig. 18:10. Mortuary offerings from Noen U-Loke Iron Age 2 burials. A. burial 37 glass beads, B. burial 53 glass beads, C. burial 23 glass beads, D. burial 37 agate pendant, E. burial 35 agate pendant, F. burial 53 agate pendant, G. burial 40 agate pendant, H. burial 53 carnelian beads, I. burial 32 carnelian beads, J. burial 49 agate beads, K. burial 39 bronze head ornament, L. burial 30 bronze bangles, M. burial 30 bronze finger rings, N. burial 54 bronze toe rings, O. burial 54 bronze bells

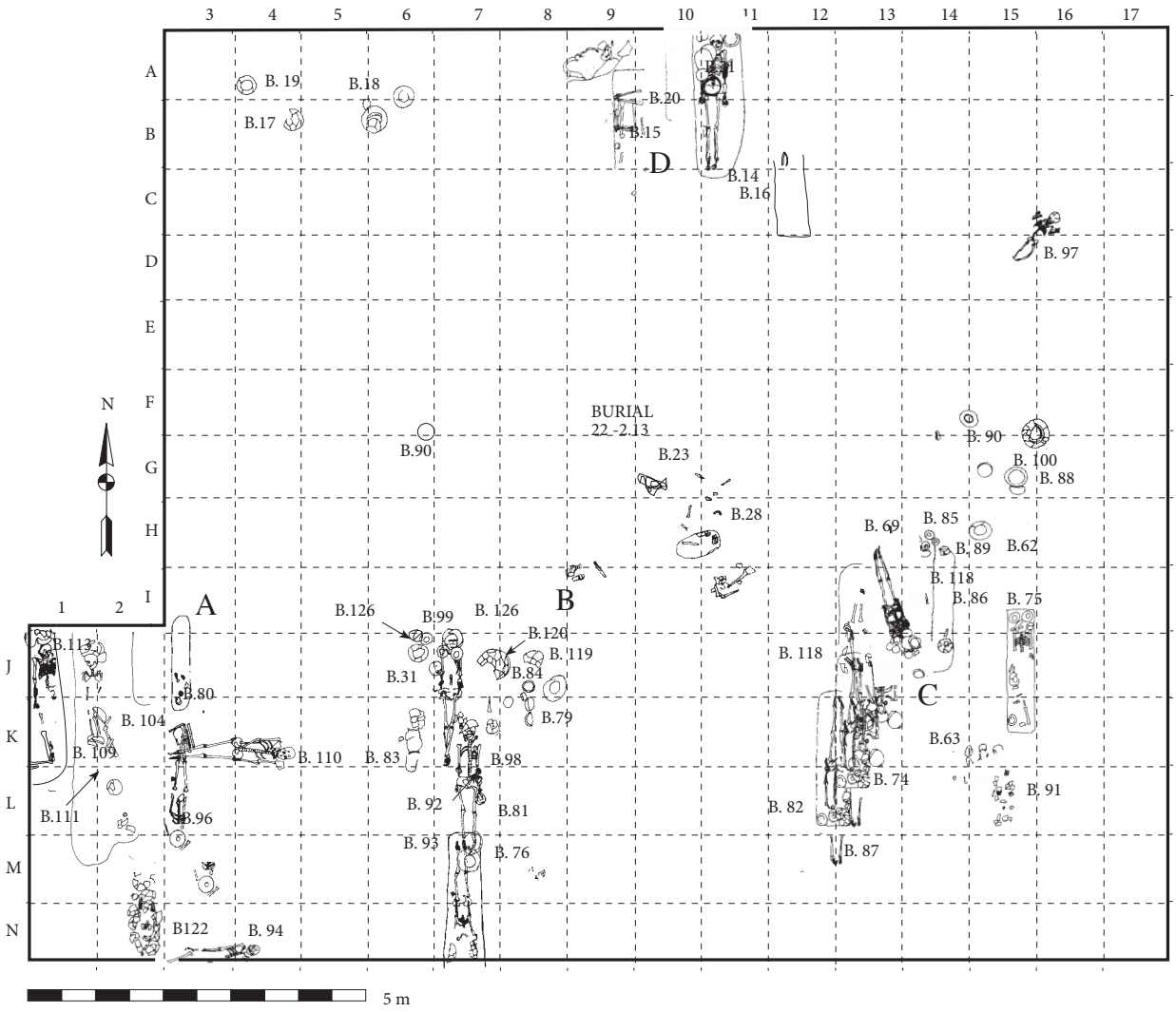


Fig. 18:11. The layout of graves belonging to Noen U-Loke Iron Age 3

are so tightly nucleated that it is considered highly likely that each comprises related individuals. Any differences between their wealth and treatment therefore, opens the possibility of exploring the social structure of this community during the later Iron Age.

Group A comprises three men, three women, three adults of unknown sex and four infants. This supports the suggestion that the group comprises related individuals. The mortuary ritual involved digging a deep grave and lining it with clay. Many were also filled with white silicified rice. The relatively intact burials - several were disturbed when later graves were dug - also contained fine Phimai Black ceramic vessels. People were buried wearing a wide range of ornaments. Burial 113 involved a woman aged about 25-30 years at death. Her grave was lined and capped with clay, and contained white burnt rice. This woman was interred wearing a necklace comprising 68 gold beads and many agate beads (Fig. 18:12L). She also wore two agate pendants at the neck. Four pottery vessels lay beyond the cranium. Her bronze ornaments comprised two ear spirals (Fig. 18:12B), 38 or more bangles (Fig. 18:12C), 64 finger rings (Fig. 18:12D) and nine toe rings. She wore a silver finger ring on her left hand and a silver toe ring on the left foot. Over her upper left arm, there lay an iron knife blade bearing the impressions of fabric. A bimetallic (bronze and iron) ring lay under her head. Burial 113 thus represents one of the richest interments of this site.

Burial 104 contained the remains of a 25-30 year-old woman. The upper part of her skeleton was found intact, but the lower limbs were in disarray, probably as a result of the later interment of burial 105. Therefore the scattered remains of pottery vessels in the vicinity of the foot bones are not in certain association. Three pottery vessels were found beyond the cranium, and she wore two agate neck pendants (Fig. 18:12I). Other ornaments included a bimetallic ring, a bronze ear ring on the left ear, and a bronze spiral together with five glass beads in the area of the body.

Burial 96 was found almost intact in a grave filled with

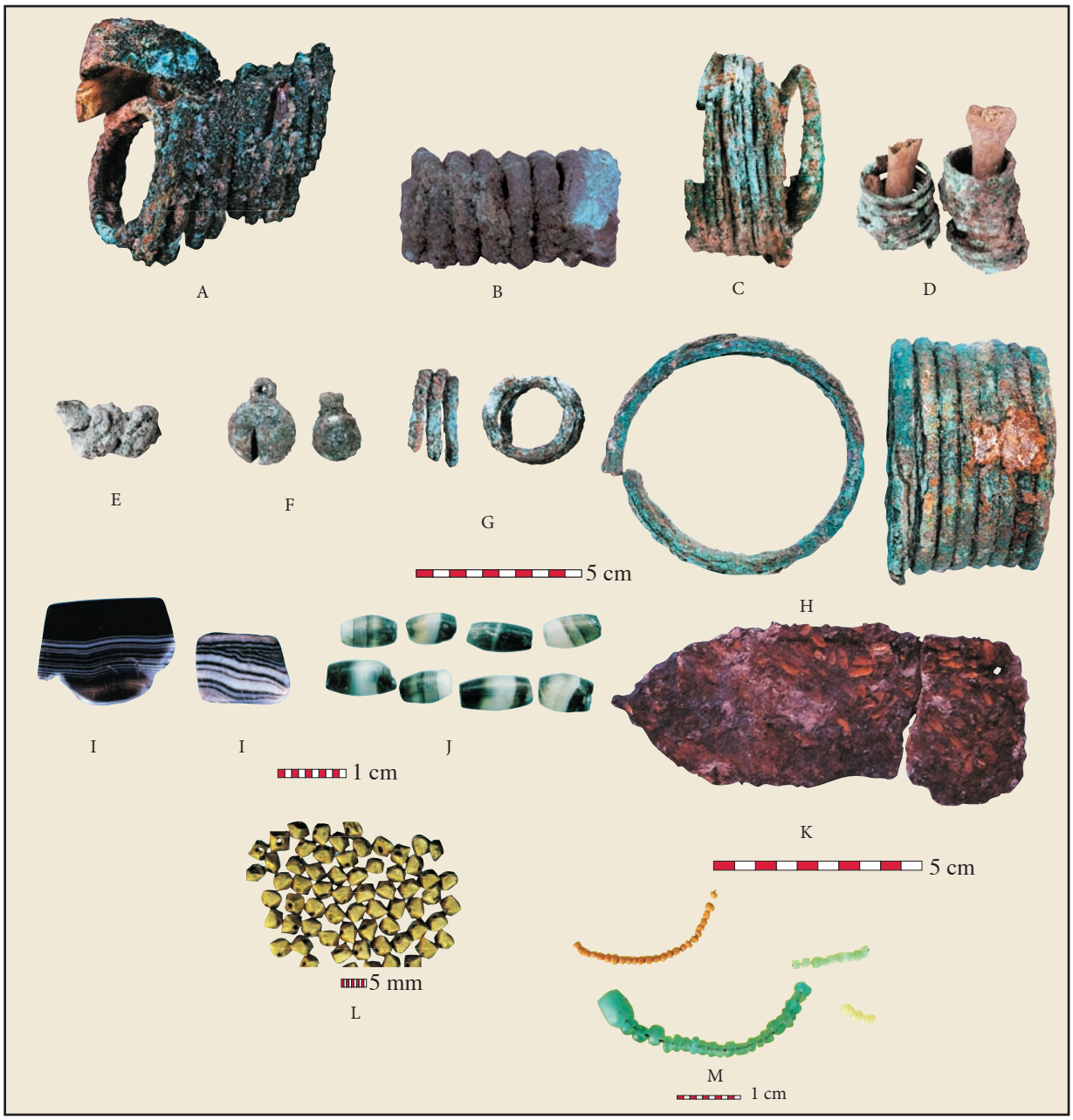


Fig. 18:12 Mortuary offerings from Noen U-Loke Iron Age 3 group A. A burial 105 bronze toe rings, B. burial 113 bronze ear coil, C. burial 113 bronze bangles, D. burial 113 bronze rings, E. burial 96 belt, F. burial 96 bell, G. burial 122 spiral, H. burial 113 anklets, I. burials 104 and 113, agate pendants, J. burial 113 agate beads, K. Burial 105 iron knife, L. burial 113, gold beads, M. burial 105 glass beads

white burnt rice. A pottery vessel had been placed over the head, but when removed, it was found that an iron blade lay over the lower part of the face. This person wore at least one bronze torc and a bronze earring on the left ear. Other bronzes included a bangle on the upper right arm, a further ring or bangle under the pelvis, 14 bronze finger rings on the left hand and five others scattered in the vicinity of the hands, part of at least one and probably more belts (Fig. 18:12E), two bells (Fig. 18:12F) and many fragments of ring or bangle. The grave was disturbed, and further items were found in the general area of the body, including a second iron blade, and glass beads.

Infants were interred with considerable wealth. Burial 122, an infant who died when aged between 3-9 months, was found in a rice bed at a depth of 2.66 m. This burial is particularly notable for the number of pottery vessels placed round the body. Although most were found in a fragmentary condition, at least seven were identifiable.

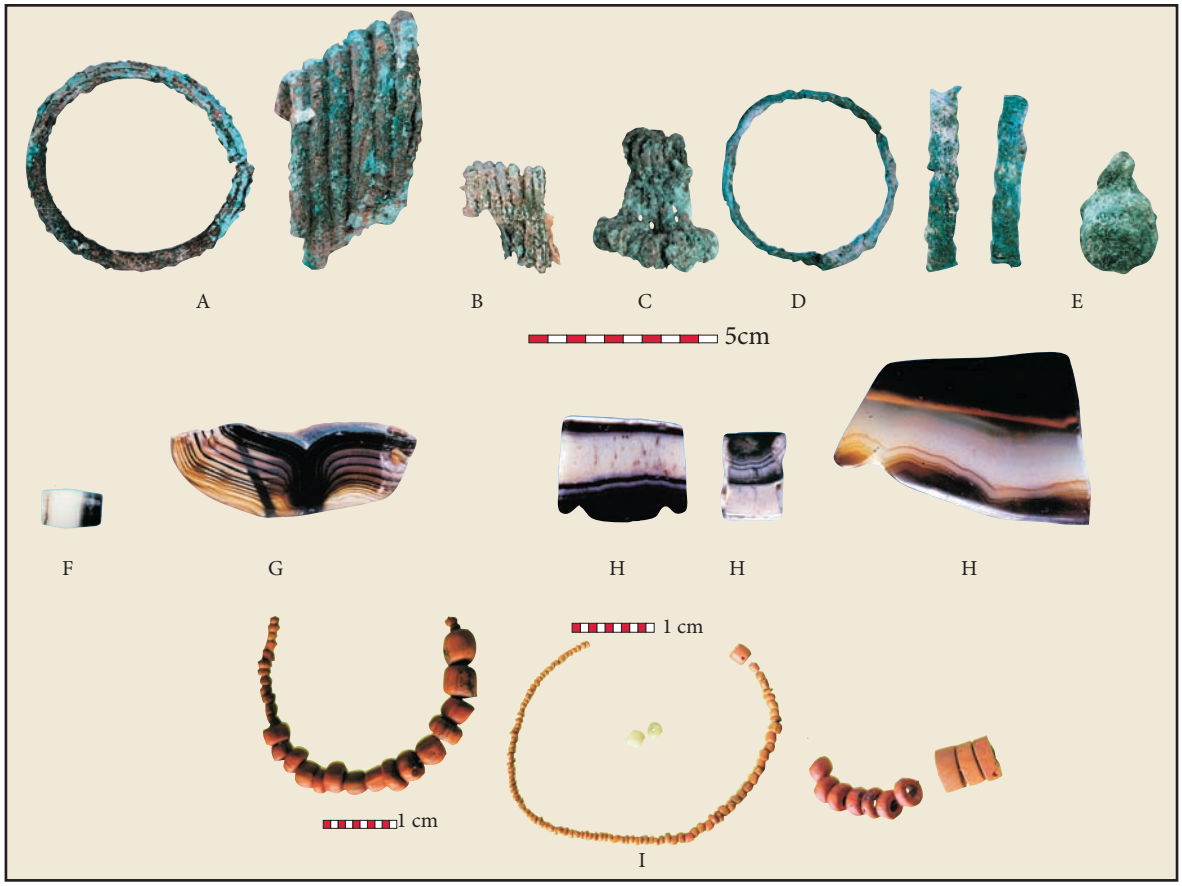


Fig. 18:13 Mortuary offerings from Noen U-Loke Iron Age 3 group B burials. A. burial 98 bangle, B. burial 98 finger rings, C. burial 99 earrings, D. burial 79 anklet, E. burial 120 bell, F. burial 120 agate bead, G. burial 99 agate pendant H. burial 129 agate pendants, I. burial 25 glass beads

TABLE 18:1 *The mortuary offerings with relatively intact graves from Noen U-loke Iron Age 3 group A*

artefact	105	111	104	113	96	110	80	122	artefact	105	111	104	113	96	110	80	122
sex	M	M	F	F		F			sex	M	M	F	F		F		
age	A	YA	MA	MA	A	A	I	I	age	A	YA			A	A	I	I
pottery vessel	8	1	3	4	1	0	1	7	bronze torc	0	0	0	0	1	0	0	0
agate pendant	0	0	2	2	0	0	0	1	bronze belt	1	0	0	0	2	0	0	0
agate bead	0	0	0	30	0	0	0	0	bronze ring	0	7	0	64	19	1	0	0
glass bead	494	0	5	0	p	0	0	1	bronze toe ring	42	0	0	9	0	0	0	0
gold bead	0	0	0	68	0	0	0	0	bronze spiral	0	0	1	1	0	0	0	1
silver bangle	1	0	0	0	0	0	0	0	bronze earring	0	0	1	0	1	0	0	1
silver ring	0	0	0	1	0	0	0	0	bronze bangle	0	0	0	38	2	0	17	40
silver toe ring	0	0	0	1	0	0	0	0	bronze ear spiral	0	0	0	2	0	0	0	0
silver strip	0	1	0	0	0	0	0	0	bimetallic ring	0	0	1	1	0	0	0	0
bronze anklet	0	0	0	0	0	0	15	0	shell earring	0	0	0	0	0	1	0	0
bronze bell	0	0	0	0	2	0	0	0	iron blade	2	0	0	1	1	0	0	0
YA young adult, MA mid adult, A adult, M male, F female, I infant									spindle whorl	1	0	0	0	0	0	1	0

The infant also wore an agate pendant at the neck, and much bronze jewellery. Nineteen bangles were counted on the left arm and at least 16 on the right. There were also three bangles by the right ear and two by the left, as well as an earring. A bronze spiral was found on one toe and a glass bead was located in the area of the body.

This cluster of graves includes men, women and infants. The preferred orientation was north to south. Two females were interred with the head to the north, and two men were buried with the head to the south. The other relatively intact adult was also found with the head to the south. The presence in this last burial of parts of a bronze belt hint that it was probably male also, since only positively identified males in other phase 3 clusters wore such belts. There is, therefore, the possibility that men and women in this cluster were interred on opposing orientations. This was found to be the case in the late Bronze Age cemetery of Ban Na Di (Higham and Kijngam 1984). Uncovering the complete cluster would test this possibility.

The graves were up to 90 cm deep, and where a cutting was identified, they originated from lower layer 3. The beds of most graves was filled with rice burnt to a white colour, and in some cases, there was evidence for a clay lining, including a cap or cover. The mortuary ritual included the placing of a bowl over the face of the dead. This was not found in any other cluster. It is clear that earlier graves were on occasion disturbed, and the bones were bundled and replaced, often in the grave fill of the subsequent interment. Infants were buried, often with a rich complement of grave goods, in the same manner as adults. No jar burials were encountered and no animal bones were placed with the dead. Intact cluster A burials were accompanied by a wide range and considerable number of grave goods. These included jewellery of gold and silver, agate and glass. Bronzes included earrings, torcs, bangles, anklets, finger and toe rings, bells and belts. Iron was rare, however, and comprised three knives and a socketed hoe or axe. One knife was covered in pseudomorphic fabric, but only two spindle whorls were found, one with an infant and the other with a male.

Noen U-Loke Iron Age 3 cluster B

Iron Age 3 cluster B was found to the east of A with an intervening space of 3-4 metres. There are two adult men, one woman and two further adults (Table 18:2). Thirteen graves contain the remains of infants, eight being pre-term or neonate, with one who survived to between 3-9 months. Three died when aged between 1-4 years and there was a 10-11 year old. This is a remarkably high proportion of infants, their graves clustering round and over that of the relatively old woman.

Burial 98, that of an adult male, lay in a bed of white, burnt rice. A pottery vessel lay over the cranium, and two spindle whorls were present, both on or near the left shoulder. Bronze ornaments incorporated nine bronze bangles, of which seven were on the left wrist (Fig. 18:13A). There were seven finger rings on the right hand, and three spirals on the left (Fig. 18:13B). Six earrings were found to the right of the head, and a small fragment possibly from a seventh at the base of the skull. An iron knife blade lay in the area of the left hand. Some glass beads were also found by the head.

Burial 99 contained the skeleton of a woman who died as a result of heavy cutting blows to the head that severed her skull. It is presumed that following this violent death, she was returned to the cemetery and interred wearing her ornaments and other items that included four spindle whorls disposed two to the right and two to the left of the upper body. A complete pottery vessel was placed on the left shoulder. Bronze jewellery incorporated four bangles on the left wrist and seven on the right. There were eight

TABLE 18:2 *The mortuary offerings with relatively intact graves from Noen U-Loke Iron Age 3 group B*

artefact	98	99	76	31	46	77	79	81	120	25	artefact	98	99	76	31	46	77	79	81	120	25
sex	M	F									sex	M	F								
age	A	MO	A	12 y	I	I	I	I	I	I	age	A	MO	A	12 y	I	I	I	I	I	I
pottery vessel	1	2	3	1	3	1	1	1	3	1	bronze spiral	3	0	0	2	0	0	0	0	0	0
agate pendant	0	1	0	0	0	0	0	0	3	0	bronze earring	6	16	1	1	0	0	0	0	0	1
agate bead	0	0	0	0	1	0	0	0	1	0	bronze bangle	9	11	0	2	2	1	2	4	0	1
glass bead	10	1	0	0	1	0	0	6	0	246	bird's egg	0	0	0	1	0	0	0	0	0	0
bronze anklet	0	0	0	0	0	4	5	2	7	6	bivalve shell	0	0	0	0	0	0	2	0	0	0
bronze bell	0	0	0	0	0	0	0	0	1	0	iron blade	1	0	1	0	1	0	0	0	0	0
bronze ring	7	2	16	6	0	0	0	1	0	1	spindle whorl	2	4	1	0	0	0	0	0	0	2

YA young adult, MO mid old adult, A adult, M male, F female, I infant, y year

TABLE 18:3 *The mortuary offerings with relatively intact graves from Noen U-Loke Iron Age 3 group C*

artefact	69	74	86	62	82	75	118	63	85	88	91
sex	M	M	M	F	F		A				
age	A	Y	YA	MO	MA	YA		3-9 m	N	N	0-3 m
pottery vessel	4	3	2	3	5	5	2	5	4	1	2
agate pendant	0	0	1	1	0	0	0	0	0	0	1
glass bead	1	0	0	2	0	0	0	0	p	10	0
glass bead necklace	0	0	0	0	0	0	0	1	0	0	0
carnelian bead	0	0	0	0	0	0	1	0	0	0	0
bronze anklet	0	0	0	10	0	0	0	7	0	0	2
bronze belt	4	0	0	0	0	0	0	0	0	0	0
bronze ring	124	0	1	64	0	0	5	5	2	0	0
bronze toe ring	33	1	0	0	6	0	22	0	0	0	0
bronze spiral	0	0	0	0	0	0	1	0	0	0	0
bronze earring	0	0	3	7	0	1	0	1	0	0	1
bronze bangle	20	0	1	26	14	0	9	12	0	0	8
bronze ear insert	2	0	0	0	0	0	0	0	0	0	0
bimetallic ring	4	1	0	3	0	0	0	2	8	0	0
iron point	1	0	0	0	0	0	0	0	0	0	0
iron blade	1	0	1	1	1	1	0	0	1	0	0
iron spade	0	0	1	0	0	0	0	0	0	0	0
iron ?pendant	0	0	0	0	0	0	1	0	0	0	0
spindle whorl	0	0	0	0	1	0	0	0	0	0	0
bivalve shell	0	0	0	0	0	0	0	0	0	0	1

M male, F female, A adult, Y young, MO mid old adult, YA young adult, N neonate, m month, p present

key-shaped earrings on each ear (Fig. 18:13C), a bronze ring by the neck and another by the left leg. She also wore an agate neck pendant (Fig. 18:13G) and a glass bead.

Burial 76 contained the remains of an adult within a bed of rice. Three pottery vessels were found beyond the head, and a spindle whorl and an iron knife blade lay to the right of head. Three bronze finger rings were found on the right hand, and 13 on the left. There was also a bronze earring on the left ear.

The infant in burial 46 died when between 1.5 and 4 years of age. A bed of rice filled the base of the grave. Three pottery vessels were associated with the body, one above the head, one under the skull and the third to the left of the ankles. An iron knife blade was present below the feet and a second indeterminate iron artefact was found in the same area. Jewellery comprised an agate bead, a glass bead, and two bronze bracelets. Burial 77, a late foetal or newly-born infant, wore four bronze anklets, a bronze bangle and a bronze ring. A pottery vessel was also found in the grave. The grave of burial 79 contained the skeleton of an infant who died when aged about 3-9 months. The body was orientated 5° east of north, and grave goods included a pottery vessel and two bivalve shellfish. Bronzes incorporated two anklets on the right leg and three on the left (Fig. 18:13D), and two bronze bangles on each arm.

The remains of the neonate in burial 81 were found just west of the feet of burial 79 and on the same orientation. The cranium lay below part of a pottery vessel, and the bronze ornaments worn comprised an anklet on each leg, four bronze bangles, a fragment of a finger ring and glass beads. Burial 120 comprised a very large burial jar, with a diameter of almost half a metre, containing the remains of a neonate interred with a two further pottery vessels and for jewellery, three agate pendants, an agate bead (Fig. 18:13F) four bronze anklets on the left leg and three on the right, and a bronze bell (Fig. 18:13E). Burial 25 was a rice bed grave for a 2-4 year-old child. The body had been laid out with the head pointing to the north. Grave goods included a pottery vessel and two spindle whorls. There was also a considerable number of glass beads. Nine were found round the waist, 15 in the vicinity of the head, with 222 being recovered from the area of the body. The child also wore several bronze ornaments: an earring, bracelet, six anklets and a finger ring.

Burial 31 partially overlies burial 99. This was the grave of a child who died when aged about 12 years. The head lay over a pottery vessel. Bronze ornaments comprised a bangle on each arm, six rings and a spiral on the right

hand, and a long spiral on the other, and an earring on the left ear. An egg had been placed near the left hand. It is the size of a hen's or a duck's egg.

There is no stratigraphic evidence to provide a relative chronology for clusters B and A. This reflects the absence of clay grave capping in cluster B graves, and hence difficulty in determining the depth from which the graves originated. The mortuary ritual remained basically similar in terms of orientation and the use of burnt rice husks to fill the base of the grave.

Unlike cluster A, there is no gold or silver jewellery, but other ornaments were similar, including the agate pendants, bronze bangles, ear and finger rings. This group, however, seemed to prefer placing the human head in or on a pottery vessel, rather than using one to cover the head. Iron knife blades were found in three of the burials. The woman of burial 99, who attained an age of over 40 years, was buried with four spindle whorls, and nine in all accompanied cluster B graves. This is a much higher frequency than for cluster A. The impression gained from the distribution of the cluster B graves is of a small core of adults, and an exceptional level of infant mortality.

Noen U-Loke Iron Age 3 group C

Iron Age 3 group C burials lay 4.5 m to the west of group B (Fig. 18:14, Table 18:3). There are three men, two women and four adults. Five of the burials are of late foetal or newly-born infants, two survived to between 1-9 months and there is also the grave of one child. Burial 69 contained a male who died when aged between 25-30 years. He lay in a bed of rice with the head orientated 20° east of south. Four pottery vessels were associated, two beyond the head, one over the shoulder and the fourth over the chest. Bronze ornaments were abundant. Two large, circular plugs were found on each side of the skull, and their position suggests that they had been inserted into the ear lobes (Fig. 18:14B). He was also buried wearing four bronze belts (Fig. 18:14F). Nine bronze bangles were present on the left wrist, and at least 11 on the right (Fig. 18:14D). Over 59 finger rings were present on the right hand, and at least 65 on the left (Fig. 18:14C). Toe rings were also abundant, particularly on the right foot, where over 26 were recovered, compared with seven on the left foot (Fig. 18:14E). Loose bronze bangles were found beyond the head and over the chest, and four bimetallic rings were recovered, two on the big toe of the left foot, another over the left femur and the fourth under the chin (Fig. 18:14A). An iron knife blade had been placed to the right of the head, and an iron point, possibly an arrowhead, was present under the leg.

The man in burial 74 died when aged between 25-30 years of age was found just to the south of burial 69, and on the same orientation with the head pointing to the south. Three pottery vessels were found in the vicinity of the head, and a bimetallic ring was also found in the area of the neck. A bronze toe ring was found on the left foot, and a further bronze ring fragment and a glass bead was recovered during the flotation procedure.

Burial 86 involved a male aged 25-30 years at death. His rice-filled grave lay under burials 69 and 85 at a depth of 2.30 m below datum, and had been disturbed to the point that the bones had been bundled and redeposited. Grave goods which were found in the vicinity of the human remains included two pottery vessels, one of which contained a complete, socketed iron spade, covered in rice remains. It appears likely that the pot had formerly contained rice grains. Glass beads were also found in the grave fill, together with a bronze finger ring, at least one and possibly three earrings, an agate pendant, bronze bangle, and an iron knife.

Burial 62 contained the complete skeleton of a woman who died when aged in the vicinity of 35-40 years. The grave retained white burnt rice fill. Three pottery vessels were present, placed by the right elbow, the right arm, and over the left shoulder. There was also an abundance of bronze jewellery: five anklets on each leg, 36 finger rings on the left hand and at least 28 on the right, 15 bangles on the right wrist and 11 on the other, and six earrings on the left ear with at least one on the right. There was also an agate pendant and three bimetallic rings. Two tiny red glass beads were recovered from the flotation procedure, while an iron knife had been placed on the left forearm.

Another woman, aged 35-40 at death, was found in burial 82. Five pottery vessels were associated, four disposed round the head, and the fifth beside the right arm. Bronze jewellery comprised seven bangles on each arm, three toe rings on each foot, and an earring. A spindle whorl was found by the right ankle and she was also interred with an iron knife (Fig. 18:14J). Burial 75 contained the remains of a young adult who reached the age of 16-20 years. The grave was recognised as a clay cap at the depth of 2.01 m below datum. The human remains lay 2.48 m below datum. An oval configuration of postholes dug from the same level as the grave appear to form a pattern centred on this burial, and might represent the foundations of a mortuary structure. The upper part of the body was intact, but the lower was disturbed and in disarticulation. Two of the five pottery vessels were found in the grave fill, one beyond the feet, a second by the right thigh. The remaining vessels had been placed round the head. An iron blade lay beside the head, and a bronze earring was the only item of jewellery recovered.

Burial 118 contained the bones of an adult of indeterminate age, with some disarticulated bones of a child aged 14-16 years at death. Two pottery vessels were associated with the body, one positioned to the right of the head, and the second to the left. The only carnelian bead of mortuary phase 3 was found on the chest. It differed from the elongated beads of phase 2 in being spherical (Fig. 18:14I). There were also two sets of enigmatic iron objects in the area of the neck. They have the appearance of arrowheads, but their shape belies such use. The shaft is a thin but broad strip of iron, and the point is a hollow within folded over



FIG. 18:14 Mortuary offerings from Noen U-Loke Iron Age 3 group C. A. burial 69, bimetallic ring, B. burial 69 ear ring, C. burial 69 rings, D. burial 69 bangles, E. burial 82 toe rings, F. burial 69 belt, G. burial 13, agate pendant, H. burial 91 agate pendant, I. burial 118 carnelian bead, J. burial 85 iron knife, K. burial 118, iron artefacts

but thin extensions of these strips. The location in the area of the neck suggests as an alternative, that they were ornamental iron pendants (Fig. 18:14K). Seven bronze bangles were present on the left wrist, and two on right. There were also five bronze rings on the fingers of the right hand, and 23 bronze toe rings, one of which was a spiral.

Some infants were interred with impressive mortuary offerings, while most of the newly-born were interred in ceramic vessels. The infant in burial 63, who died when aged between 3-9 months, was associated with five pottery vessels, which virtually enclosed the body on both sides. There was also a glass bead necklace. Bronzes comprised six bangles on the left arm and the same number on the right, three anklets on each leg and an earring. There were in addition, a further anklet near the left leg, two loose bangles and five fragments of rings. Two bimetallic rings were also present, one over the chest and the other under one of the pottery vessels located by the left arm.

The neonate in burial 85 was not interred within a mortuary vessel. It was, however, associated with a rich array of offerings including at least four pottery vessels one of which contained a concentration of rice. An iron knife blade (Fig. 18:14J) and a bimetallic ring lay in the area of the neck. The infant also wore three bimetallic rings on the right arm, and a further four on the left. Two bronze rings were found under the knife blade, while the flotation procedure recovered some glass beads and fragments of bronze. Burial 88, a further neonate, was interred in a group of infant jar burials to the northeast of the main cluster. The infant lay in a crouched position with the head pointing to the north, under a bed of white silicified rice. Glass beads were present within the vessel.

The infant in burial 91 died when aged up to 3 months. It had been interred in a rice bed grave with one pottery vessel beside the head, and another by the left ankles. There was an agate pendant (Fig. 18:14H) in the area of the neck, and a bivalve shellfish in the vicinity of the abdomen. Bronzes comprised four bangles on each wrist, two

bronze anklets on the left leg, and an earring.

This cluster of graves displays the same proliferation of bronzes as was noted for cluster A. Burial 69 is prominent in this respect, with four bronze belts in addition to multiple bangles, finger and toe rings. It also has two unparalleled bronze ear plugs. Iron knives were relatively frequent, and two further unique iron items were recovered, a spade and a set of possible neck ornaments. Only one spindle whorl was found in this group, and a small number of three agate pendants were present. There was also one globular carnelian bead.

Noen U-Loke Iron Age 3 cluster D

Iron Age 3 cluster D lay 5.5 m north of clusters B and C. It is highly likely that more burials lie further north, for the excavated area terminated when only five burials were identified. The available burials incorporate a male, a female, an adult, one grave within which the age and gender are not known, and an infant. Only one of these, burial 14, is undisturbed, and in this case, the cranium just lay within the bounds of the excavation. This rice-filled grave contained the remains of a male aged 35-40 years at death. He was the richest person recovered. At least eight pottery vessels were present, and more may well lie beyond the excavated area. One lay just left of the cranium, two to the right of the head and three more over the lower part of the face, the upper left arm and the elbow area of the right arm. A further vessel was present beside the right knee. Many glass beads were associated as grave goods. A concentration was recovered from the area of the feet, others from between the lower legs, and the head.

An iron knife was found over the left wrist. Perhaps the most impressive part of the burial, however, was the quantity of bronze. He wore three bronze belts. Seventy-five bangles were present on each arm. There were also 45 finger rings, and at least two novel finger spirals on the left hand and 16 rings and four spirals on the right. There were also two bronze toe rings on each foot. This man wore two ear coils, an ornament not previously encountered, made of silver covered in gold foil. There were also two agate pendants and two bimetallic bronze rings in the area of the neck.

Burial 20 contained the disturbed remains of an adult. There was a very clear cutting seen in the distribution of white silicified rice. The grave goods within the cutting were a circular agate bead in the area of the head, a bronze earring, two finger rings and two bronze bangles.

The three-month-old infant in burial 13 was interred in a rice bed grave west and on the same orientation as burial 14. It was richly-endowed with grave goods, but the infant bones were few and poorly preserved. Two agate pendants were found to the left of the area where the skull would have lain, and two pottery vessels were recovered. One lay over the grave and might well represent a separate infant jar burial. Three bimetallic rings were encountered, and at least two bronze bangles, although a further bronze ring and a fragment of an earring were recovered from the flotation procedure. Many glass beads lay over the area of the body, and part of what may have been an iron spear point was also recovered from the general area.

The complete recovery of all the graves in this cluster is a priority for any future work at Noen U-Loke, because stratigraphically, it is the latest in IA3, and in terms of burial 14, the richest. Burial 14 was recovered at or near the same depth from which some of the cluster A, B and C graves were cut. The unparalleled weight of bronzes, in addition to the silver and gold ornaments found with burial 14, reveal a further increase in mortuary wealth towards the end of IA3. The infant burial 13 is also richly endowed, but unfortunately, the other interments in this cluster were disturbed in antiquity.

Iron Age 4 AD 400-600

Thirty-one Iron Age 4 burials were recovered at Noen U-Loke, comprising seven males, three females, seven adults, two children and 12 infants. The spatial distribution reveals far less of the tight nucleation evident in the preceding phase (Fig. 18:15). However, there is some evidence for grouping, particularly in the case of six burials in the northeastern part of the excavated area, where four people were superimposed over a depth of 68 cm. There are other examples of such superpositions, while burials 4, 5, 9 and 12 might comprise a group, since all were interred at a similar depth and orientation. IA4 burials probably cover a reasonable period of time, since the lowest was found 1.77 m below datum, while the uppermost lay only .58 m below datum. The orientation was similar to that seen in phase 3, and Phimai Black ceramics were still in use, but we lack the rice bed burials, and the grave goods, while still abundant, did not reach the heights seen in IA3. Gold, silver, agate and glass continued to be worn as jewellery. There were also changes in the nature of the offerings, seen in both the style of the ceramics and the range and number of iron implements that now included sickles.

The 35-40 year-old male in burial 1 was interred prone at a depth of 1.45 m, and directly to the south of the infant jar burial 2. Apart from the group of potsherds next to his head, which probably come from up to three vessels, most of the grave goods recovered took the form of bronze ornaments. These incorporated 14 bangles on the right hand and eight on the left (Fig. 18:16B). He wore an ear coil on each ear (Fig. 18:16C) and at least 27, possibly 33 rings on this right hand, including two on the thumb (Fig. 18:16A). A further 26 rings were found on the left hand. Bimetallic rings continued to be favoured, two being located by the upper left leg, and two more by the right shoulder.

Burial 5, a 20-25 year old probable male, wore an agate pendant (Fig. 18:16H) and necklace of agate beads. A bimetallic ring were also found in the neck area. Two iron implements lay by his left hand. One looks like a modern sickle, and the other a tanged spearhead. The 20-25 year-old male in burial 60 was found in a most unusual

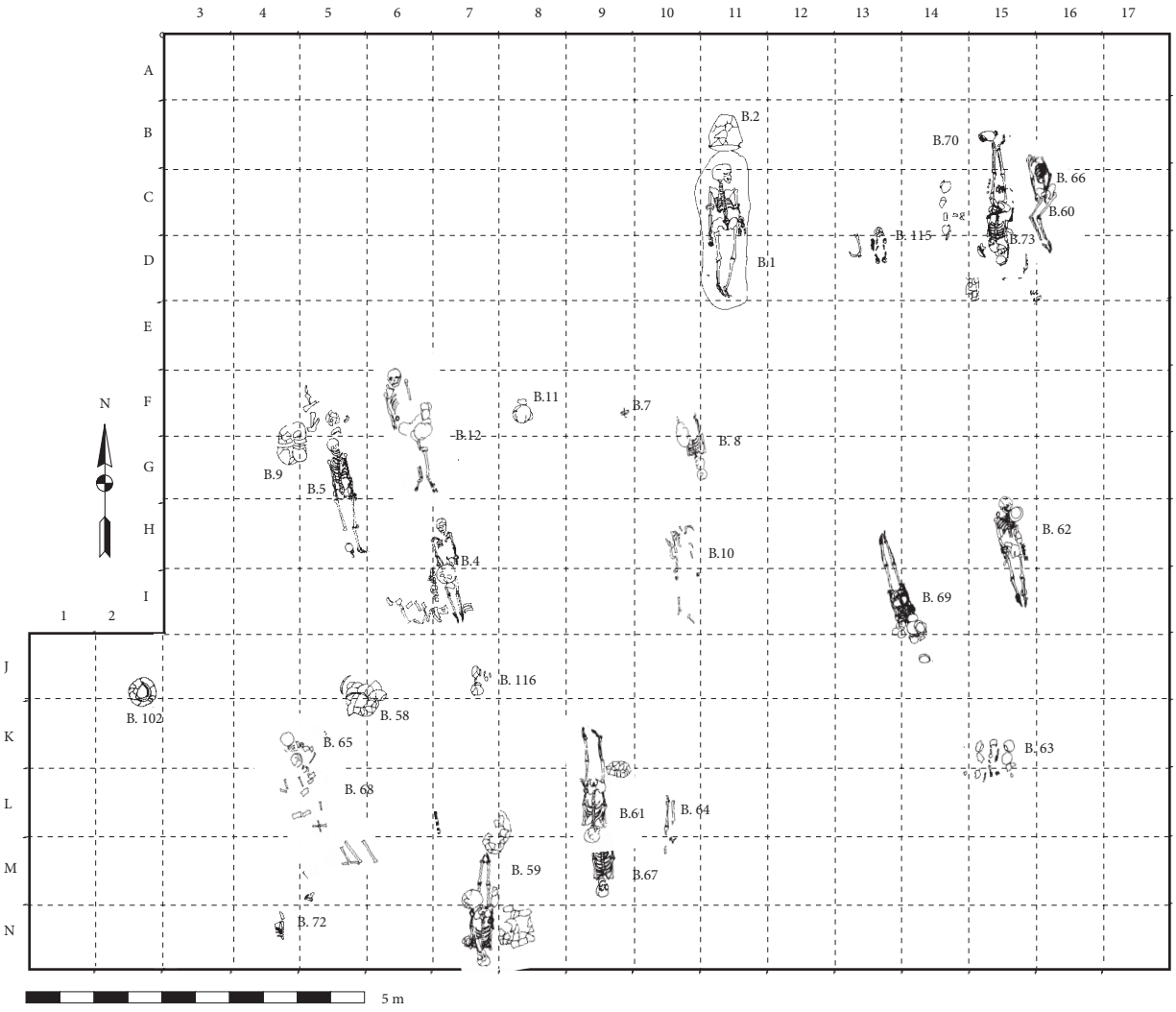


Fig. 18:15. The layout of graves belonging to Noen U-Loke Iron Age 4

position, in which the legs projected well above the level of the body, as if the latter had slumped downward. The toe bones were found 1.09 m below datum, but the upper body was 30 cm deeper. No grave goods were found.

The man in burial 61 lay prone, with the head pointing south. The grave goods were sparse: a bronze bangle on each arm, two bronze rings on a right hand finger and a bronze earring. The most interesting aspect of this burial was the recovery of a tanged iron arrowhead lodged in the man's spine. Its position indicated that it entered the body from in front and slightly below, and it was surely a fatal wound.

The older male in burial 66, who died when aged between 35-40, was found at a depth of 1.52 m, below burial 60 and above burials 70 and 73. It was poorly preserved and no grave goods were found in association, but was clearly orientated with the head to the north. Burial 68, a 25-30 year old probable male, lay under burial 65, and were equally disturbed. The bones were identified at a depth of 1.25 m below datum, and were accompanied by a bimetallic ring at the chest area, a bronze bangle and ring fragments in the area of the left hand and 53 gold beads in the vicinity of the neck which were presumably a necklace. Sherds possibly from three pottery vessels were recovered in the grave fill.

The woman in burial 10 died when aged over 40. Several bronzes were recovered: six finger rings on the right and three on the left hand, three bangles on the right wrist, two earrings and an anklet on the right leg. An agate bead was found in the area of the neck, while an iron sickle and knife were found on the right upper arm. Burial 12, an older female, died when aged over 40 years. Her grave goods included two fragmented pottery vessels over the left thigh and abdomen respectively and several bronze ornaments. These comprised a bangle on the right arm, an earring, three rings on the fingers of the left hand and toe rings, three on the left and five on the right foot. An iron knife blade and sickle were also recovered.

Burial 4 contained the remains of a 15-18 year-old. Grave goods comprised an agate pendant at the neck, a

TABLE 18:4 *The mortuary offerings with relatively intact adult graves from Noen U-Loke Iron Age 4*

artefact	1	5	60	61	68	10	12	4	8	59	67	73
sex	M	M	M	M	M	F	F					
age	A	YA	YA	YA	A	O	O	15-18 y	YA	A	MA	OA
pottery vessel	3	0	0	0	3	0	2	2	2	4	0	3
agate pendant	0	1	0	0	0	0	0	1	0	0	0	1
agate bead	0	p	0	0	0	1	0	0	0	0	0	0
glass bead	0	0	0	0	0	0	0	0	p	0	2	4
gold bead	0	0	0	0	53	0	0	0	0	0	0	0
silver earring	0	0	0	0	0	0	0	0	0	1	0	0
bronze anklet	0	0	0	0	0	1	0	0	0	0	0	0
bronze ring	59	0	0	2	1	3	3	3	0	7	1	15
bronze toe ring	0	0	0	0	0	0	8	0	0	0	0	9
bronze earring	0	0	0	1	0	2	1	0	0	0	1	0
bronze bangle	22	0	0	2	1	3	1	2	0	2	1	0
bronze ear spiral	2	0	0	0	0	0	0	0	0	0	0	0
bimetallic ring	4	1	0	0	0	0	0	0	0	1	0	0
iron blade	0	0	0	0	0	1	1	1	1	1	0	1
iron spear	0	1	0	0	0	0	0	0	0	0	0	0
iron sickle	0	1	0	0	0	1	1	1	1	1	0	0
bivalve shell	0	0	0	0	0	0	0	0	0	0	1	0

M male, F. female, A adult, YA young adult, O old, MA mid adult, OA old adult, y year, p present

bronze bangle on each wrist and three bronze rings on the left hand. There were two pottery vessels in association, both positioned over the abdomen. An iron knife and iron sickle complete the list of offerings. One of the pottery vessels has the form of a phase 4 infant jar burial. Burial 8, a young adult was accompanied by two pottery vessels placed over the chest and beyond the head, some glass beads in the area of the head, and an iron knife and sickle. Burial 59, a mid-aged adult, was interred with a bimetallic ring in the pubic area, a bronze bangle on each wrist, and seven bronze finger rings, three on the right hand and four on the left. There was also an iron blade and a sickle, and four pottery vessels, two over the abdomen, one over the right femur and another at the left shoulder. A silver earring was recovered by the left ear.

Burial 67 contained a 20-26 year-old adult interred with the head pointing 10° west of south. The screening of the material from the vicinity of the skeleton yielded two glass beads, part of a bronze ring and a bangle fragment. The other grave goods found were a bronze earring and a bivalve shellfish. Burial 73 contained the skeleton of a 35-40 year-old adult. Grave goods comprised three pottery vessels positioned beyond the head, and an iron knife. There were also several bronze items of jewellery: nine toe rings on the right foot, six finger rings on the right hand and nine on the left and several ring fragments and four glass beads from the flotation process. There was also an agate neck pendant (Fig. 18:16J).

The large mortuary jar of burial 2, that of a neonate, was found just beyond the head of burial 1. The infant within was accompanied by two pottery vessels and an iron knife blade. Jewellery comprised a bimetallic bangle on the right arm, two on the left arm, a loose bimetallic ring at the lip of the mortuary vessel and an earring. Burial 6, another neonate, was interred in a lidded burial jar with no grave goods. Burial 9 was a neonate interred within two mortuary jars. These had been placed mouth to mouth to contain the infant, at a depth of 69 cm below datum. A further pottery vessel was found within the two jars. The grave goods included an iron knife and sickle grouped to the left of the skeleton, which wore an agate bead necklace (Fig. 18:16K), and bronze earrings. There were also two bronze bangles one on each arm, and four bimetallic rings on the cranium. The neonates in burials 11 and 56 were found in mortuary vessels with no grave goods. Burial 58, a further neonate, was found within two mortuary vessels which faced each other. An iron sickle was found below these vessels and may have been in association as a grave good.

TABLE 18:5 *The mortuary offerings with relatively intact neonate graves from Noen U-Loke Iron Age 4*

artefact	2	6	9	58	56	71	102	115	116
pottery vessel	3	0	3	2	0	3	2	0	3
agate bead	0	0	p	0	0	0	0	0	0
glass bead	0	0	0	0	0	0	2	0	p
bronze anklet	0	0	0	0	0	0	0	5	0
bronze ring	1	0	0	0	0	2	0	1	0
bronze earring	0	0	2	0	0	2	0	1	0
bronze bangle	0	0	2	0	0	0	5	33	0
bimetallic ring	4	0	4	0	0	1	1	1	1
iron blade	1	0	1	0	0	1	0	0	1
iron sickle	0	0	1	1	0	0	0	0	0
deer antler	0	0	0	0	0	0	0	1	0



FIG. 18:16. Mortuary offerings from Noen U-Loke Iron Age phase 4. A. burial 1 finger ring. B. burial 1 bangles, C. burial 1ear coil, D. burial 12 toe ring, E. burial 102 glass beads, F. burial 116 glass beads, G. burial 73 iron knife, H. burial 5 agate pendant, I. burial 100 agate pendant, J. burial 73 agate pendant, K. burial 9, agate beads.

The skull of a probable neonate in burial 71 was found under three pottery vessels. Other offerings and the most likely placement were an iron knife to the left of the body, two bronze rings, two bronze earrings and a bimetallic ring in the head area. The jar of burial 102, a neonate, was found at the head of burial 96. It contained a second pottery vessel, as well as a necklace of glass beads, five bronze bangles and a bimetallic ring. Unusually, the neonate in burial 115 was not interred in a mortuary jar, but was laid out in the same manner as adults during this phase, with the head orientated to the north. The skeleton was found lying parallel with the shed antler of a medium-sized deer. Other grave goods comprised 33 bronze bangles, five bronze anklets, a bronze earring and a bimetallic ring in the area of the skull. A further bronze ring was present in the general area of the body. Burial 116, a neonate, was found with three pottery vessels, two over the head and one by the right ankle. The infant wore a glass bead necklace (Fig. 18:16E), and a bimetallic ring lay beside the head. An iron knife blade was found to the left of the skull, and another iron object was recovered from the general area.

At Ban Non Wat, IA4 burials are found in a small opening towards the southern edge of the site, while the distinctive Phimai Black pots accompanied some scattered and rather disturbed graves in the main square where one complete jar burial contained the remains of a newly-born infant associated with miniature bronze bangles, glass beads and an agate pendant. One badly disturbed

adult had worn gold, glass and carnelian beads and an agate pendant. The small area excavated at Non Muang Kao included 11 burials in at least two phases. While all were accompanied by Phimai Black pottery, only the later set included graves filled with rice and lined in clay.

A STATISTICAL ANALYSIS OF IRON AGE BURIALS

C.F.W. HIGHAM AND B.F.J. MANLY

The Iron Age burials of Ban Non Wat and Noen U-Loke have been subjected to principal component analyses in order to investigate any significant similarities or differences between the sites, individuals of different sex and age, and any differences that took place over time.

The adults of Ban Non Wat Iron Age 1

The distribution of principal components 1 and 2 for the adults from Ban Non Wat reveals a marked nucleation with several slight and two extreme outliers (Fig. 18:17, Table 18:6). In order to clarify any differences between the treatment of men and women, figure 18:18 shows those burials only for which the sex, or probable sex, has been identified. Figure 18:19 shows the distribution of burials on the basis of the age of the deceased. The artefacts with the highest discriminatory value in determining the relative values for each burial are illustrated in figure 18:20, and the scores for all the artefacts associated with these burials are given in table 18:7. Some of these artefacts are relatively rare, such as the conical rollers and the tin beads. For the PC2, however, we find that the number of fish, pottery

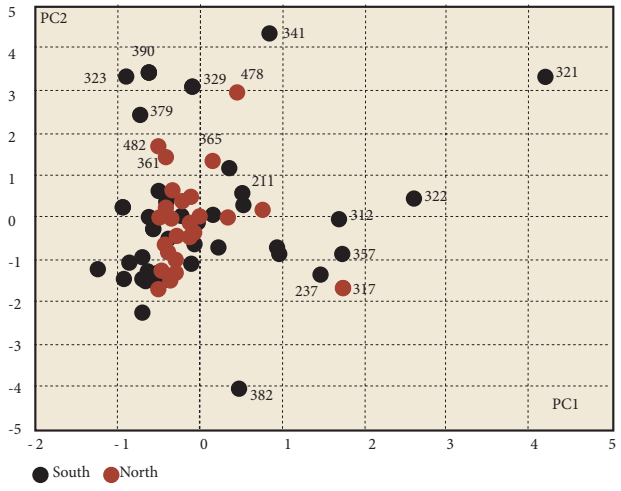


FIG. 18:17 Distribution of the coefficients of the principal components for adult burials from Ban Non Wat on the basis of all mortuary offerings. Two burials are excluded from this diagram since they are such outliers. Their values are: burial 356, north group, PC1 16.33, PC2 -0.99. Burial 352 north group, PC1 -0.52, PC2 10.26



FIG. 18:18 The distribution of the coefficients of the principal components for male and female burials from Ban Non Wat on the basis of all mortuary offerings. Burials 352 and 356 are not shown due to their extreme outlier positions.

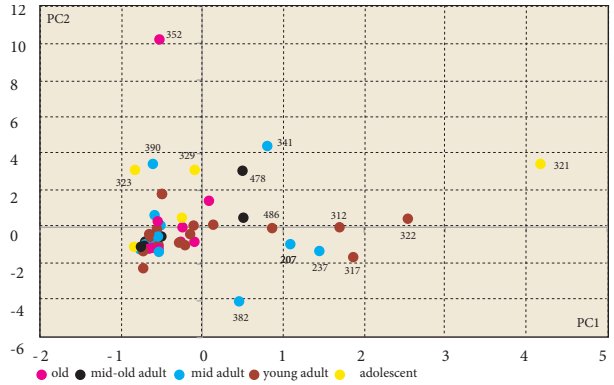


FIG. 18:19 The distribution of the coefficients of the principal components for adult burials from Ban Non Wat on the basis of all mortuary offerings against age at death. Burial 356 is not shown on account of its extreme outlier position.

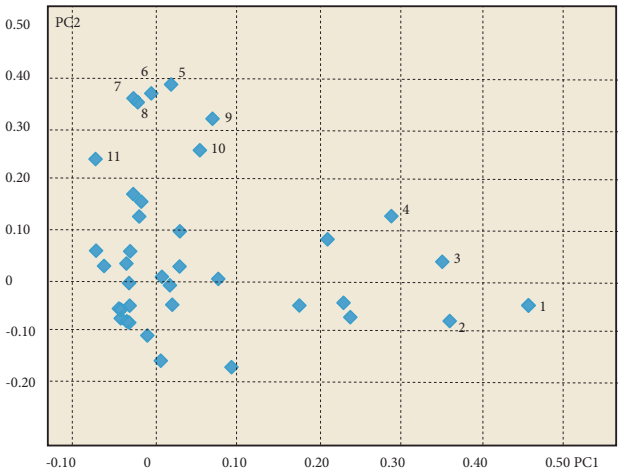


FIG. 18:20 The distribution of the coefficients of the principal components 1 and 2 values for the mortuary offerings from Ban Non Wat adult Iron Age 1 burials. 1. Conical rollers and pellet bow pellets, 2. stone adzes, 3. agate beads, 4. spindle whorls, 5. fish skeletons, 6. red ochre, 7. iron points, 8. tin beads, 9. iron blades, 10. pottery vessels, 11. grey clay

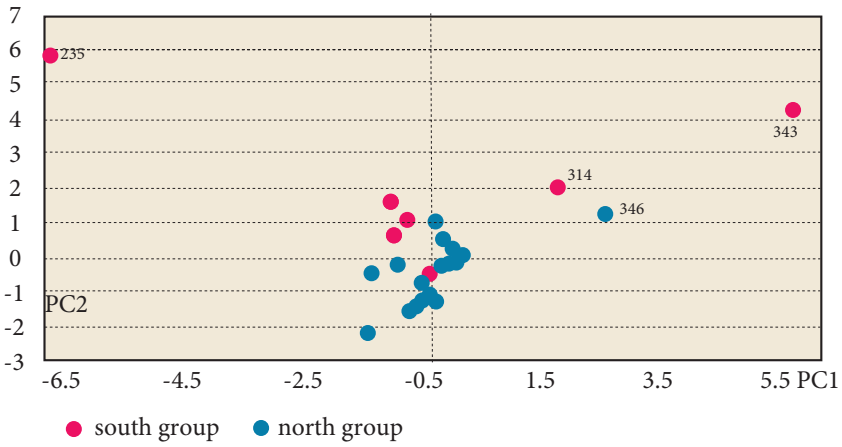


FIG. 18:21 The distribution of the burials of young individuals from Ban Non Wat Iron Age 1, based on the coefficients of the principal components 1 and 2, on the basis of the north and south groups

vessels, iron points and blades, grey clay and red ochre pellets have high scores.

Burial 352 is distinguished by an unusually large quantity of fish, red ochre and pellet bow pellets, there being 12 of each. There are also seven pots and two conical rollers. There is nothing unusually exotic in this assemblage. On the other hand, burial 356 was interred with a single glass, an agate and a carnelian bead, which are decidedly exotic and rare, together with three spindle whorls, two fish, two iron and a shell bangle, red ochre and an iron blade. This individual therefore stands out as being unusually well endowed, although by no means as wealthy as the later Iron Age grandees of Noen U-Loke.

Eight individuals from the southern group stand out from the majority. Four were women. The young woman in burial 322 was accompanied by six pottery vessels, five fish, two pellets of red ochre and two spindle whorls. She wore four bronze bangles, an agate bead and a shell earplug, all three relatively rare in IA1, and she also had an iron chisel. Burial 237, a mid-adult woman, was less wealthy, being accompanied by seven pots, a bivalve shell and two glass ornaments. Closer to the majority, burial 312, a young woman, had seven pots, four bronze bangles, a shell earplug and one spindle whorl. Burial 323, an adult female, was found with nine pots, 13 pellets of red ochre, two bivalve shells, a spindle whorl, two sets of pig bones, two deposits of grey clay and six fish.

A man in burial 390 died when classified as a mid adult. He was distinguished by the presence in his grave of a bimetallic spear, with a bronze haft and iron blade. He also had five iron knives, six pots, a bivalve shell, two sets of pig bones, a bovid bone, grey clay and 11 pellets of red ochre. Burial 211 is relatively close to the majority nucleus. It contained a mid to older man, with an interesting assemblage that included a crucible, and a glass earring. There were also nine pots, three sets of pig bones, two fish and articulating bovid foot bones, as well as three items of iron.

Five further burials stand out for the quantity and range of offerings relative to the majority. Burial 341, for example, that of a mid adult man, had seven pots, 13 pellets of red ochre, ten bronze bangles and eight iron artefacts including a hoe, knife and two spears. Burial 321, a teenager, had ten pots, 12 fish, two spindle whorls, pig bones and two iron knives, a further iron object and a rare agate bead. while burial 357 is distinguished by two glass earrings, in addition to a spindle whorl, red ochre and seven pottery vessels. Burial 329, an adolescent, was associated with seven pots, pig bones, three red ochre pellets, five iron knives and two iron spears.

Six burials from the northern group are also set apart from the great majority. Apart from burials 352 and 356, the probable female in burial 478, who died when a mid to old adult, was distinguished in death by being interred with 15 pottery vessels. In terms of food remains, there were nine fish and the bones of a pig. She may well have been a weaver, because there were two spindle whorls and clay in her grave. She also wore five shell earrings, and had three bivalve shells and red ochre as offerings. A young- to mid adult in burial 317 was buried with six pots, a bivalve shell, an iron object and one agate and a single tin bead. The other two are young to mid-adult males. Burial 482 was buried with two bronzes that are unique in the upper Mun Iron Age: thin socketed items which have parallels in the Khao Wong Prachan Valley. There were also nine pots, red ochre, two lumps of grey clay and a spindle whorl. In terms of food remains, there were six fish and

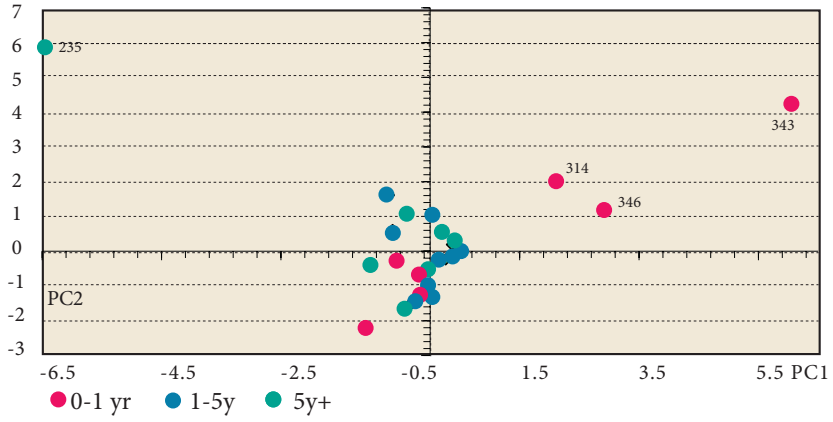


FIG. 18:22 The distribution of the burials of young individuals, based on principal components 1 and 2, on the basis of age

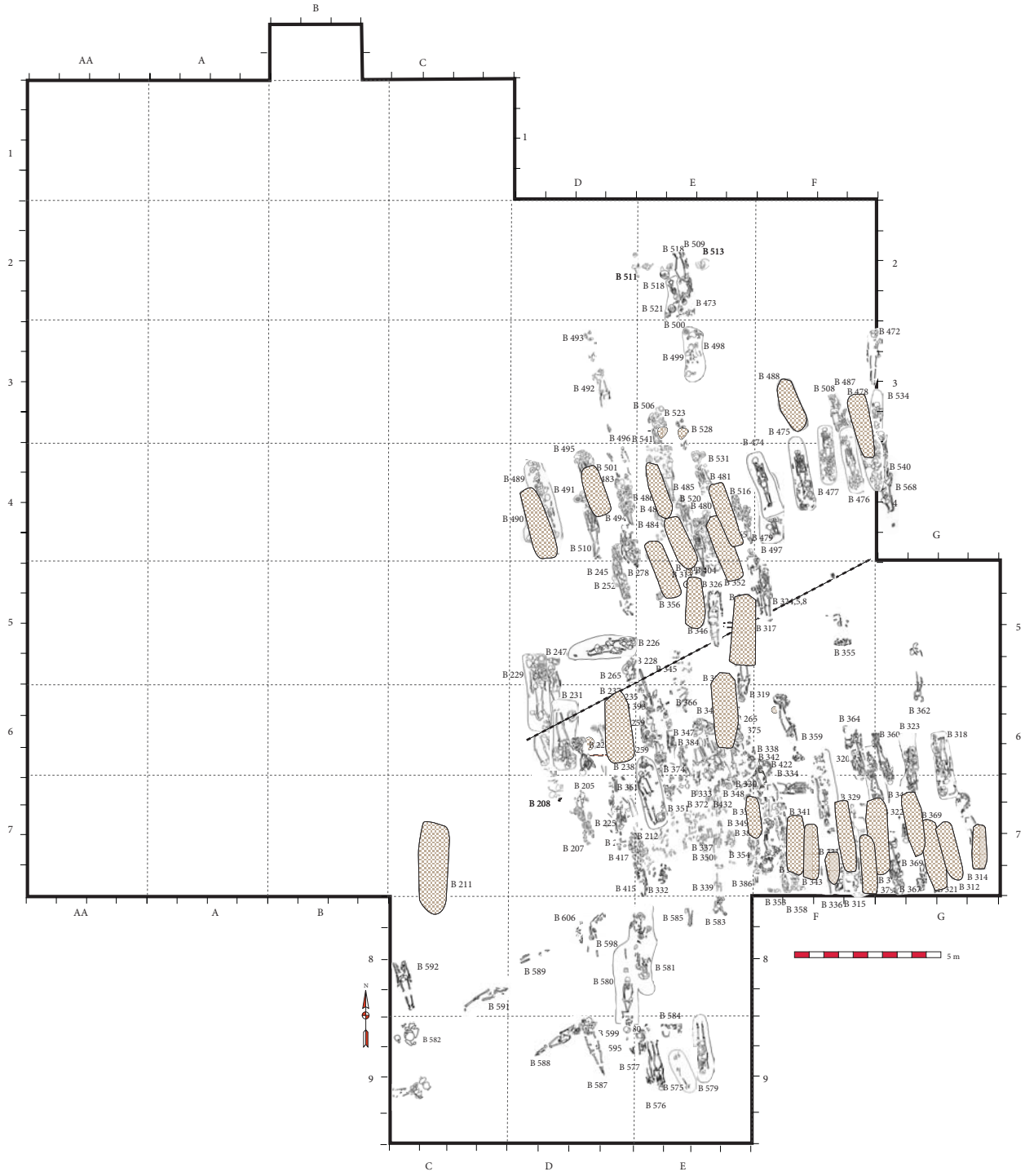


FIG. 18:23 The Iron Age 1 cemetery of Ban Non Wat, with relatively wealthy burials highlighted

bovid bones. Burial 361 had seven pots and nine fish. There were also two bronze bangles, an iron hoe, spear and point.

The other burials of the southern group for which the sex and age have been identified concentrate in the large group seen in figure 18:17. Burial 318 contained an old adult woman with 12 pots, five fish, a bivalve shell, pig bones and an iron object. The mid old woman in burial 319 had only three pots, a bivalve shell and eight fish. A mid adult man in burial 231 was endowed with three pots, a bovid bone and an iron artefact while a mid to old adult male found in burial 580 had an iron spear, red ochre, a bivalve shell and a single pot. A probable man of mid adult age in burial 576 was interred without any mortuary offerings at all.

The female or probable female graves from the northern group which lie within the large nucleus of graves reveal how a relatively poor individual was buried during

the early Iron Age. Thus the mid-adult in burial 247 was found with just one pot. Three of these women died when classed as young adults. Burial 474 was found with two pots, a bivalve shell and a chicken bone. Burial 487 had five pots, pig bones, two pellets of red ochre and a spindle whorl. Burial 485 was found with a single pot, a bivalve shell, two sets of pig bones, red ochre, a spindle whorl and grey clay. There are also three old adult women and their range of grave goods parallels that for the younger ones. There are seven pots and a bivalve shell with burial 226. Burial 489 was accompanied by four pots, a spindle whorl, three fish and a bronze ring while burial 495 also had four pots as well as a bivalve shell, three red ochre pellets, a fish, a spindle whorl and clay.

Relatively poor men from the northern group of burials include an adolescent, two young, two mid and two mid to old adults. The adolescent was buried with just three pots. One of the young men had eight pots, a bivalve shell, water buffalo bones and an iron blade and the other was found with six pots, two bivalve shells, pig bones, three fish, a bronze bangle and an iron artefact. The mid adults were no richer, burial 477 had a bivalve shell, a fish, bovid bones and an iron spear, while burial 497 was interred with seven pots, five fish and a bivalve shell. Finally, one of the mid- to old men had respectively three pots, clay and bovid bones, while the other was found with six pots and two fish.

The infants of Ban Non Wat Iron Age 1

The distribution of infant burials from the north and south groups of Iron Age 1 on the basis of a principal component analysis is seen in figure 18:21. The majority cluster together, but four are separate (Table 18:8), Three of these come from the southern group. A review of the mortuary offerings with each reveals that they were distinctly more wealthy than the norm. Burial 235 involved a child aged between 10-12 years at death. It was interred with glass earrings and a glass necklace, both being very rare during IA1. There were also four spindle whorls, more than any other person in the site, two iron artefacts and two bivalve shells. Burial 343 contained a nine-month-old infant and again, was considerably richer than its contemporaries. The grave contained nine ivory bangles, a glass and an agate bead, red ochre, grey clay, two large bronze bangles, an iron artefact, three fish, pig bones and eight pellets of red ochre. No northern group infant approached this degree of wealth. Burial 314 was also less than a year old at death, and was interred in a grave wearing two very fine bronze anklets, a shell bangle, four pellets of red ochre, two fish, a bivalve shell and five ceramic vessels. Burial 346 is also a very young infant and while just within the area designated the northern group, it was orientated with the head to the south. It is distinguished by the presence of eight ivory bangles, five pottery vessels, two fish, grey clay and red ochre. While there is no significant difference between the two infant groups on the basis of the number of pottery vessels associated with each individual, there is clear evidence that at least three individuals in the southern group were set apart on the basis of the elaboration of their mortuary rituals. Two of these three were associated with glass, which must have been very rare during the early Iron Age.

The distribution of the burials of young individuals on the basis of their age reveals that age was no impediment to the wealth of grave goods. The burials were divided into three: those who died when under a year of age, then 1-5 year olds and children aged from 5 to 15 years. Indeed, three of the richest individuals died when under a year of age (Fig. 18:22). The concentration of the remaining graves include all three age groups.

The remaining issue to be explored before turning to a consideration of the Iron Age cemetery at Noen U-Loke, is whether or not there were, at Ban Non Wat during Iron Age 1, nuclei of relatively wealthy graves. As may be seen in figure 18:23, there appear on visual inspection to be two such concentrations. The first is seen in the southeastern corner of the excavated area and the latter in the centre of the northern group.

The rich row of burials in the southern group includes adolescents, men, women and an infant. Taken as a group, they were set apart on the basis of the presence with each of several pottery vessels, iron tools and weapons, rare agate beads, bronze bangles, two finely-decorated bronze anklets, red ochre pellets, fish skeletons, grey clay and spindle whorls. Burial 341, a mid adult man, provides an example of the larger than usual mortuary wealth found in

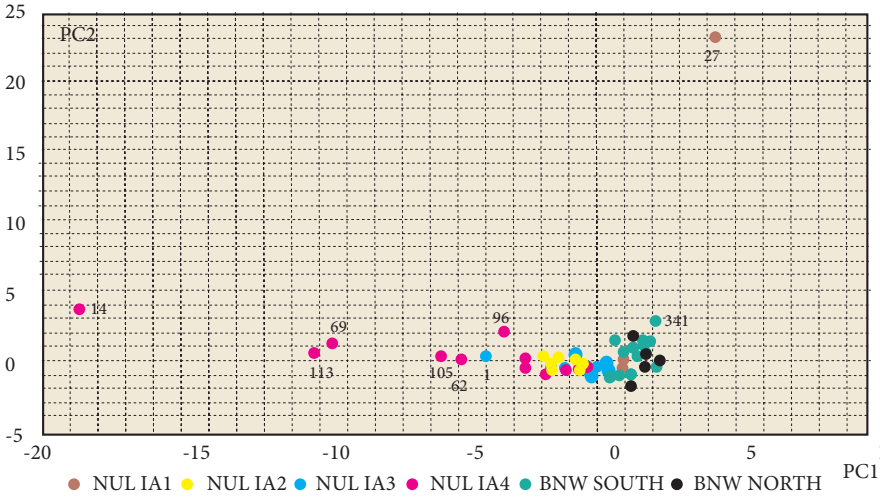


FIG. 18:24 Distribution of the coefficients of the principal components for adult burials from Noen U-Loke and Ban Non Wat on the basis of all mortuary offerings

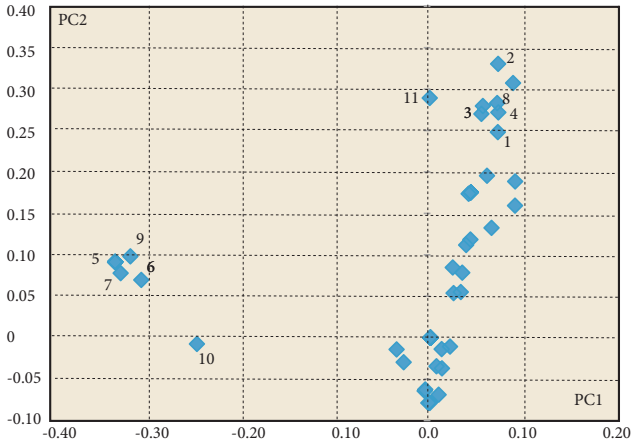


FIG. 18:25 The distribution of the mortuary offerings with adult individuals from Noen U-Loke, based on principal components 1 and 2. 1. bimetallic ring, 2. bronze bangle 3. bronze belt, 4. bronze spiral, 5. bronze spear, 6. bronze torc, 7. fish skeleton, 8. glass beads, gold and silver ear coils, 9. iron hoe, red ochre, shell ear discs, tiger tooth necklace 10. pig bones 11. pottery vessels

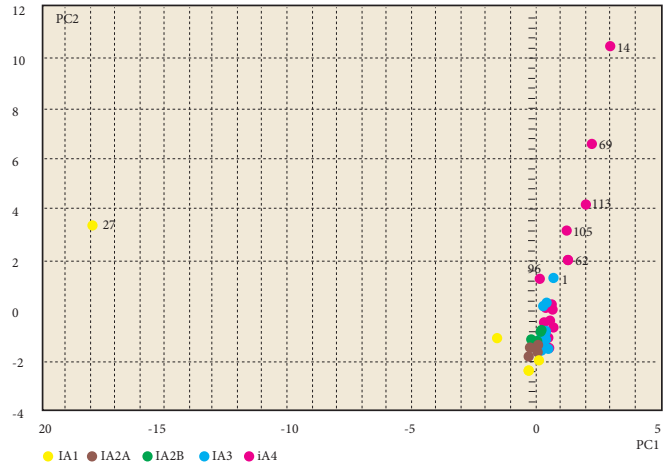


FIG. 18:26 Distribution of the coefficients of the principal components for adult burials from Noen U-Loke on the basis of all mortuary offerings

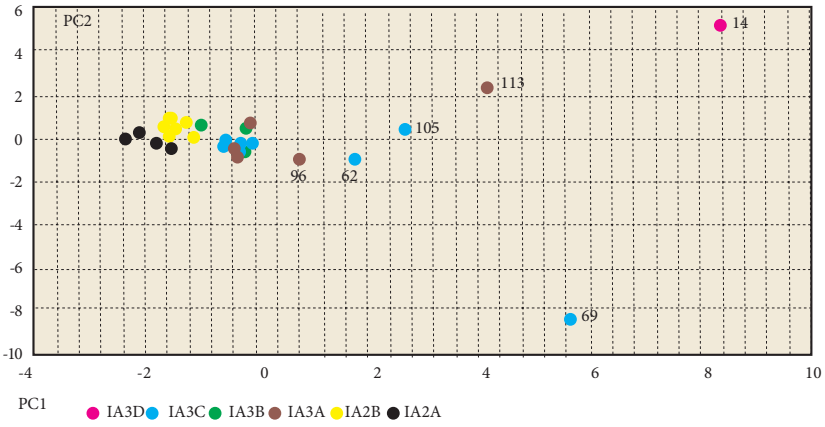


FIG. 18:27 The distribution of adult burials from Noen U-Loke Iron Age 2-4 on the basis of the coefficients of the principal component values derived from the associated grave goods

this row. He was accompanied by many iron items including spears, a hoe and knives, as well as pellets of red ochre, grey clay, three spindle whorls, fish skeletons and a bivalve shell. There are two principal explanations for this concentration of relative wealth. The first is that these burials comprise a group was socially more successful than the norm. The other is that there was a chronological succession of burials from west to east, and that being later, these individuals were taking advantage of a rise in the amount of exotic items that were newly available.

The second possible nucleus of relatively wealthy individuals lies in the centre of the northern group (Fig. 18:23). Once again, it contains the remains of men, women and an infant. All have a generous number of pottery vessels, with the mid to old woman in burial 478 having 15. She also

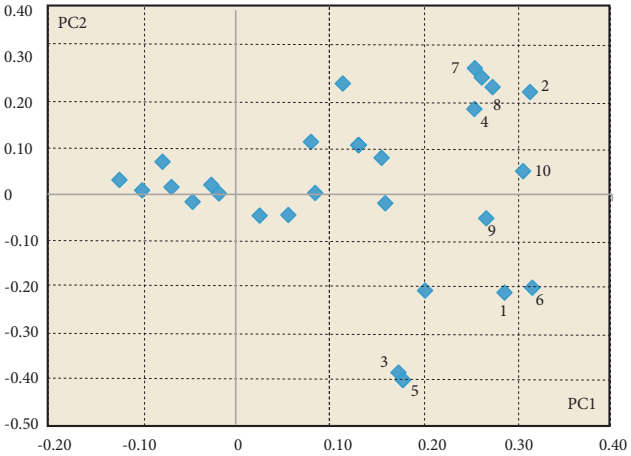


FIG. 18:28 The values of the coefficients of the principal components the coefficients of the principal components 1 and 2 for the mortuary offerings found with Iron Age 2-3 burials from Noen U-Loke. 1. bimetallic ring, 2. bronze bangle, 3. bronze bell, 4. bronze belt, 5. iron point, bronze ear disc, 6. bronze ring, 7. bronze socketed implement, 8. glass bead, 9. iron

was interred with two bivalve shells, two spindle whorls, clay and fish and pig bones. Two thin socketed bronze artefacts unique to the site were found with the mid adult man in burial 482, together with fish and cattle bones, grey clay, red ochre and a spindle whorl. Both the mid adult and the old man in burials 361 and 352 were accompanied by an iron spear, the former also having a iron hoe and two iron points. The old woman in burial 356 wore two iron bangles, as well as one bead each of carnelian, agate and glass. An agate bead was also found with the adult in burial 317, as well as a bead of tin. The infant found in burial 346 wore ivory bangles, and was also accompanied by

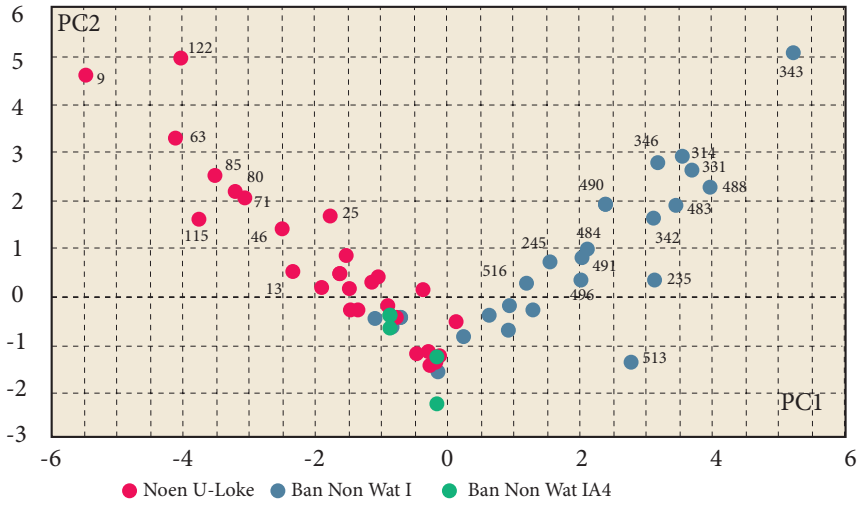


FIG. 18:29 The distribution of infant and child burials from Noen U-Loke and Ban Non Wat on the basis of the coefficients of the principal component values derived from the associated grave goods

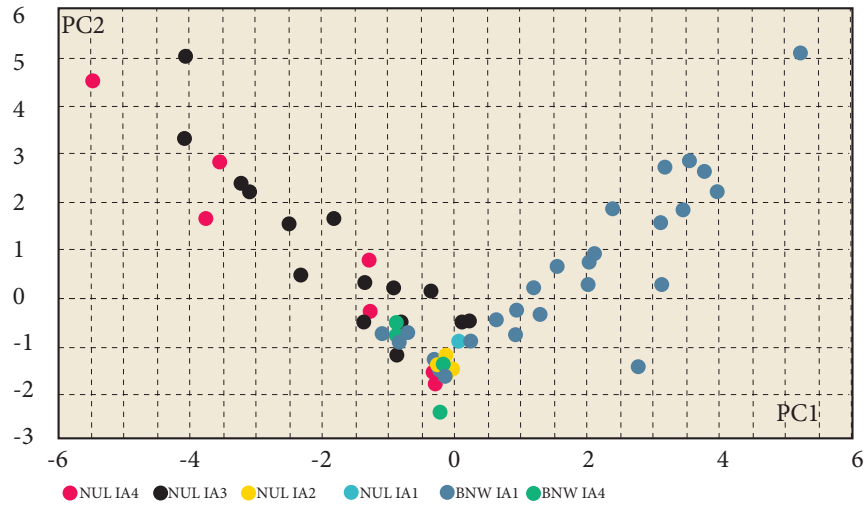


FIG. 18:30 The distribution of infant and child burials from Noen U-Loke and Ban Non Wat on the basis of the coefficients of the principal component values derived from the associated grave goods. The mortuary phases of each burial are highlighted by colour

grey clay and red ochre. All these people were interred with fish.

In the case of this nucleus, we cannot claim that they were later than the majority because of their location in the middle of the northern group, and there were poorer individuals to the east. It is considered likely that they represent a subset of individuals whose social prominence was rather greater than the norm, although by comparison with the later Iron Age burials of Noen U-Loke, they were by no means outstanding in terms of mortuary wealth. We will now turn to a comparison between the Iron Age of Ban Non Wat and that of Noen U-Loke, a site located only 1.8 km to the west.

The adults of Ban Non Wat and Noen U-Loke

Noen U-Loke is the only site in Southeast Asia with an assemblage of published burials for comparison with those from Ban Non Wat. The sites are separated by only 1.8 km. The result of combining the adults from both sites are seen in figure 18:24, which presents the values of the coefficients for principal components 1 and 2. It is immediately apparent that there are highly significant differences between the assemblage from Ban Non Wat, which dates to IA 1, and the later Iron Age burials from Noen U-Loke. Thus, the outstandingly rich IA3 men and women are set apart from all others. The IA1 and 2, while not so widely separated, are also distinguished from IA1 Ban Non Wat. There is one outlier from Noen U-Loke IA1 (burial 27 in figure 18:24), which is separated from all others for its unique set of offerings that includes a tiger tooth necklace, bronze torcs, and shell ear inserts.

The adults of Noen U-Loke

The analysis of variation among the mortuary offerings placed with the adult dead over the four phases at Noen U-Loke reveals two distinct groups (Fig. 18:25, Table 18:10). The first of these incorporates tiger tooth pendants, red ochre, pig bones, fish bones, and iron spears. This reflects the remarkable suite of offerings placed with the men in burials 27 and 28. Variation in the second group is determined largely by the weight of bronze ornaments, glass beads, gold and silver ear coils and pottery vessels. The rarity of pots in IA2 burials accounts for the last item (Table 18:10).

The coefficients for the principal components for all intact adult burials from Noen U-Loke have been computed (Table 18:9, Fig. 18:26). It is evident from the resulting distribution of principal components 1 and 2 that the majority cluster in one group, the members of which are set apart from particularly wealthy outliers. The richest of these is burial 14 of IA3D. This is hardly surprising, given this man's wealth of bronzes. Burial 69, a man from IA3C, also wore multiple bronze belts, bangles and rings as well as bronze ear inserts. Burial 113 is third. This mid-aged woman from IA3A was interred also with great wealth, including a necklace of gold and agate beads, and bronze and silver jewellery. Burial 105 is an adult male also from

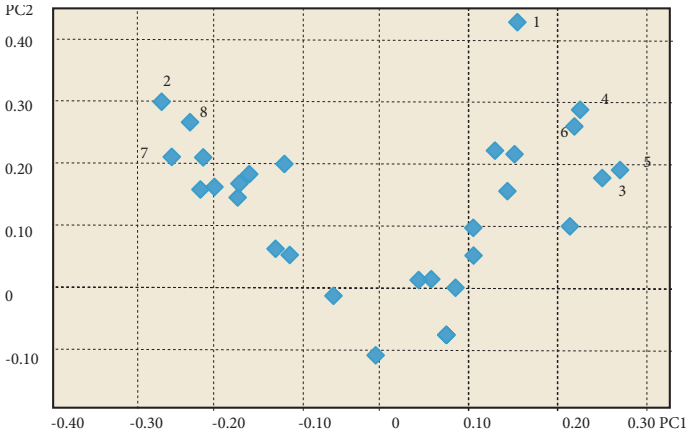


FIG. 18:31 The values of the coefficients of the principal components for artefacts interred with infants from Noen U-Loke and Ban Non Wat 1. pottery vessel, 2 . bronze earring, 3. pig bones, 4. red ochre, 5. fish skeleton, 6. grey clay, 7. glass beads, 8. bronze bangle

IA3A, who also had an impressive quantity of bronze ornaments as well as a silver bangle. His grave was disturbed and he might well have been even richer, given the fact that bronze belt fragments, a bimetallic ring, two iron blades, glass beads and an iron point were found in the general area of the body. Burial 96 is the third individual from IA3A to rank highly. This adult was probably also male, for the grave contained fragments of a bronze belt. Only one individual from IA4 rivalled the rich IA3 people, a young adult man in burial 1.

The burials from IA2 and 3 have been separately analysed in order to ascertain whether or not there is any distinction chronologically between IA2-3 or between the constituent groups of IA3. As may be seen in figure 18:27, there is a regular progression of wealth from IA2 into IA3. During IA3 itself, there are no outstanding burials in cluster B, but each of clusters A, C and D has at least one person set apart from the rest. The determinant contributors to this variation are seen in figure 18:28, and it is noted that bronze ornaments are prominent in identifying the particularly wealthy, together with pottery vessels and glass beads.

The infants of Ban Non Wat and Noen U-Loke

The infant burials from Ban Non Wat have been combined with those from Noen U-Loke in a principal component analysis, to identify any differences between and within each site (Table 18:11). The sample from Ban Non Wat involves IA1 burials, and five infant burials from square X belonging to IA3. The Noen U-Loke sample comprises graves from IA2, 3 and 4. As may be seen in figure 18:29, the two sites are clearly distinguished. There is a concentrated group in the centre of the diagram with the axes for PC1 and PC2. These are individuals with few offerings. It is notable that the IA4 graves from Ban Non Wat fall into this nucleus. The burials radiating to the top left of the image are all from Noen U-Loke, and they grow in wealth as they extend away from the nucleated poor individuals.

An examination of the contents of these rich burials from Noen U-Loke discloses that first, they all come from IA3 or 4. The wealth is largely measured in the quantity of bronze ornaments found with each young person (Fig. 18:30).

Burial 122 is the most wealthy. This 3-9 month old infant was accompanied by seven pottery vessels, an agate pendant, a bronze earring and a bronze spiral in the toe area. Most significantly, 42 bronze bangles were found in association. This infant comes from IA3A. Burial 80 comes from the same group. No bones were identified, but the layout of the grave suggested a very young individual. Bronzes in this case comprised 17 bangles, 15 anklets, while there was also a necklace of agate and glass beads and a spindle whorl. Burial 63 involved an infant who died when between 3-9 months, associated with group C of IA3. This infant wore 12 bronze bangles, a bronze earring, five rings and seven anklets. There were also five pots, a glass bead necklace and two bimetallic (iron and bronze) rings. Burial 85 also comes from IA3 cluster C. A neonate, it too was accompanied by five pots, as well as two bronze rings, eight bimetallic rings, an iron knife and glass beads.

A 3-month-old infant from IA3D, the group that contained the richest adult in the site, was associated with two pots, an agate pendant, glass beads, and in terms of bronzes, two bangles, a ring and three bimetallic rings. It is notable that the poorest of the four IA3 groups, group B, also had the less wealthy infants. Burial 46, who died aged 2-4 years, was accompanied by three pots, an iron knife and two bronze bangles. The single agate and glass bead might have been present by chance. Burial 25 also contained a 2-5 year old, found with one pot, two spindle whorls, a bronze earring, bangle, ring and six anklets. Some glass beads were also found in this grave.

Impressive wealth with at least some infants continued into the final Iron Age phase 4. The same variety of bronze, agate and glass ornaments continued in vogue, while iron artefacts were added. Thus burial 9, a neonate, was interred with three pots, and bronzes incorporating four bangles, four rings and two earrings. There as also an agate bead, iron knife and an iron sickle. Burial 115 was uniquely buried with a complete spread of deer antlers, as well as 33 bronze bangles, five anklets, an earring and one bimetallic ring. Seven pots were found with burial 71, another neonate, as well as an iron knife, two bronze rings, two bronze earrings and one bimetallic ring. Five contemporary IA4 burials from square X at Ban Non Wat, while buried within identical pottery vessels to those at Noen U-Loke, were all uniformly poorly endowed with mortuary offerings, but a single IA4 jar burial from the main square at Ban Non Wat contained a small ceramic vessel, an agate pendant and set of yellow, blue, red and orange glass beads A bronze ring and eight small bronze bangles were also found with a pre-term infant.

TABLE 18:6 *The values of the coefficients for the first two principal components for the adult Ban Non Wat burials of Iron Age 1*

Burial	Sex	Age	PC1	PC2	Burial		Age	PC1	PC2
329S		Ad	-0.08	3.08	360S	M	MA	-0.60	-0.02
334S	F	YA	-0.59	-1.45	344S			-0.01	-0.10
357S	M	YA	1.70	-0.83	372S			-0.90	0.25
378S	M	MO	-0.50	0.63	226N	?F	OA	-0.55	-0.86
579S	?F	MA	-0.54	-1.22	489N	F	OA	-0.07	-0.68
417S	M	OA	-0.52	-1.17	495N	F	OA	-0.31	0.06
390S	M	MA	-0.61	3.46	474N	F	YA	-0.84	-1.46
312S	F	YA	1.71	-0.02	485N	F	YA	-0.41	-0.01
322S	F	YA	2.55	0.45	487N	?F	YA	-0.11	-0.24
321S		15 y	4.18	3.36	478N	?F	MO	0.49	3.13
341S	?M	MA	0.83	4.35	247N	?F	MA	-0.57	-1.37
348S	M	YMA	0.99	-0.73	229N	?M	YA	-0.67	-0.38
577S		MO	-0.87	-1.01	510N	?M	MO	-0.47	-0.75
247S	?F	MA	-0.57	-1.37	476N	M	Adol.	-0.85	-0.41
237S	?F	MA	1.46	-1.33	477N	M	MA	-0.64	0.51
259S	F	YA	-0.73	-2.25	482N	M	YM	-0.62	1.98
238S	?F	OA	-0.70	-0.91	325N	M	MO	-0.85	-0.55
319S	F	MO	-0.55	-0.20	497N	?M	MA	-0.51	-0.26
323S	F	A	-0.81	3.17	473N	?M	YA	-0.57	-0.23
318S	F	OA	-0.39	0.40	361N	?M	YMA	-0.51	1.80
212S	?M	YA	-0.47	-0.50	486N		YMA	0.86	0.12
231S	M	MA	-0.68	-1.00	520N	?M	Y	-0.75	0.19
580S	M	MO	-0.70	-0.76	480N		YA	-0.18	-0.50
576S	?M	MA	-0.59	-1.45	481N		7 y	-0.72	0.59
211S	?M	MO	0.52	0.59	568N	?F	Y	-0.22	0.77
265S	M	YA	0.14	0.12	404N	?M	O	-0.30	0.52
367S	M	YA	-0.20	0.03	355N	?M	YM	-0.85	-1.32
207S		MA	1.11	-0.72	324N	F	MO	-0.56	-1.17
393S		A	-0.65	-0.20	492N	F	YMA	-0.57	-1.37
225S		OA	-0.56	-0.95	352N	M	O	-0.52	10.26
384S		YA	-0.54	-0.97	494N	?M	MA	0.01	0.46
340S	?M	A	-1.24	-1.23	365N	M	O	0.10	1.38
379S	?M	A	-0.77	2.46	475N		A	-0.60	0.78
333S	M	MA	0.22	-0.67	508N	F	Y	-0.23	-0.80
382S		MOA	0.47	-4.05	534N	F	Y	-0.78	0.01
375S		OA	0.34	1.26	506N		Ad YA	-0.38	0.25
338S	?M	A	-0.10	-0.60	356N	F	O	16.33	-0.99
422S		YA	-0.12	-1.05	278N		OA	-0.62	0.02
330S	?M	A	-0.89	-1.34	326N	F	O	-0.45	-1.36
359S		A	-0.55	-0.61	317N		YMA	1.85	-1.62
364S	M	YA	-0.36	0.49	328N	F	YMA	-0.59	-1.45
320S	M	YM	-0.56	-0.68	501N	?F	A	-0.55	-1.18

Ad: adolescent, MA: mid adult, YA: young adult, OA: old adult, YMA: young to mid adult, MO: mid-old adult, A: adult. S: south group, N: north group,

TABLE 18:7 *The value of the coefficients for the principal components 1 to 2 for artefacts found as mortuary offerings with the IA 1 adult burials of Ban Non Wat*

Artefact	PC1	PC2	Artefact	PC1	PC2
Agate beads	0.35	0.05	Iron blade	0.08	0.32
Bivalve shell	-0.06	0.04	Iron chisek	0.18	-0.03
Bimetallic spear	-0.03	0.05	Iron hoe	-0.01	0.14
Bos bone	-0.06	0.07	Iron object	0.08	0.02
Bronze anklet	-0.03	0.01	Iron point	-0.02	0.36
Bronze arrowhead	-0.02	-0.03	Iron spear	-0.02	0.18
Bronze bangle	0.04	0.04	Ivory bangle	0.01	-0.14
Bronze ring	0.03	-0.03	Lead object	-0.04	-0.06
Bronze socketed implement	-0.02	0.07	Pelllet bow pellet	0.46	-0.03
Buffalo bone	-0.03	-0.06	Pig bone	-0.01	0.16
Carnelian beads	0.00	-0.09	Pottery vessel	0.06	0.26
Chicken bones	-0.04	-0.04	Red ochre	0.00	0.37
Conincal roller	0.46	-0.03	Shell bangle	0.21	0.09
Crucible	0.01	0.02	Shell ear pendant	0.04	0.11
Dog bone	-0.02	-0.07	Spindle whorl	0.29	0.14
Fish skeleton	0.03	0.39	Stone adze	0.36	-0.06
Glass earring	0.23	-0.03	Tin beads	-0.01	0.36
Glass ornament	0.24	-0.06	Whetstone	0.02	0.00
Grey clay	-0.07	0.25	Variance	3.925	3.168
Iron bangle	0.10	-0.15	% Variance	10.1	8.1
Iron billhook	-0.03	-0.04	% Cumulative	10.1	18.2

TABLE 18:8 *The values of the coefficients of the principal components 1 to 2 for Ban Non Wat infant burials on the basis of associated mortuary offerings*

B	N/S	Age	PC1	PC2	B	N/S	Age	PC1	PC2
513	N	0 m	-1.086	-2.199	492	N	2-4 y	-0.022	-1.054
484	N	5 y	0.495	0.009	483	N	2-4 Y	-0.629	0.610
516	N	5 y	0.125	-0.268	496	N	2-4 Y	0.031	-1.256
488	N	2.5 y	0.052	1.038	491	N	4y	0.411	-0.121
472	N	15 y	-1.003	-0.434	490	N	15y	0.365	0.192
245	N	child	0.259	-0.235	331	S	2 y	-0.691	1.612
541	N	7 y	0.013	-1.223	342	S	15 y	0.190	0.542
346	N	inf.	2.914	1.183	415	S	8 y	-0.356	-1.571
368	N	32w	-0.153	-0.675	369	S	8 m	-0.189	-1.313
479	N	2-4 y	-0.273	-1.442	314	S	9 m	2.102	2.047
511	N	5y	-0.273	-1.442	584	S	3 y	-0.356	-1.571
490	N	15y	-0.422	1.096	221	S	10 y	-0.070	-0.546
500	N	35-7 w	-0.245	-1.423	343	S	9 m	6.054	4.263
499	N	0	-0.560	-0.236	235	S	10 y	-6.439	5.840
498	N	0-4 m	-0.245	-1.423					

B: burial, N. north, S. south

TABLE 18:9 *The values of the coefficients for the prinicipal components 1 to 2 for Noen U-Loke adult burials on the basis of mortuary offerings*

Burial	Phase	PC1	PC2	Burial	Phase	PC1	PC2
73	4	0.61	0.23	98	3B	0.70	0.24
67	4	0.16	-1.73	96	3A	0.21	1.28
59	4	0.54	0.14	113	3A	2.03	4.21
8	4	0.36	-0.93	104	3A	0.64	0.12
4	4	0.42	-0.90	111	3A	0.34	-1.30
12	4	0.38	-0.94	105	3A	1.27	3.19
10	4	0.38	-1.66	52	2B	0.48	-0.89
68	4	0.23	-0.87	49	2B	0.04	-1.23
61	4	0.12	-1.56	40	2B	-0.03	-0.94
60	4	0.10	-1.61	35	2B	0.45	-0.52
5	4	-0.56	-1.07	30	2B	-0.23	-0.73
1	4	0.79	1.32	39	2B	0.39	-0.87
14	3D	2.98	10.53	33	2B	0.19	-1.30
118	3C	0.58	-0.24	37	2A	-0.14	-1.49
75	3C	0.46	-0.23	36	2A	0.11	-1.58
82	3C	0.50	0.09	2	2A	0.10	-1.61
62	3C	1.31	2.03	42	2A	-0.27	-1.80
86	3C	0.64	-0.52	114	1	0.10	-1.47
74	3C	0.35	-0.62	108	1	-0.33	-2.42
69	3C	2.29	6.61	27	1	-17.91	3.44
76	3B	0.52	-0.31	26	1	-1.52	-1.12
99	3B	0.23	-0.97				

TABLE 18:11 *The value of the coefficients for the principal components 1 and 2 for artefacts found as mortuary offerings with the Iron Age infant burials from Ban Non Wat and Noen U-Loke*

Pots	0.17	0.42	ear plug	0.12	0.11
bivalve shell	0.24	0.11	bronze anklet	-0.18	0.15
pig bones	0.28	0.18	bronze bangle	-0.24	0.27
red ochre	0.25	0.28	shell disc bead	-0.01	-0.09
spindle whorl	0.14	0.22	bimetallic ring	-0.23	0.16
fish skeleton	0.30	0.19	bronze spiral	-0.12	0.20
turtle bone	0.08	-0.05	agate pendant	-0.13	0.08
gastropod shells	0.08	-0.05	bronze earring	-0.28	0.30
grey clay	0.24	0.26	burnishing stone	0.12	0.06
ivory bangle	0.17	0.22	agate bead necklace	-0.18	0.17
pellet bow pellet	0.05	0.03	iron knife	-0.22	0.21
bronze ring	-0.21	0.17	bronze bell	-0.06	0.00
glass earring	0.09	0.02	iron sickle	-0.17	0.19
glass beads	-0.26	0.21	antler	-0.11	0.07
iron artefact	0.06	0.03	Root	3.8	2.8
shell bangle	0.16	0.16	%Exp	12.5	9.3
			Cum %	12.5	21.9

TABLE 18:10 *The values of the coefficients for the principal components 1-4 for the mortuary artefacts from Noen U-Loke adult burials*

Object	PC1	PC2	Object	PC1	PC2
Agate bead	0.03	0.06	Iron blade	0.09	0.19
Agate pendant	0.06	0.13	Iron hoe	-0.33	0.09
Bimetallic ring	0.07	0.25	Iron object	0.00	0.00
Bivalve shell	0.00	-0.08	Iron point	0.04	0.18
Boars tusk	-0.03	-0.03	Iron spade	0.01	-0.01
Bronze anklet	0.02	0.05	Iron sickle	0.01	-0.07
Bronze bangle	0.07	0.33	Iron spear	-0.31	0.07
Bronze bell	0.04	0.17	Iron torc	-0.01	-0.06
Bronze belt	0.05	0.27	Pig bone	-0.25	-0.01
Bronze ear disc	0.04	0.18	Pottery vessel	0.00	0.29
Bronze earring	0.02	-0.01	Red ochre	-0.33	0.09
Bronze ring	0.09	0.31	Rice bed burial	0.09	0.16
Bronze spiral	0.07	0.27	Shell bead	-0.01	-0.06
Bronze spear	-0.33	0.09	Shell disc	-0.33	0.09
Bronze toe ring	0.06	0.20	Shell earplug	0.00	0.00
Bronze torc	-0.32	0.10	Silver bangle	0.02	0.08
Carnelian bead	0.01	-0.04	Silver ring	0.04	0.12
Conical roller	0.00	0.00	Silver strip	0.01	-0.03
Fish skeleton	-0.33	0.08	Silver toering	0.04	0.11
Glass bead	0.07	0.28	Spindle whorl	-0.04	-0.01
Gold and silver earcoil	0.06	0.28	Tiger tooth necklace	-0.33	0.09
Gold bead	0.03	0.08	Root	8.34941	5.88083
Iron bangle	0.00	-0.08	% Var	20.4	14.3
Iron Billhook	0.00	0.00	% Cum	20.4	34.7

The infant burials of IA1 from Ban Non Wat differ markedly in their distribution from those of Noen U-Loke during IA3 and 4 (Fig. 18:30). The expressions of mortuary wealth employed a quite different range of offerings. Burial 343, an infant who died when about nine months old, was found with nine pottery vessels, three fish skeletons, eight pellets of red ochre, a lump of grey clay, nine ivory bangles, two bronze bangles and an iron artefact. Most of these do not recur at Noen U-Loke. The same could be said of burial 314, another nine-month old, found with five pots, two fish, four red ochre pellets, a shell bangle, grey clay and two bronze anklets of considerable technical sophistication. Burial 331, that of a two year old, again had a collection of four pottery vessels as well as a bivalve shell, two shell bangles, a shell earplug, cattle and pig bones and a spindle whorl. Burial 235 contained three pots, two bivalve shells, pig bones, four spindle whorls and two iron artefacts. A child aged 15 in burial 342 was interred with three pots, a bivalve shell, nine fish, red ochre, a spindle whorl and grey clay. All five of these graves come from the southern group, and all contain artefacts associated with spinning and dying cloth.

Infants of the northern group were similarly endowed.

TABLE 18:12 *The values of the coefficients for principal components 1 and 2 for the infant burials from Ban Non Wat and Noen U-Loke*

burial	age	context	P1	P2	burial	age	context	P1	P2
nul116	neonate	IA4	-1.55	0.80	nul39	inf	IA2	-0.06	-1.13
nul115	neonate	IA4	-3.79	1.63	nul40	inf	IA2	-0.15	-1.35
nul102	neonate	IA4	-1.16	-0.20	nul7	neonate	IA2	-0.06	-1.13
nul71	neonate	IA4	-3.09	2.09	nul2	inf	IA2	-0.15	-1.35
nul58	neonate	IA4	-0.06	-1.13	nul35	inf	IA2	-0.15	-1.35
nul56	neonate	IA4	-0.06	-1.13	nul1	inf	IA2	-0.15	-1.35
nul11	neonate	IA4	-0.24	-1.56	bnw100	6m	X IA4	-0.15	-1.35
nul9	neonate	IA4	-5.48	4.64	bnw102	infant	X IA4	-0.80	-0.60
nul7	1-12m	IA4	-0.53	-1.30	bnw98	neonate	X IA4	-0.84	-0.52
nul6	infant	IA4	-0.06	-1.13	bnw109	neonate	X IA4	-0.80	-0.60
nul97	2-3y	IA3	-0.36	0.10	bnw113	neonate	X IA4	-0.20	-2.11
nul43	neonate	IA3	-0.15	-1.35	bnw513	0 m	N	2.75	-1.35
nul19	neonate	IA3	-0.15	-1.35	bnw484	5 y	N	2.16	1.04
nul18	neonate	Ia3	0.21	-0.49	bnw516	5 y	N	1.22	0.32
nul17	neonate	Ia3	-0.06	-1.13	bnw488	2.5 y	N	4.03	2.34
nul13	3 m	IA3	-2.32	0.53	bnw472	15 y	N	0.91	-0.69
nul100	neonate	IA3	-0.24	-1.56	bnw245	child	N	1.60	0.69
nul91	0-3m	IA3	-1.05	0.48	bnw541	7 y	N	0.37	-0.90
nul90	neonate	IA3	-0.15	-1.35	bnw346	inf.	N	3.22	2.80
nu89	late foetal	IA3	-0.15	-1.35	bnw368	32w	N	0.81	-0.41
nul88	neonate	IA3	-0.79	-0.54	bnw479	2-4 y	N	-0.15	-1.35
NUL85	neonate	IA3	-3.52	2.53	bnw511	5y	N	-0.15	-1.35
nul63	neonate	IA3	-4.11	3.30	bnw490	15y	N	2.41	1.95
nul25	2-4 y	Ia3	-1.77	1.68	bnw500	35-7 w	N	-0.01	-1.26
nul126	neonate	IA3	-0.15	-1.35	bnw499	0	N	1.29	-0.19
nul123	neonate	IA3	-0.15	-1.35	bnw498	0-4 m	N	-0.01	-1.26
nul120	neonate	IA3	-1.96	0.11	bnw493	2-4 y	N	0.12	-0.71
nul119	neonate	IA3	-0.15	-1.35	bnw483	2-4 Y	N	3.47	1.89
nul103	neonate	IA3	-0.15	-1.35	bnw496	2-4 Y	N	2.00	0.36
nul81	neonate	IA3	-1.49	-0.21	bnw491	4y	N	2.07	0.82
nul79	3-9m	IA3	0.34	-0.49	bnw490	15y	N	2.41	1.95
nul77	late foetal	IA3	-0.89	-1.01	bnw331	2 y	S	3.88	2.64
nul46	2-4y	IA3	-2.50	1.42	bnw342	15 y	S	3.13	1.71
nul80		IA3	-3.21	2.25	bnw415	8 y	S	-0.24	-1.56
nul122	3-9m	IA3	-4.02	5.02	bnw369	8 m	S	-0.06	-1.13
nul38	neonate	IA2	-0.06	-1.13	bnw314	9 m	S	3.58	2.99
nul106	neonate	IA1	0.42	-0.91	bnw584	3 y	S	-0.24	-1.56
nul266	foetal	IA3	-1.60	0.42	bnw221	10 y	S	0.90	-0.20
nul37	inf	IA2	-0.15	-1.35	bnw343	9 m	S	5.23	5.10
nul8	neonate	IA2	-0.06	-1.13	235	10 y	S	3.14	0.41

The infant in burial 346 lay with five pots, red ochre, two fish, two lumps of clay and eight ivory bangles. Eleven fish were buried with the infant in burial 488, together with a bivalve shell, pig bones, clay and a spindle whorl. An infant who died when aged 2-4 years in burial 483 had six pots, a bivalve shell, pig bones, six fish, a spindle whorl and two burnishing stones. A second 15-year-old in burial 490 had seven pots, a bivalve shell, two red ochre pellets, two spindle whorls and three fish.

The values of the principal components 1 and 2 for the combined sample from both Ban Non Wat and Noen U-Loke on the basis of age at death likewise reveals that neonates at both were accorded lavish mortuary offerings. At the latter site, there was a considerable preponderance of neonates relative to those who survived beyond a year of age, and they were interred with a considerable weight of bronze ornaments.

The regularity with which artefacts associated with weaving and the manufacture of cloth are found with relatively wealthy infants and children at Ban Non Wat, although most would have been far too young to employ them, suggests that this industry was a feature of the early Iron Age at this site. It is also stressed that at both sites, throughout the Iron Age, the interment of infants and children was given a degree of ostentation and ritual that would have reflected the social standing of the donor family. This is nicely illustrated at Noen U-Loke during IA3, where there are four grave clusters. That with the poorest adults also contained the graves of the poorest infants and children.

MORTUARY EVIDENCE: SUMMARY

C.F.W. HIGHAM

There are only six burials in the IA1 cemetery of Noen U-Loke. They reveal that iron was used for ornaments, weapons and heavy, socketed implements. Bronze was also cast into torcs and bangles as well as socketed spears. Fish and pig bones were placed with the dead. However, no burial contains glass or exotic hard stone ornaments. This might be due to the small sample size for in the initial IA1 cemetery at Ban Non Wat, where there was a transition directly from the late Bronze Age, we do find in a

much larger sample, glass ornaments and the occasional bead of agate and carnelian. The IA1 cemetery of Ban Non Wat comprises inhumation graves that initially formed as a tightly nucleated group, in which there was much disturbance as burials were added. It is then suggested that the graves were added progressively to the east, and in two rows with far less disturbance as more graves were found intact. In the northern row of graves people were interred with the head to the north, but in the southern row, the head was directed to the south.

As with the Late Bronze Age, ceramic vessels remained similar in form, and continued to be packed with fish. Some people were interred with spindle whorls and grey clay. But there were also changes, seen in the increase in bronze ornaments, bimetallic spears, iron spears and tool kits, lead castings, exotic stone ornaments and domestic water buffalo bones. The relatively intact burials have been analysed on the basis of principal component analyses. The results reveal that the majority of individuals were grouped closely together in one nucleated group irrespective of their age, group affiliation or sex. However, a handful of graves are separated from the rest on the basis of a larger and more varied set of mortuary offerings. There is no indication, however, that these people were distinguished by their age, sex or their group. Despite the possible presence of two nuclei of relatively wealthy burials, we have not found any evidence for hierarchic social distinctions at Ban Non Wat in the early Iron Age.

The sequel is seen at Noen U-Loke. Here, the second mortuary phase saw the tight nucleation of burials, each group containing the remains of men, women, and young individuals. Glass, agate and carnelian made their appearance at this site, and in the later group, there were further changes. The dead were interred in graves filled with white silicified rice, bronze ornaments were more common and took on complex forms, and all but one of the carnelian beads were found.

This trend towards nucleated groups and increased wealth continued into IA3 (Fig. 18:19). Four sets of burials were laid out on a chequer board pattern. Again, they comprised men, women and young individuals, and it is suggested that they were related consanguinally and affinally. The mortuary rituals became more elaborate: some graves were lined and capped with clay, and rice still covered the dead. Exotic grave offerings now included gold and silver. One of the most striking features of this phase is the proliferation of bronze ornaments, that now included ear lobe inserts, belts, and multiple toe and finger rings as well as rings made of iron and bronze. There are intriguing distinctions in the relative wealth of these nucleated groups. Group B is markedly the poorest, lacking gold, silver and multiple bronze ornaments but also containing many spindle whorls. The other three groups were much richer, each containing at least one outstandingly wealthy individual as well as well-endowed burials of children and infants. The man in burial 14 of group D was associated with 244 offerings and an assemblage dominated by bronzes that included 150 bangles and three belts. Burial 69, another man, had 198 offerings including four bronze belts. Burial 113, a woman not completely found within the excavated area, was interred with at least 159 items, including silver bangles and gold beads. This subset of wealthy individuals expressed their social standing through the ownership of a remarkable quantity of bronze ornaments.

With the final phase, the tight nucleation of burials came to an end. Graves were widely distributed across the excavated area. Extreme wealth also fell away, although burial 1, a man, did wear a notable quantity of bronze ornaments. No more rice-filled graves were found. Iron grave goods now often included spears and sickles.

THE PALAEOENVIRONMENT

The Mun is the major river that drains the southern half of the Khorat Plateau. It rises in the Petchabun Range and augmented by many tributaries, flows eastwards to join first with the Chi, and then the Mekong. It thus forms a highway for exchange between Central Thailand and the lands bordering the Mekong. This location has recently taken on a new significance with the discovery, beyond the Mekong in Laos, of a major Iron Age copper mining complex at Sepon (Sayavongkhamdy *et al.* 2009) The terrain is relatively flat, comprising the broad flood plain of the river, flanked by a series of slightly elevated terraces. Apart from extensive land suited to rice cultivation, the Mun Valley is a major source of salt.

In their analysis of palaeoenvironmental change in this region, Habberfield-Short and Boyd (2007, 2007a, 2007b) have identified six phases, of which the fifth is relevant to Iron Age settlement. Phase 5A covers the late Bronze Age, which ended in the fifth century BC. Settlements were located on elevated tracts near single-channel rivers. This was a period of reducing rainfall. With phase 5B, from 500-200 BC, the river system, judging from the analysis of air photographs, converted to multiple, narrow channels. Phase 5C represents the later Iron Age from 200-500 AD, when a decline in rainfall stimulated human management of water through the construction of banks round the settlements that filled with water fed by stream inflows. The distribution of sites and the reconstructed course of the rivers within the study area are set out in figure 18:32. The results of pollen analyses suggest that there were at least six phases of vegetation change during the course of the Iron Age, beginning with increasing encroachment into the natural cover, which is predominantly dry, deciduous dipterocarp forest. This forest clearance accelerated as more land was brought under rice cultivation, the deforestation doubtless contributing to the changing water regime and increasing sedimentation (Boyd 2007).

Today, the lower terrace that surrounds the moated sites is given over almost entirely to the cultivation of a

single rice crop per annum. The fields are prepared with the onset of the rainy season in late April or early May, and the harvest is usually in by the end of October. Any consideration of the cultural sequence in prehistory must take account of the fact that rice was cultivated at Ban Non Wat from the initial Neolithic settlement until the present. This continuity is underwritten by the fact that rice can be grown on the same land for years without the addition of fertilizer (De 1939). This is underwritten by the role of cyanobacteria in fixing nitrogen in the water that percolates through the rice fields (Wilson *et al*. 1979, Roger and Kulasooriya 1980, Mishra and Pabbi 2004, Saadatnia and Riahi 2009). It must also be stressed that there are many potential setbacks in cultivating rice. As Greenland (1997) has noted, there are many insects, diseases and weed competitors. Insect pests include stem borers, leafhoppers, whorl maggots and rice bugs, but rats are worse than all other pests combined. On the positive side, wet rice fields are also a source of fish. In Sichuan, one hectare can supply 83 kg per annum, a figure that increases tenfold if fish are contained within permanent canals or reservoirs. Again, the rice fields can, if ringed by fences that incorporate traps, act as a magnate for wild mammals. The capacity of rice to yield a harvest virtually indefinitely, given sufficient rainfall, has permitted sites to be occupied for millennia.

THE PEOPLE OF NOEN U-LOKE

The human remains from Noen U-Loke have provided the first opportunity in Southeast Asia to assess the health and demography of an Iron Age population (Tayles *et al*. 2007), although the sample size for each of the phases is too small to permit a detailed review of changes over the millennium involved. The sample as a whole comprises 120 individuals, of which 53 died when less than 15 years of age, 70% of this group being from pre-term to less than a year of age. Of the mature individuals, four were probably aged from 15-19 years at death, while 24 are classified as young adults, 14 as mid adults, 12 as old and 13 cannot be classified. Over half of all adult males belong in the young adult category. The average stature for women was 154.6 cm, and for men, 169.3 cm. The women were of similar height as the early Bronze Age population at Ban Lum Khao, but the men were significantly taller than their predecessors. Overall, the adult population was in reasonably good health with less evidence for growth disruption in childhood than during the Bronze Age at Ban Lum Khao (Domett 2004). However, two individuals suffered from leprosy, and tuberculosis might well have been present. One child suffered from cerebral palsy. Evidence for bone trauma from violence is found in one woman, who died when her head was violently attacked with a sharp instrument, while a young man from the final mortuary phase was killed by an arrow that pierced his spine.

The bones suggest a population that did not face malnutrition despite the demographic evidence for a rising population. There is a consistent body of evidence for a healthy diet during the Iron Age. Rice, for example, was found in considerable quantities at Noen U-Loke, where surpluses were used in the second and third mortuary phases to fill the graves and mortuary vessels. Feasting is suggested by the regularity with which the severed limbs of pigs, on occasion whole pigs were placed in graves. Pottery vessels used as mortuary offerings often contained fish skeletons. Cattle and water buffalo bones also accompanied the dead. In the occupation layers, we find butchering floors littered with the discarded bones of cattle, pigs and water buffalo.

The faunal spectrum of Noen U-Loke reveals not only the dominance of domestic bovids, pigs and water buffalo, but also a regular occurrence of large, medium and small-sized deer (McCaw 2007). Shellfish now adapted to rice fields are abundant in all layers, over 24,000 coming from the gastropod *Filopaludina*, and 4618 from the large species *Pila ampullacea*. Fish remains from occupation layers were also present, and reflect the local presence of ponds and rivers. The moats would doubtless have been a further source of aquatic food (Thosarat 2007).

THE MOATS AND BANKS

Ban Non Wat lies within two visible banks that ring the site, each of which encloses a moat. The inner moat has a width of approximately 30 m, the outer is *c* 20 m wide. According to Boyd (2007), these moats were fed by a former stream or river visible on air photographs, that also flowed past Noen U-Loke to the west (Fig. 18:32). At least one further moat might lie on the periphery of the mound, now covered by Iron Age occupation. By any measure, the provision of such engineering works would have required considerable labour. This entailed the removal of surface material to form the diversionary and retaining banks within which there would have been a permanent presence of water. The cross-section excavated through the moats and banks reveals shallow infill deposits overlying old stream channels. The dates of the inner and outer bank have been identified on the basis of eight AMS radiocarbon determinations on shell that was recovered when they were sectioned (McGrath and Boyd 2001). These reveal that at 68.2% probability, the inner bank was constructed between the last centuries BC and the second century AD while the outer bank was built between the last centuries BC and the end of the Iron Age (Fig. 18:33). The inner moat seems therefore to have been constructed first, and their construction thus appears to integrate with the later Iron Age occupation of this site. It is noted that it was during this time at Noen U-Loke that the smiths forged a large, socketed spade. We also find socketed iron hoes at both Noen U-Loke and Ban Non Wat. Both types



FIG. 18:32 Location of Noen U-Loke and Ban Non Wat relative to evidence for former rivers, as mapped from the 1:16,700 aerial photographs taken in 1974. This interpretation shows the sites of, from west to east, Ban Non Ngiu, Ban Kho Hong, Noen U-Loke and Ban Non Wat: (top) sediment mapping from the aerial photograph interpretation, showing the outlines of former river channels and areas of channels; and (bottom) the interpretation of the sediment mapping

of tool would have facilitated the large-scale removal of earth to form the banks.

For Noen U-Loke, two AMS dates from a channel buried below the edge of the mound are 81-339 cal AD and 87 BC – 114 cal. AD. The other two determinations come from carbonized rice grains found in a channel below the first moat, and are 405-600 cal AD and 543-798 cal AD respectively.

Non Ban Jak lies 9 km to the west of Noen U-Loke and is surrounded by two banks and moats (Figs 18:34-6). Two AMS dates come from a channel beneath the mound edge (all calibrated): 384-621 and 254-416 AD. A buried channel beneath the first bank returned a date of 362-617 AD. A channel between the two banks is dated 254-427 and 356-535 AD, while the outer bank has provided five similar determinations with a minimum and a maximum range of 263-559 AD. The Bayesian analysis of these five determinations suggest that the outer bank was constructed in the early fifth century AD (Figs. 18:35-6, Table 18:13).

Ban Makham Thae has two moats, and at least two channels now covered by Iron Age occupation deposits. A determination from one of the former channels is 32-336 AD. Three dates from a channel under the innermost bank are 231-531 and 422-642 AD, while one further sample from moat infill is 341-641 AD.

These determinations combine to indicate that bank construction and the active infilling of the sediments within the moats belong to the later Iron Age occupation. It seems most likely, that the settlements in question were ringed by these water control measures during IA3 and 4.

The objectives of those who planned and organized the construction of these very large and impressive water control measures remains conjectural. There are several possibilities and none is mutually exclusive of the others. Defence is the most obvious, particularly so given the evidence for conflict seen in the iron weaponry that proliferated during the later Iron Age, and the discovery of an iron arrowhead lodged in a young man's spine atNoen U-Loke. They may well also have been a means of projecting the status of the presumed elite members of society. The provision of water for a growing population during the long dry

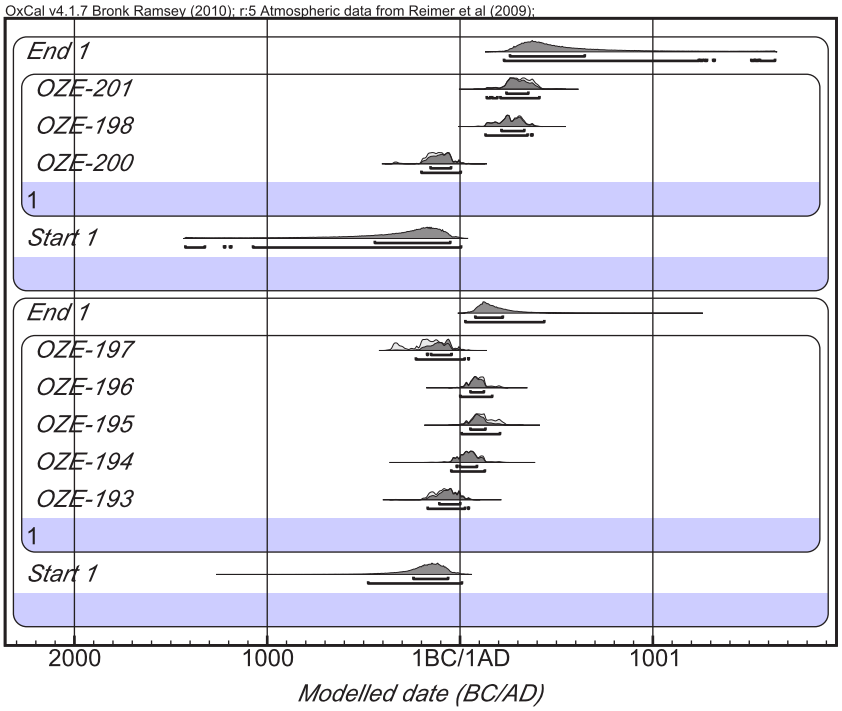


FIG. 18:33 The radiocarbon determinations from the banks and moat of Ban Non Wat, showing the start and end dates for their construction. The outer moat (upper series) appears to be the later

TABLE 18:13 *The radiocarbon determinations for the moats and banks of Ban Non Wat, with the modelled data following the application of OxCal 4.0*

Name	Unmodelled (BC/AD)						Modelled (BC/AD)					
	from	to	%	from	to	%	from	to	%	from	to	%
End 1						End	260	648	68.2	229	635	95.4
OZE-201	253	381	68.2	143	422	95.4	241	355	68.2	139	413	95.4
OZE-198	216	338	68.2	134	380	95.4	215	334	68.2	133	377	95.4
OZE-200	-168	-54	68.2	-341	1	95.4	-154	-47	68.2	-201	5	95.4
Start 1						Start	-443	-51	68.2	-1425	6	95.4
End 1						End	80	223	68.2	28	438	95.4
OZE-197	-345	-59	68.3	-359	-42	95.4	-172	-44	68.2	-230	46	95.4
OZE-196	56	130	68.2	18	214	95.4	55	125	68.2	2	168	95.4
OZE-195	62	210	68.2	26	233	95.4	54	133	68.2	9	208	95.4
OZE-194	2	121	68.2	-53	209	95.4	-18	89	68.2	-46	130	95.4
OZE-193	-161	-3	68.2	-191	25	95.4	-108	2	68.2	-169	47	95.4
Start 1						Start	-243	-62	68.2	-477	11	95.4

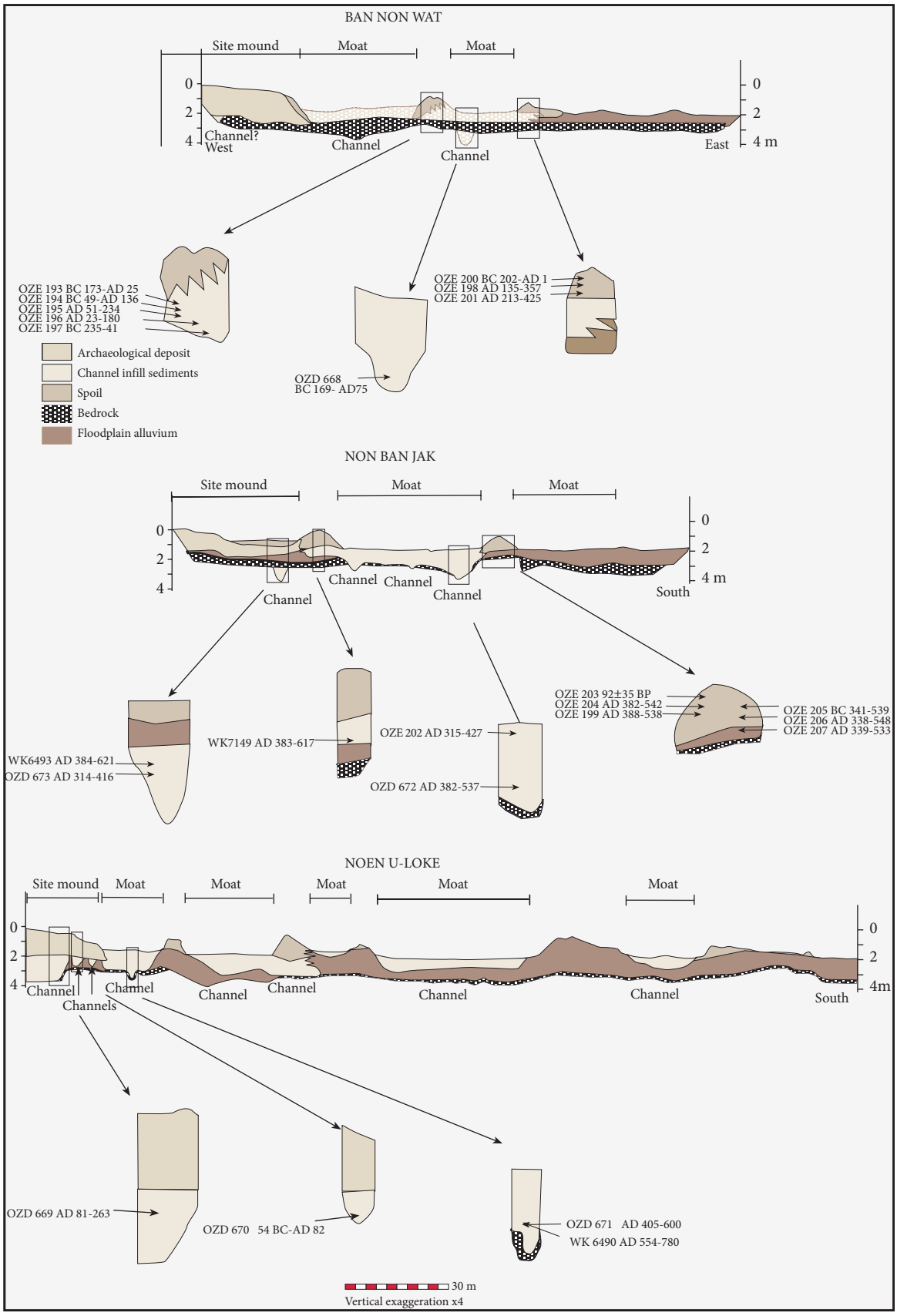


FIG. 18:34 The cross sections through the moats of Ban Non Wat, Non Ban Jak and Noen U-Loke in association with the radiocarbon determinations



FIG. 18:35 The inner moat and bank at Non Ban Jak

season for domestic purposes cannot be ruled out, nor the natural increase in the supply of fish, shellfish, and perhaps even rice, that would accompany the presence of large bodies of water. Where several communities relied on the same watercourse to fill and replenish their moats, their very presence might have been a cause of competition and friction.

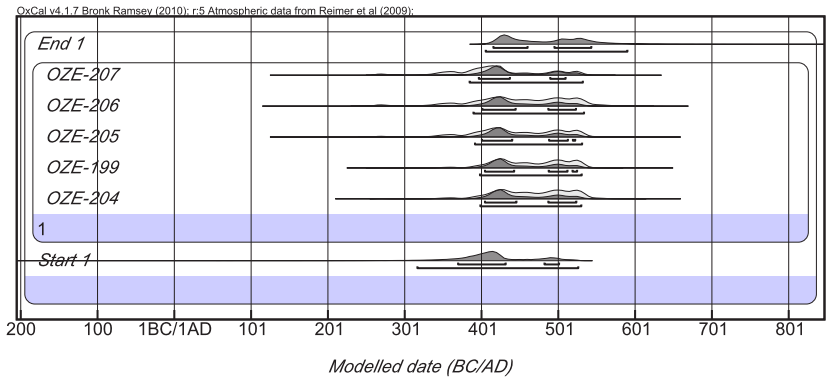


FIG. 18:36 The radiocarbon determinations for the outer bank at Non Ban Jak showing the beginning and end dates for its construction

TABLE 18:14 *The radiocarbon determinations for the outer bank of Non Ban Jak, with the modelled data following the application of OxCal 4.0*

Name	Unmodelled (AD)						Modelled (AD)					
	from	to	%	from	to	%	from	to	%	from	to	%
End 1							415	545	68.2	405	595	95.4
OZE-207	350	530	68.2	335	540	95.4	395	510	68.2	385	535	95.4
OZE-206	400	535	68.2	265	560	95.4	400	525	68.2	390	535	95.4
OZE-205	390	535	68.1	340	540	95.4	400	525	68.2	390	535	95.4
OZE-199	410	535	68.3	385	540	95.4	405	525	68.1	395	535	95.4
OZE-204	410	535	68.2	355	550	95.4	405	525	68.2	395	535	95.4
Start 1							370	505	68.2	315	530	95.4

XIX THE ORIGINS OF ANGKOR: CONCLUSIONS

C.F.W. HIGHAM

Our project began in 1992 with the objective of exploring the prehistoric sequence in a defined study area in the upper Mun Valley. The Mun Valley provides the strategic link between Central Thailand and the Mekong River. The presence there of brick temples belonging to the so-called Chenla period (*c* AD 550-802) and major Angkorian sites at Phimai, Phanom Wan and Phanom Rung reflect that the Mun Valley was always a major part of the kingdom of Angkor. Therefore, it might reasonably be expected that the prehistoric cultural sequence would throw some light on the origins of early states. This was supported by the documented concentration of large prehistoric settlements throughout the Mun Valley ringed by banks and moats.

There are several environmental factors that favour this region. In the first place, rivers formed the highways for the transport of goods, ideas and people when the Khorat Plateau was densely forested. The upper reaches of the Mun Valley incorporate a pass over the Petchabun Range providing a natural link between Central Thailand with its direct access to marine resources, and the Mekong River. It could reasonably be expected to have been a natural conduit for the marine shell so valued for the manufacture of personal ornaments in prehistory. Again, the Petchabun Range which feeds the headwaters of the Mun River is a source of high quality stone, not to mention the copper ore of the inselbergs on its western flank. To the east, unknown to us until recently, there is a second source of copper ore at Sepon in Laos.

There are several other environmental factors which must be taken into account in any enquiry into human settlement in the Mun Valley, and in particular, its upper reaches. The broad and flat flood plains are, when cleared of the natural forest, suited to the cultivation of rice. This plant has a particularly important property: it can flourish virtually indefinitely on the same soil provided that there is sufficient water to percolate past the stems during the growing season. Naturally, applying fertilizers will improve yields, but rainfall holds the key. With sufficient monsoon rain, rice can sustain the same community for centuries, even millennia. The mounded settlements of the Mun Valley thus can take on the attributes of deeply-stratified Middle Eastern tells. The abundance of natural food sources is also stressed. Until the spread of firearms and a sharp rise in population leading to deforestation, the Mun Valley sustained a remarkable variety of plant and animal species. Sambar, brow-antlered and hog deer as well as the munjtak and possibly Schomburgk's deer were widespread and abundant. There were herds of wild gaur and banteng, among the largest bovids known. Water buffaloes would have been attracted to the wetlands. There were wild pigs, and in attendance, their predators - tiger and leopard. Elephants, crocodiles and rhinoceros were native to this region. And the rivers, lakes and marshes would have abounded, then as now, with fish and shellfish. It is notable that even today, when the low terraces bordering the rivers are given over almost entirely to rice, the villagers can still fish, collect shellfish, take wild honey, trap insects, and hunt rice field rats. The hot climate also leads to rapid tree growth, and there is a great variety of fruit and other food trees.

The Mun Valley is also noted for a particularly vital resource: salt. It is hard to overemphasise the importance of salt to this day. During the dry season, villagers are drawn to the best salt deposits, seen by a coating of white as the wet season swamps dry out. They accumulate the salty soil into a container, often a hollowed tree trunk, and filter water through it to concentrate the salt. This is collected and boiled, incidentally placing demands on the supply of fuel wood. This method is little changed from that practiced in the prehistoric period. Salt is widely traded, and used essential for preserving fish, which are abundant during the wet season, for consumption during the five or six months of the ensuing dry season. Salt is also fed to domestic cattle, for adding it to the diet increases their health and rate of growth.

The upper Mun Valley can therefore be seen as a bottleneck, that concentrated the passage of desirable goods - marine shell, copper and tin ingots, salt, lead, carnelian, agate and glass - between the Central Plain and the Khorat Plateau. It remains so to this day, seen in the strategic location of the city of Nakhon Ratchasima, and in Angkorian times by the foundation of the great centre of Phanom Wan. It is also crowded with the prehistoric moated settlements that attracted us to our study area in the first place.

THE SITES AND THEIR SEQUENCE

We have opened four sites by excavation, and when combined, have identified 13 cultural phases (Fig. 19:1). The sequence in the Mun Valley began with occupation of Ban Non Wat by probable hunter-gatherers. There were then two Neolithic, six Bronze Age and four Iron Age phases. The area excavated at Ban Lum Khao was occupied during Neolithic 2, Bronze Age 2 and Bronze Age 5 (Higham and Kijngam 2009). This site was not encircled by moats and banks. A small excavation at Non Muang Kao, a very large moated settlement, revealed IA 3-4 occupation and burials. Noen U-Loke is a second large moated site which was occupied during the Bronze Age, but the area we excavated covers all four phases of the Iron Age (Higham *et*

al. 2007). Ban Non Wat is the site with the longest cultural sequence that encompasses all phases except for Iron Age 3.

The 76 radiocarbon determinations from Ban Non Wat comprise the anchor chronology for the upper Mun Valley sequence (Higham and Higham 2009). Describing the initial phase has hunter-gatherer is based on the flexed burial position of the dead, which is widespread among Southeast Asian hunter-gatherer groups, and the unusual mortuary offerings which do not match those of any known Neolithic group. The phase has been dated on the basis of shell mortuary offerings, the earliest determination being just prior to the initial Neolithic settlement, and they then seem to have been contemporary with the Neolithic and possibly even the early Bronze Age occupation. A deeply-stratified shell lens has furnished a date in the 16th millennium BC, but the lens was only marginally within the excavated area, and no artefacts were found in association. Only further excavations will reveal whether this was a natural deposit or the result of human occupation in the late Pleistocene.

The timespan for the succeeding phases is summarised in table 19:1. The initial occupation by rice farmers belongs in the 17th century BC, and this first phase lasted for about four centuries. It was followed by Neolithic 2, represented at Ban Lum Khao and Ban Non Wat, in both sites being dated in the 13th to the 11th centuries. The five phases of the Bronze Age cover the six centuries from about 1050-420 BC (BA3 has two subphases). Bronze Age (BA) 5 merged with the early Iron Age in the late 5th century, and its four phases overlapped with the formation of advanced chiefdoms, perhaps even early states, by the 6th century AD.

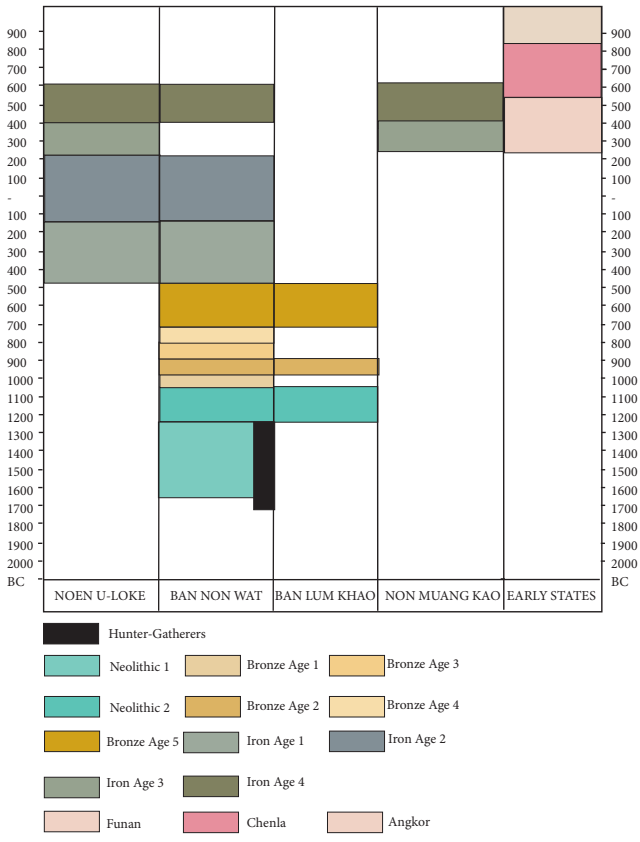


Fig. 19:1 The chronological sequences at the four sites excavated in the Upper Mun Valley

NEOLITHIC 1

Assessing the nature of the initial Neolithic settlement is based on the occupation and mortuary evidence from Ban Non Wat. The former is represented by midden deposits that contain freshwater shellfish, fish and mammalian bones and a range of artefacts that includes broken ceramic vessels, stone adzes or adze flakes, clay counters, bangles and pellet bow pellets, whetstones and a small number of clay spindle whorls.

This material culture, in particular the ceramic vessels, permits two major points to be emphasised. The first is that they represent a fundamental new stage in the prehistory of this region. Secondly, the motifs incised, impressed and painted onto the pots have parallels over much of Southeast Asia. With Neolithic 1, we encounter a community that cultivated rice, and maintained domestic pigs, cattle and dogs. The establishment of permanent agricultural villages on the Khorat Plateau, which coincided with similar events across much of the lowlands of Southeast Asia and southern China, was the bedrock on which all subsequent cultural changes were founded. Identifying such Neolithic settlements relies on good fortune rather than planning through directed fieldwork, because they are stratified below later occupation layers. Even at Ban Non Wat, our two other excavated squares towards the edge of the site were devoid of Neolithic remains, and it was only when Dr Nigel Chang excavated a series of squares from east to west across Ban Non Wat that he was able to demonstrate the relatively small size of the Neolithic settlement (Fig. 19:2). The Neolithic cemetery at this site is the largest to be opened in Northeast Thailand, and the only one to be published (Higham and Kijngam 2011).

The Neolithic 1 mortuary rituals were complex, and again, set the trend for the following 2000 years. The dead were interred either in a supine and fully extended position, or in the case of two adults, in a seated posture within lidded pottery vessels. Offerings placed with the deceased were dominated by pots, the most with any individual being nine. There is a notable rarity of shell jewellery. One person wore a shell necklace, and another was found with a single shell bangle. Two individuals were accompanied by cowrie shells. In the case of burial 86, these were pierced and worn as ear ornaments. No such associations suggesting use as jewellery were identified with the five cowrie shells associated with burial 292, but their presence indicates that already there was an exchange route linking

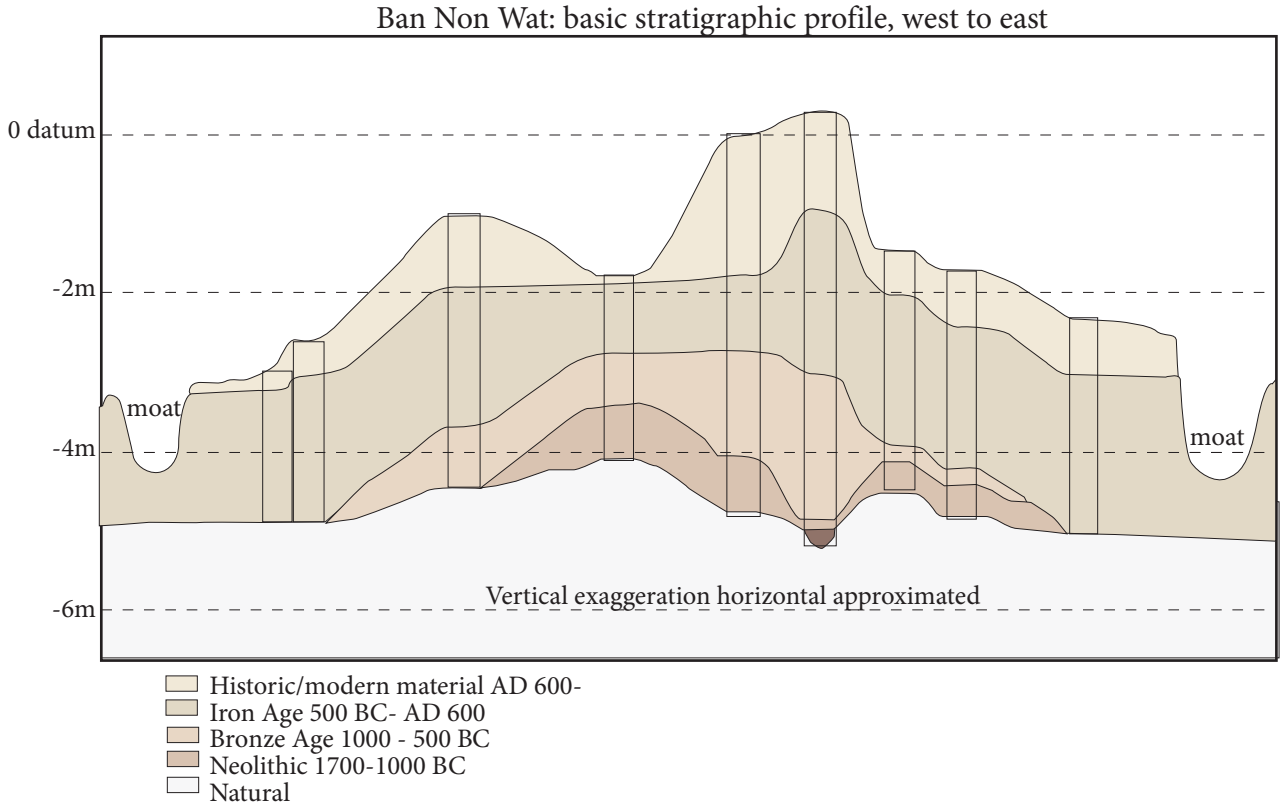


FIG. 19:2 Schematic cross section of Ban Non Wat showing the extent of the settlement during the Neolithic, Bronze and Iron Ages. Courtesy Dr N. Chang

Ban Non Wat with the coast. Animal offerings involved pig and fish bones, the latter contained in ceramic vessels. Four stone adzes were also placed with burials.

The two adults found within pottery vessels had been inserted after the pot had been broken on one side to admit the body. One of the pots had been decorated with complex red painted designs on the body, while incised and impressed motifs had been added to the shoulder. Smaller versions were used for the interment of some of the 14 infants. It is these motifs that allow us to link this community with other Neolithic groups. One motif, for example, resembles a highly stylised human figure that recurs in Central Thailand at Khok Charoen, Tha Kae, Sab Champa, Non Pa Wai and Khok Phanom Di. This is an unmistakable link that joins these sites into an early Neolithic horizon. Further afield, the same or similar pattern is seen at Non Nok Tha and Ban Chiang in the northern part of the Khorat Plateau, and in the Red River delta sites of Xom Ren, Go Bong and Phung Nguyen.

Further parallels in ceramic motifs have been catalogued and described by Wiriyaromp (2011) in his consideration of the Neolithic occupation of Ban Non Wat and all contribute to the conclusion that there was a rapid spread of Neolithic groups into the lowlands of Southeast Asia. Rispoli (2007) and Zhang and Hung (2010) have followed this trail north into Lingnan, where it meets with the southern expansion of rice farmers from the Yangtze Valley described by Fuller *et al.* (2010) as the fifth such thrust. At Ban Non Wat, we have identified not only the establishment in the 17th century BC of one such community, but also a possible contemporaneity and interaction with indigenous hunter-gatherers.

TABLE 19:1 *A summary of the prehistoric and early historic chronology for the upper Mun Valley, based on the radiocarbon determinations for Ban Non Wat, Ban Lum Khao and Noen U-Loke*

Cultural Period	Date in calibrated radiocarbon years (BC)	Date
Flexed burials	1750-1050	
Neolithic 1	1650-1250	
Neolithic 2	1250-1050	
Bronze Age 1	1050-1000	
Bronze Age 2	1000-900	
Bronze Age 3	900-800	
Bronze Age 4	800-700	
Bronze Age 5	700-420	
Iron Age 1	420-150	
Iron Age 2	150-AD 200	
Iron Age 3	AD 200-400	Funan AD200-550
Iron Age 4	AD 400-600	Chenla AD 550-802

NEOLITHIC 2

Neolithic 2 is represented at Ban Lum Khao and Ban Non Wat. In the former site, there are ten burials, and a group of refuse pits. Most inhumation graves were laid out on an east to west orientation with the head pointing to the east. They were accompanied by pottery vessels distinct from those of Neolithic 1 at Ban Non Wat. Most are globular and cord marked with an everted rim and no decoration. There are also small pedestalled bowls. One man wore a necklace of 786 shell beads, and a woman wore a marble bangle. Otherwise, there were no ornaments. Two people were accompanied by pig's bones and one, with a bivalve shell.

Five Neolithic 2 pits were found cut into the natural substrate. These were densely filled with bones, shellfish and potsherds, and look like organically rich pits dug to contain rubbish. Each represents a brief episode, and the frequency of species in each will be considered first. It is stressed that the entire contents of these pits were subjected to flotation, and that therefore the sample is complete.

The first pit was cut about 50 cm into the natural substrate. Its contents included a large sample of mammalian bone. The sample of bovidae was dominated by the remains of very large water buffalo, 12 Eld's deer, six pigs, four dogs, a small deer, and one sambar deer. A total of 58 fish were also identified, most coming from *Ophicephalus striatus*, the snake head, followed by *Fluta alba*, the swamp eel, *Anabas testudineus* (climbing perch) and *Clarias* sp. Most of the other fish species are present in small frequencies.

A1:C 3:2 feature 1 is a pit measuring 75 by 60 cm. It contained a radius of *Muntiacus muntjac* and a humerus and maxilla from the pig. A total of 284 individual fish were identified in a sample dominated by *Anabas testudineus*, followed by *Ophicephalus striatus*, which together contribute three quarters of the sample. Most of the other fish represented at the site are also present, but in small numbers.

A further pit contained a large collection of biological remains, including three water buffalo, six Eld's deer, a pig, small deer, dog and turtle carapace. This pit contained 348 individual fish, with *Anabas testudineus* being the most abundant, followed by *Ophicephalus striatus.* Some other species also attain high frequencies, particularly *Mystus* sp. and *Clarias* sp.

The fourth pit has few food remains, indeed there are only 15 individual fish represented, again dominated by *Anabas testudineus* and *Ophicephalus striatus*.

The last pit had no mammalian remains, but 130 individual fish were recognized, just over a third being represented by *Ophicephalus striatus,* followed by *Anabas testudineus*, *Clarias* sp. and *Mystus* sp.

Five radiocarbon determinations from charcoal have been obtained, three from the above pits and the other two from *in situ* contexts relating to the Neolithic 2 occupation. Such charcoal dates are now interpreted as *termini post quem* due to the unknown inbuilt age of non-speciated material. The Bayesian analysis indicates that the site was initially occupied after 1400 BC. This provides a satisfactory concordance with the span of 1250-1050 BC for the corresponding Neolithic 2 occupation of Ban Non Wat.

There is no occupation evidence from Ban Non Wat that corresponds to the pits found at Ban Lum Khao. The Neolithic 2 burials were quite distinct from their predecessors. The preferred orientation of the corpse was with the head to the east, although some burials were oriented to the south, west or north. Apart from one or two cord-marked vessels placed beyond the head or feet, one adult was interred with pig bones in the head area and two others were associated with bivalve shells. Two further individuals wore waistbands fashioned from long shell beads.

Ceramic vessels were virtually the only items placed with the dead and in their form and decoration, they contrast markedly with the richly-decorated pots found with the Neolithic 1 burials. In terms of the distribution, we find that there were possible groupings of graves. Men and women were found in equal numbers Some infants were interred in ceramic vessels, others were laid out on the back. Just over a quarter of the 38 individuals were infants or young children, a marked decline on the figure for Neolithic 1.

The Neolithic 2 phase is enigmatic. There is a sharp distinction in material culture and mortuary practices when compared with the preceding Neolithic 1. The disappearance of the incised and impressed decoration on ceramic vessels is absolute. There are two principal explanations. The first is that the site was abandoned at the end of Neolithic 1 and then reoccupied by a different group of rice farmers. There is no evidence, in terms of the stratigraphic build up at Ban Non Wat, for a period of abandonment. The second possibility would involve an internal development over time that saw different preferences for pottery form and decoration, as well as burial orientation and practices. In either case, there is very little evidence for exchange in exotic materials, such as marine shell or marble, and no hint of any knowledge of copper or bronze. The pits at Ban Lum Khao indicate the importance of fish in the diet. The fish are not only very abundant, but also large relative to modern equivalents. There was also much hunting of wild game, particularly deer. The water buffalo bones are large, and may well also have been wild.

THE BRONZE AGE

The Bronze Age occupation of the upper Mun Valley falls into five phases, one of which has two sub-phases (Higham 2011b). All are represented at Ban Non Wat, and two at Ban Lum Khao. Excavations at Ban Prasat (Monkhonkamnuanket 1992) and Noen U-Loke (Wichakana 1991) have also yielded Bronze Age burials.

There are no radiometric dates for Ban Lum Khao, but a large series from Ban Non Wat, which indicate that the Bronze Age falls within the span c 1050-420 BC.

Bronze Age 1

The seven graves of the Bronze Age 1 date to the late 11th century BC, with a very brief span. Four of the five extended inhumation graves, involving two women, a man and 10-year-old child, were undisturbed. Their mortuary ritual was considerably more complex than that of the preceding Neolithic 2. Burial 569, for example, was cut deeply into the substrate, and the young woman was interred in a wooden coffin with a pointed end resembling that of a boat. Fourteen finely-made pots had been placed within and outside the coffin. She wore a shell bangle, and over 2,000 shell disc beads were found as belts and necklaces, and perhaps significantly, 20 were also found on the skull. In the next phase of the Bronze Age, such beads on the skull were invariably associated with great mortuary wealth. She was also interred with several probably symbolic bivalve shells, two positioned beside the hands. A socketed copper-base axe had been placed beside her head.

Apart from the infant jar burials, all five individuals were interred with a copper-base artefact, even the two-year-old. This infant was buried within a wooden coffin under a layer of gastropod shellfish as a form of shroud. Seventeen ceramic vessels were found grouped beyond the head and feet and again, bivalve shellfish were placed beside the hands. Six marine trochus shell bangles were worn. A ten-year-old reveals similar wealth, measured in pots, a copper-base axe and a wooden coffin.

As a crude measure of the increased wealth associated with these earliest Bronze Age people, we find that on average 14 pottery vessels of high quality were placed in the intact graves, compared with an average of just under two for the late Neolithic.

The form of the pottery vessels is clearly derived from those of Neolithic 2, but they are more finely made and decorated. With the first copper base mortuary offerings in the site, we also find a marked increase in shell ornaments. These were worn as necklaces and belts. The form of at least two of the copper base axes is matched by a similarly early example from Non Pa Wai in the Khao Wong Prachan Valley, as well as from Tha Kae, Non Nok Tha, Mlu Prei in Cambodia, and Dong Dau and Dong Den in northern Vietnam. They contrast with the shouldered form of copper base axe found in BA2 burials at Ban Non Wat.

During the brief span of BA1 at Ban Non Wat, mortuary rituals reveal a marked increase in complexity when compared with the preceding Neolithic 2. Graves were dug deeply into the natural substrate. Many more mortuary offerings were placed with the dead. At least one, probably more, of the adults was interred within a wooden coffin one end of which was pointed as in the prow of a boat. Exotic copper and marine shell were now travelling along an exchange route that involved the Mun River valley.

Bronze Age 2

The Bronze Age 2 cemetery has three or four demarcated areas, in which the graves were laid out in rows. The span of this phase centres on a period of about 150 years, and it might well be that the rows represent successive generations of the same descent group. The cemetery contained the remains of men, women, infants and children. There is a close similarity in the manner of the interments, the *post mortem* treatment of some corpses, and the style and range of the offerings laid with the dead.

Male burials

There are ten male burials, from very young to old individuals. Graves were deeply excavated, and far larger than was necessary to contain the coffin. The extra space was employed to accommodate ceramic vessels and other offerings. These reveal a signal departure from those of the preceding phase. There is a greater variety of forms and most were far larger than their predecessors. Several were elaborately decorated with red-painted designs. Significantly, the number of vessels is markedly larger than at any other Bronze Age site in Southeast Asia, with an average of 30 per burial. Burials 20/90, contained in the same grave, were accompanied by 73. The longest grave, that of an old male, contained 40.

The weight of ornaments was also a quantum leap over the earlier Bronze Age range, and much greater than at any other such site of similar age or cultural affiliation in Southeast Asia. All but one man wore multiple exotic marine trochus shell bangles. Burial 571 wore 53, and the average is 25. This figure would be higher if it were possible to include all the broken specimens in burials 20 and 90. Six men also wore bangles from the larger tridacna shell. They shared between them, 17 marble bangles, bangles that are very rare at other Bronze Age sites, and so precious that at Ban Na Di and Nong Nor, they were repaired up to three times with bronze ties. Shell disc beads are laborious to manufacture, and may be seen as a reflection of personal wealth. Burial 197, a mid to old man, wore nearly 10,000. The old man in burial 466 wore 6419, and the very young man in burial 443 had 1632. The average is nearly 3500. Some men also wore shell earrings.

Six of the ten men were accompanied by at least one copper-base artefact. Socketed axes in three distinct forms predominated. Of the nine recovered, three came from burial 290, a mid-aged adult. He was also buried with a tanged copper-base chisel. Three chisels, an awl and two axes had been placed with burial 197. They look like a set of wood-working tools. Copper-base ornaments were rare. Unlike Ban Na Di, Non Nok Tha and Nong Nor, there were no bangles. One young man wore 25 bells.

In terms of ritual offerings, most men were buried with bivalve shells and caches of red ochre were present in four

graves. Rituals also appear to have seen people return to at least two male burials some time after the interment. Burials 20 and 90 contained two skeletons, and each had been dismembered, and partially exhumed, before the bones were carefully replaced. The skull of burial 20 had been placed upright over the set of reinterred long bones. This was a deliberate act: the femora of burial 90 were cut with a sharp instrument. An adult whose bones cannot be sexed in burial 553 was similarly treated. While it is clearly impossible to explain this custom, these people may well have been revered ancestors whose physical remains projected *mana*. Perhaps they were joined in death, with living ceremonials, just as the Merina are in modern Malagasy (Green 1997).

Bronze Age 2: female burials

There are seven female burials. They share the same mortuary rituals and levels of wealth with the men. Again, we find graves enlarged beyond that necessary to contain a coffin, to make space for ceramic vessels. Just as was the case of burials 20-90, burials 105 and 106 shared the same large grave. They were accompanied by 88 pottery vessels of great diversity, size and quality. The average number of vessels with women is 31. Heavy shell bangles were worn by all women, the youngest having 41. Burial 105 is an old adult who was interred with 13 tridacna bangles. Three women also possessed marble bangles, and two wore shell earrings. There are some differences between men and women. The latter had more shell disc beads. The old women in burial 105 wore 19,410 as multiple strands of necklaces and belts. The average number for females is 5676. Copper-base items were confined to two axes. There are no copper-base ornaments, nor wood-working tools. In terms of ritual, we find many bivalve shells. Red ochre was almost universally present, and large quantities had been spread round the coffins of burials 105 and 106. Again we find that two people had been partially exhumed and the bones, replaced. In the case of burial 106, the feet remained undisturbed, and a rat skeleton had been laid by the instep, under a pellet bow pellet.

Bronze Age 2: infants

There are 13 infant burials. Two were foetal, two were newly born, the remainder died when between eight months and five years of age. Burial 550 was contained in a lidded jar. The infant within was aged 27-32 weeks from conception. The jar contained five ceramic vessels and a bivalve shell. The newly-born infant in burial 406, a second lidded jar burial, was accompanied by seven smaller pots. The mortuary jar and lid are very large and impressive in form. A second neonate was interred in a similar lidded vessel. The interior of the lid was painted in a complex design that might represent birth. Two small pots, a bivalve shell and red ochre had been placed within. The last jar burial contained the remains of an infant who died when aged about 9-12 months. It is remarkable for the red-painted designs that cover both the pot and its lid. Burial 469 contained a fragmentary trochus shell bangle and bones, from at least four fish. The 8-16 month-old infant in burial 532 was interred in a remarkable jar embellished with a curvilinear appliqué band in the form of an encircling snake. In early historic accounts of the Dian chiefdom in Yunnan, the snake represented rebirth. The infant was accompanied by one ceramic vessel and a bivalve shell.

The burial of the other infants in this group closely followed the rituals that attended adult men and women. Graves were invariably far larger than necessary for the body alone, and the areas beyond the feet and the head contained groups of ceramic vessels and other mortuary offerings. The average number of pots in these graves is 16, burial 468, a 3-9 month-old, having as many as 28. Shell beads were found as necklaces, and in two cases, many were found on the skull. Burial 457 had a total of 2154, and the average is 731. Burial 543 wore 10 trochus bangles and burial 302, seven. Two infants were buried with socketed copper-base axes, and five bells accompanied burial 468. Pig's limb bones were found with six of the infants, and in terms of ritual or symbolic objects, bivalve shells and red ochre were common. Burial 293 is a good example of the energy expended on these infants. The grave itself is four metres in length for the tiny body. The infant wore large tridacna shell bangles, and shell disc bead earrings. The body was covered in shell beads. Two bivalve shells were carefully positioned over the left hand. The severed foot bones of two pigs lay among the pots beyond the feet. Burial 320 likewise had beads all over the cranium and bivalve shells placed over the shoulder and feet. This infant, aged only 1-2 years at death, was accompanied by one of the most remarkable ceramic vessels from this or any other Bronze Age site in the region, covered with a painted design of a stylised human face. Burial 457 barely attained 18 months of age, but was buried with a large marble bangle, two trochus bangles, bivalve shells over the face, right hand and left shoulder and beyond the head, a large socketed copper-base axe. Several strands of shell disc beads were worn round the waist.

Ban Lum Khao BA2

The second mortuary phase at Ban Lum Khao has been equated chronologically, on the basis of the form of the ceramic vessels placed with the dead, with BA2 at Ban Non Wat. The graves were laid out in approximate rows, with the head orientated a few degrees the east of due north. There are 95 burials, incorporating men, women, infants and children.

There is a stark difference between the two cemeteries, despite the virtually identical forms of the most common ceramic vessels. The dead at Ban Non Wat were far wealthier in terms of mortuary offerings. The most pots with any person at Ban Lum Khao is 15, but at Ban Non Wat it is up to five times that number. Moreover, there is a much greater variety of forms at Ban Non Wat, and many

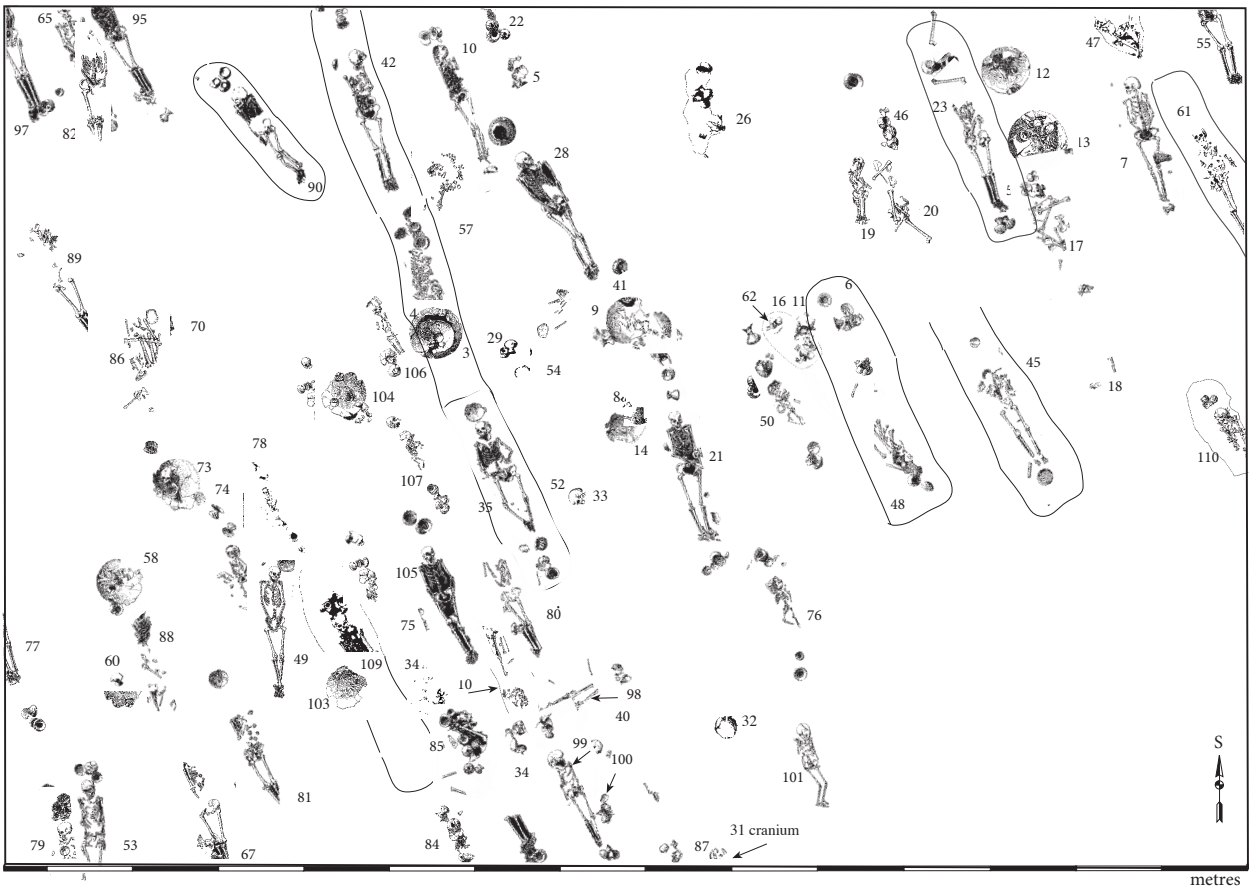


FIG. 19:3 The plan of the Bronze Age 2 cemetery at Ban Lum Khao

vessels were painted with complex designs. Just over 3,000 shell disc beads were found with the 95 individuals at Ban Lum Khao, whereas there were 74,838 with 17 adults at Ban Non Wat. Fifty-three bangles of marine shell or marble were recovered from Ban Lum Khao, against 410 for the far fewer number of adults of BA2 at Ban Non Wat. Most tellingly, where 18 copper base offerings were found at Ban Non Wat, not one was recovered from the Ban Lum Khao cemetery.

This list of differences continues. Pig bones were placed with the dead at both sites. At Ban Non Wat, 39% of burials contained pig bones, but at Ban Lum Khao, the figure falls to only 6%. The graves at Ban Non Wat were much larger, and five adults had been partially exhumed, the bones later being replaced in the grave.

These many differences have been subjected to multivariate statistical analyses to compare not only these two expressions of Bronze Age mortuary behaviour, but also with every available sample drawn from the rest of Southeast Asia. The conclusion is clear. The social group represented at Ban Non Wat during the second Bronze Age phase was far wealthier than any other comparable site.

Bronze Age 3A

Bronze Age 3A at Ban Non Wat is distinguished from its predecessor on the basis of the orientation of the grave, and the fact that wherever there is a superposition, it is always later. However, the same or very similar forms of pottery vessels continued, as did the outstanding wealth of mortuary offerings. The figures speak for themselves: Twelve adults shared 77,872 shell disc beads and 389 exotic shell or marble bangles. These and the one infant were associated with 36 copper base objects. 58% of all burials contained pig bones.

Thus, for a period of about 150-200 years, perhaps accounting for six to eight generations, the central part of Ban Non Wat served as a cemetery for outstandingly wealthy men, women, infants and children. Graves were positioned in rows. An elevated social group by definition requires a contemporary that was poor. Our excavations at Ban Non Wat included a small exposure towards the north-eastern edge of the mound and here, deep in waterlogged deposits, we encountered wooden coffins containing poor BA2 individuals. A similarly poor BA2 cemetery has been found at Ban Lum Khao. Indeed, the wealth of the early Bronze Age inhabitants at Ban Non Wat is seen in sharp relief when their mortuary ritual is compared with that of other sites in Thailand. There is no

doubt that they represent the missing dynamic of White and Pigott (1996): "a distinct, isolated area exclusively for well-endowed graves."

The number of BA 1-3A graves invite a detailed examination not just of the quantities of mortuary offerings, but the specific acts of those responsible for the interring the dead. It is held that by illuminating consistent protocols, we can isolate the intentions and ambitions of those who lived at Ban Non Wat during the early Bronze Age.

The corpse was dressed and wrapped in a shroud wearing personal items of jewellery. The disposition of the bones of some individuals, together with the survival of mineralised wood, suggest the use of coffins. Pottery vessels in several forms were carefully placed in groups, and in rows. Many still had their lids in place. Food clearly played an important role, for we find that articulating pig's limb bones predominated.

There are three forms of pottery vessel in BA1 graves. Two are round-based bowls that differ in terms of their surface decoration. One was cord impressed, the other cord impressed and red slipped. The third form is a pedestalled bowl. It is suggested that the first two conform with a food bowl, while the third could have been used as a drinking vessel or perhaps for the display of food items. The cord-marked food bowls are most abundant. All three could have contained food and drink for the deceased.

In the case of burial 572, pig's bones were found within a globular presumed food vessel placed beyond the feet and probably outside the coffin. Other round-based pots with this individual were found still face up, and it is considered likely that they were supported in some way to stop them from toppling. The burial of the two-year-old in burial 453 included spreading a layer of gastropod shells over the body but whether these covered the wooden coffin or were placed within it is not known. The pots beyond the feet and head had clearly been balanced and placed upright, and pig bones were found beyond the feet. A shell shroud covered the skeleton of burial 446, a young man. He was accompanied by fish bones as well as pots sitting upright beyond the head and feet. He virtually held a small possible food vessel in his right hand, and a pedestalled pot which could have contained liquid lay by the shoulder.

With BA2, food remains included pigs, a chicken, fish and shellfish. While it is not possible to be sure of the use to which the ceramic vessels were put, their forms suggest possible functions. These vessels were made to an exceptional standard, were often very large, and decorated with sophisticated designs. Small cord-marked vessels with a wide mouth and everted rim are described as food vessels, and these match the form of those found previously. Similar forms remain in use for this purpose in the area to this day. Some of these vessels are distinguished by their large size. The footed open bowls also match those found in BA1 graves, and these could have been used for a variety of purposes, to display food, to contain a small amount of liquid or as lids. There is also a variety of saucer-shaped vessels which could have been used for a small amount of food, or as a lid. Many are actually found in place as lids.

The complexity of BA2 male burial rituals is particularly seen in burial 20/90. The grave is large, measuring 5 by 3.5 metres. It contained two skeletons. Burial 90, a mid-adult male, had been placed centrally within the grave, while a younger man's remains were located at the north-western corner. There are 32 vessels described as fine food bowls and a similar number are thought to have contained drink.

The ceramic vessel forms found with the infants interred in graves were found in two groups, one beyond the head and the other beyond the feet. The infants were interred together with many personal ornaments, at least two copper-base axes and bivalve shells. We also find articulating pig's limb bones. Burial 468 was associated with 28 ceramic vessels, burial 302 with 23. The vessels with the infants included large and impressive items for display and it is suggested, storing and dispensing liquids. There are, as with adults of the same period, pots for drinking and eating. The finest painted design from the entire site comes from one of these infant graves. It comprises a highly stylised human face looking up from the surface of a vessel in the form of a stemmed fruit stand. The jars containing infants were also of outstanding quality and contained miniature food and drink vessels.

The burials of BA3A were laid out on a different orientation to those of BA2. In most other respects, the rituals evident from the layout of the body and the associated offerings are similar. Pig bones are found with the majority of the dead, and one woman was also accompanied by cattle bones. There were typological changes in the forms of some ceramic vessels, others remained identical. Large vessels described as liquid containers were identified usually at the head end of the grave. Small cord-marked food vessels are numerous and often found upright despite their round bases. There are also many decorated drinking vessels and the more elaborate pots of a form that suggests that they contained food. Pots that could have been used to display or receive small quantities of food, or be used as lids to seal vessels once placed in the grave, are also frequently encountered.

Female burials are just as elaborate, and followed the same mortuary tradition as those identified for men. Again, pig bones are a regular occurrence. There are several pedestalled display or serving vessels and large liquid containers. Decorated drinking vessels, small pots for display or use as lids and food vessels are abundant. Only one infant belongs to this group. It had been contained in a wooden coffin, and was richly endowed with copper-base bells on its anklets, and a series of drinking and food vessels.

BRONZE AGE AGGRANDIZERS

It is self evident that the starburst of social display seen at Ban Non Wat during the early Bronze Age requires a reconsideration of the social impact of metallurgy in Southeast Asia. In doing so, I turn to the political model as described by Hayden (2001), a model that involves the behaviour of aggrandizer individuals in transegalitarian societies (Clark and Blake 1996). An essential element in such societies is competitive emulation for status, involving differential access to resources and social distinctions based on prestige and wealth. A transegalitarian society may thus be defined as one in which social inequalities are expressed by the private ownership of rare prestige goods, and the accumulation of valuables that can be employed through such a medium as feasting to distinguish the relative wealth and status of different corporate groups within society. Social inequalities, while compatible with some heterarchic features, can be perceived archaeologically through the presence of distinctively large houses, the construction of ritual monuments or facilities, and the demonstration of wealth through mortuary indicators, particularly when adults and young are restricted to a specific burial area. Success for a particular lineage within the community turns among other factors, on charismatic leadership, wealth creation, the display of valuables in life, and the provision of debt obligations at death by the giving of opulent feasts (Owens and Hayden 1997, Dietler and Hayden 2001).

Clark and Blake (1996) have emphasised the role of aggrandizers in generating social distinctions through their pursuit of prestige and esteem. Their model of transegalitarian social change, formulated in the context of the archaeological record in the Mazatan region of coastal Mexico, incorporates ideas that are directly relevant to the present discussion. It begins with the notion that human societies include aggrandizers, those who seek renown and prestige. How can this be achieved within a single generation, and by what means might it be transferred through succeeding generations? It is certainly advantageous to live in a community that has unfettered access to others of similar standing, in a physical environment where exchange routes employing passes or river routes favour access to prestige valuables. In this respect, the inhabitants of Ban Non Wat could take advantage of the Mun River as a conduit for goods from remote sources. The flat river floodplain is well suited to rice cultivation and there is an abundant supply of salt, still used to preserve wet season fish for dry season consumption. There is then, ample opportunity for aggrandizers to accumulate valuables for competitive display and emulation. Already during the Neolithic, marine shell was being obtained through exchange.

With the Bronze Age, marble and copper were added to the list of valuables that could be used to display social prominence. And this brings one to the core of the issue. As Clark and Blake have written, "The conversion of external resources into social leverage locally requires (near) exclusive access to outside goods, material or information" (Clark and Blake 1996:19). When this monopolising of desirables is maintained, then high esteem and rank can be passed down the generations. However, the system has an inherent fragility. Failure to maintain exclusive access to wealth, and the provision of opulent ceremonials such as mortuary feasting, can negate many years, if not generations, of social endeavour. It was a case of snakes and ladders.

The issue to be addressed, is whether or not the new data from Ban Non Wat reformulate a heterarchic model by identifying aggrandizers and durable social elites. By following Hayden's (2001) political model, we can seek signals in the mortuary record for some at least, of the behaviour he identifies as reflecting aggrandizers. It is suggested that the clearest evidence lies in the weight of exotic ornaments worn by the dead during BA2 and 3A. The amount of marine shell and marble jewellery encountered is unprecedented in Southeast Asia. Again, many of these same wealthy individuals were also interred with copper-base axes, chisels, awls, bells and anklets. Given the presence in another part of Ban Non Wat, and at Ban Lum Khao, of contemporary but poor graves, I conclude that there is compelling evidence for preferential access to valuables that reflect status and achievement.

The graves of BA2 and 3A contain the severed limbs of pigs, on occasion fish remains and shellfish. The dead were also interred with many large and elegantly ornamented pottery vessels. Pottery vessels are virtually ubiquitous in Southeast Asian Bronze Age burials, but the number and size of those involved at Ban Non Wat reflect particularly lavish mortuary rituals including opulent feasts. As Hayden (2001, 2009) has pointed out, the mortuary feasts are a means of demonstrating social prowess, and provisioning them requires the accumulation and deployment of food surpluses that in their turn, establish ties with elites from other communities while at the same time creating reciprocal debts. The degree to which such debts can be repaid is a clear measure of social relativities.

Investment in children is a further avenue whereby aggrandizers can achieve their ambitions. Ceremonial feasting during rites of passage is a means of ensuring successful and profitable affinal relationships. While such activities are beyond archaeological visibility, the treatment of infants, children and the young at death is graphically seen in their graves. One of the most arresting aspects of excavating BA2 and 3A contexts at Ban Non Wat, was to trace the outline of a grave larger than necessary to contain an adult, and find within, the remains of an infant barely a year old accompanied by a copper-base axe, hundreds of shell beads and 20 pottery vessels. All infants during the early Bronze Age were interred with multiple prestige items. The same situation is found with young men and women. It is worth considering for a mo-

ment, the labour that would have been necessary for the manufacture of over 23,000 shell disc beads found with one woman, or the 65 trochus shell bangles found with a BA3A man. One man in BA2 was accompanied by three socketed copper-base axes. This wealth is seen as the result of the conversion of surpluses into prestige items.

Aggrandizers, again following Hayden, commonly lay claim to direct communication with influential and revered community ancestors. This might assist our understanding of a singular characteristic of the BA2 cemetery: five adults had been interred with rich and intense rituals, only for their bones to be exhumed at a later date before being placed back in the grave. This was a deliberate and carefully executed social act. Burials 20 and 90 were both men who shared a particularly large grave. Cut marks on the femora of the latter indicate that the body from the knees to the head was taken from the grave without disturbing the surrounding pottery vessels. In the case of burial 20, while part of the body remained undisturbed the head and major limb bones had been removed, again without toppling the adjacent pots, and then neatly replaced with the head on the top of a stack of bones looking eastwards. Such exhumation is restricted to the particularly rich BA2 people. While speculative, it is suggested that this practice might have involved taking ancestral remains to participate in further rituals, thereby exhibiting the aggrandizers' special esoteric power. In terms of the actual layout of the BA2 and 3 cemeteries at Ban Non Wat, the considerable area uncovered has allowed us to trace their boundaries. This reveals beyond any reasonable doubt, a reserved area for a wealthy corporate group or lineage. Again, the reservation of such an area for their own members is a widely identified aspect of aggrandizer lineages.

The mortuary evidence at Ban Non Wat is extensive and compelling, but the area and internal structure of the settlement remains fugitive and under investigation. Evidence for bronze casting at Ban Non Wat has been identified on the basis of crucibles, moulds and furnaces (Cawte 2008). Over 400 fragmentary moulds, predominantly of clay but also of sandstone, have been identified, as well as 29 complete clay moulds for casting axes and bangles from burial 549 (BA4). Six hundred and sixty-four crucible fragments have also been recovered. Two areas in the site appear to have been employed in casting bronzes, given the local concentration of moulds, crucibles and fragments of bronze. In his exhaustive study of the Ban Non Wat bronze industry, Cawte (2008) has sought evidence for the presence there of either independent specialists, or a workshop in which attached specialists worked under the control of a social elite. This is not straightforward, because over the 500 years involved, there might have been changes in organisation not visible due to the nature of the site's stratigraphy. Layers encompassing the Bronze Age, were disturbed by mortuary activity, and assigning an assemblage of moulds or crucibles to any given phase of the Bronze Age is not always possible. It is, however, noted that there are fewer moulds and crucibles in the earlier than in the later Bronze Age contexts.

While one cannot rule out the presence of a bronze workshop maintained under the control of a social elite somewhere on this site, the weight of evidence rather suggests that bronze founders worked independently within a technical tradition replicated at other Northeast Thai sites such as Non Nok Tha and Ban Na Di. Known copper sources are some distance from Ban Non Wat. Present evidence favours exchange in ingots of copper which were then liquefied and cast in the consumer settlements. These ingots might have arrived as the property of an independent and itinerant specialist, whose output during BA1-3A was commandeered by the elite. On the other hand, an elite might have controlled the exchange in exotic items, such as copper, marine shell and marble, and made ingots available to itinerant specialists to produce to their requirements. Finally, there might have been resident specialists who undertook castings at the behest of the elite. There is some early evidence from the detailed analyses being undertaken to order these alternatives in terms of plausibility. Pryce (pers. comm.) has found that the BA2 axes were made from unalloyed copper. However, Cawte (2007), in his study of the crucibles, had concluded that they were used to cast a copper-tin alloy. It is thus possible that the BA2 items were imported ready made from an exotic source, and bronze founders were present only with BA4, validated by the presence of the grave of a bronze founder.

Whichever the case, the first evidence for copper at Ban Non Wat was coincident with the formation of demarcated sets of outstandingly rich burials that endured for at least two centuries. Rituals were complex. The graves were deep and large. They contained wooden coffins containing shrouded corpses covered in exotic valuables: copper-base anklets and bells, bangles and earrings of marine shell and marble as well as thousands of shell disc beads. There are copper-base axes, awls and chisels. Ceramic vessels were embellished with complex, possibly symbolic, painted designs.

I suggest that the recurrent evidence for the inclusion of animal bones at Ban Non Wat, taken in conjunction with the careful placement of pottery vessels reflects mortuary feasting. This remains a widespread practice in Southeast Asia to this day, and its implications have been explored by Hayden (2009). His findings provide insight into why this rite of passage is invested with such social importance. Thus, the open display of wealth, the accumulation and giving of food, and the immolation of valuables, are a measure of social attainment for the sponsoring social group. The act of giving creates debt obligations from those receiving. Lack of reciprocity in the fullness of time, means a commensurate loss of prestige and respect. The social linkages created through giving and receiving provide for alliances between elites in contributing communi-

ties. They facilitate access to exchange routes for prestige goods, and for restricted social transactions, such as the formation of affinal relationships. Again, the provision of opulent feasts and attendant display requires the accumulation of wealth items, such as special food, marble or marine shell ornaments and copper. Is it coincidental that the appearance of copper-base axes came just as an elite lineage occupied centre stage at Ban Non Wat? I suggest that the novelty, probably the rarity and certainly the desirability of owning and displaying bronzes contributed significantly to the rise of social elites.

It is concluded that during the 11th century BC, aggrandizers in the upper Mun Valley began actively to seek prestige and status through controlling and deploying exotic materials and knowledge for social advantage. They were interred with a great weight of exotic ornaments. Even some of their infants were accompanied by copper-base axes. Their graves contained splendid decorated ceramic vessels of forms suited to displaying, distributing and consuming food and drink. The severed limbs of pigs were also placed with the dead. Such competitive emulation recalls the provision of ostentatious mortuary feasting described for the Toraja by Volkman (1985).

Bronze Age 3B

Bronze Age 3B graves lie to the south of those ascribed to phase 3A. In one instance, a 3B grave overlies a 3A burial. That they lie immediately adjacent to 3A burials, and on the same orientation, suggests that they might be slightly later, and a continuation of a cemetery for the same descent group. On the other hand, one cannot rule out entirely, the possibility that they were contemporary. The burials of BA3B are markedly poorer in terms of mortuary offerings.

While the nature of the grave goods persisted, the quantities plummeted. A single copper-base bell was found from the 14 adult and six infant or child graves. Just over six ceramic vessels were found on average with the adults, the figure falling to 3.1 for the young individuals. Thirteen BA3A adults provided 19 marble bangles, whereas 14 3B adults had only two. There was a massive decline in the quantities of shell disc beads. Burial 262 of BA3A wore over 23,000. If one excluded the individual in 3B with 3941 such beads, the average for 3B adults is 23, while an average of 15 disc beads were found in infant or child graves. On average, 32 marine shell trochus bangles were found with each BA3A adult. One individual from BA3B wore 56 of these ornaments, but the average for all the other adults is 1.7. Only one such bangle was found with the 3B infants. Ear ornaments, stone beads and ear pendants are absent from 3B graves.

It is noted, however, that three BA3B individuals stand out from their contemporaries. Thus burial 615 wore 56 trochus bangles. The older man in burial 431 had 12 trochus bangles and 294 long shell beads, while a mid adult woman in burial 635 wore 3941 shell disc beads. This fairly small variation in wealth is similar to that seen in some other Bronze Age cemeteries, such as Non Nok Tha and Ban Na Di.

Bronze Age 4

With BA 4, we encounter a series of graves that cover the entire excavated area of the main square at Ban Non Wat. This is the only site we have excavated that has yielded remains of this phase. At some other Bronze Age cemeteries in Thailand, it has been noted that graves tend to lie in rows. Whereas there is some evidence for similar rows in the fourth phase of the Bronze Age at Ban Non Wat, there are also several cases where burials were situated head to toe, to form columns.

It is suggested that there might be five groups based on the clustering of burials, labelled from A to E. Group A is located at the northern end of the excavated area. It incorporates 11 adult men, 13 women and 11 infants or children aged between newly born and 10 years old at death. This composition, with about 30% infants or children, suggests that it represents a viable social unit. There is no recurrent link between the location of a man and a woman that could indicate an affinal relationship. In two cases, two or three men seem to have clustered together. There is also a pattern of interring the dead head to toe, that might reflect successive generations of the same social group. In one case, a woman, a child, a man and a further child were interred in this manner. In another part of the area of group A, a woman was found with three infant graves beyond her feet, and three more to her right. No part of area A was restricted to the infants: they were found in proximity to adults of both sexes.

The protocol for this group was to dig a grave large enough to receive the body, probably within a coffin, with space reserved beyond the head and feet for a group of ceramic vessels. The average number of pots for each man is just over 9, but the range is from 2 to 21. A common practice was to place a large and distinctive form 6 vessel in an elevated location at the head of the grave. There were nine other forms with men, which were on the basis of form and surface finish, clearly derived from Bronze Age 2 and 3 antecedents, but with changed contours. Thus the thin-waisted and trumpet rims of the BA2 and 3A form 10 and 12 pots became shorter and broader. The form 6 pots are commonly found in group A but very rare or absent in the other BA4 burials.

Compared with Bronze Age 2 and 3A, the men in this group were interred with modest mortuary wealth. No marble bangles were found. One man wore a single trochus shell bangle, and another had four. Shell disc beads were rare, with an average of only 20 per person. Three individuals were accompanied by a bivalve shell.

There are 13 complete or relatively intact female graves in group A. We find a similar structure of burial to the men: a grave that contained the coffin together with pots placed beyond the head and feet. Again, the women were

modestly accompanied by offerings compared with their ancestors. The most pots with any burial is 14, with an average of five. While one woman wore 30 trochus bangles and another had 19, the average is only 4.5. The average number of shell disc beads is 44, with a maximum of 230. No marble bangles were found. The presence of bronze is equivocal. A fragment of a copper-base bangle might have been associated with burial 89, while a piece of bronze was found beside the head of burial 22.

The infants and children in group A provide an intriguing pattern. Those inhumed were found in a supine position with pots arrayed beyond the head and feet. The youngest, a newly-born infant, was buried in a large ceramic vessel that contained two small pots, red ochre, a bivalve shell and shell beads. The impression gained during the excavation was that red ochre and bivalve shells were symbolic of rebirth. Seven of the 11 infants found in group A had such mortuary offerings, a higher fraction than for the adults.

Burials of group C form a block in the central part of the excavated area, in which columns of head-to-toe graves are a feature, within which the dead were placed alongside each other. It is considered highly likely that groups A and C are in fact the same and could well be coalesced, because it would only take one or two intervening graves to link them. As with group A, men are on occasion interred next to women, and young people adjacent to either men or women. That there is some biological coherence to this group is suggested by the presence of seven men and ten women, along with eight infants or children.

These people were not wealthy in terms of mortuary offerings. The men were accompanied by six ceramic vessels on average, with a range of four to 11. The average for women is 4.5 such vessels, ranging from none to 11. There were six marble bangles among the adults, three with men, and the same number with women. One man wore seven trochus shell bangles, while a woman had 26, and another just one. Shell disc beads, so abundant during the preceding two phases of the Bronze Age, were very rare, varying between none and 15 for men, with an average of 5.6, and none and 15 for women, with an average of 3. Even some of these might have been there fortuitously. One man and two women were accompanied by pig's foot bones, and bivalve shells were found with one man and one woman. Four individuals had been buried with pieces of red ochre, three males and one female. One burial stands out. The young to mid-aged man in burial 549 was interred with 29 clay moulds, for casting socketed axes and bangles. It is highly likely that he was a specialist bronze founder. Yet his other grave goods were poor, comprising four pots, some red ochre and a clay pellet. Moreover, no person in this group was accompanied by a copper-base artefact. Infants were also relatively poor, especially when compared with their predecessors during Bronze Age 2 and 3A. Associated pottery vessels numbered between 0-6 with an average of 2.9. Two were buried with pig bones, and two others with red ochre.

The burials assigned to group B of the fourth phase of the Bronze Age appear to form a discrete group in the south-western part of the excavated area. There are 13 males, 10 females and five infants or children, all interred on the same axis with the head orientated to the north-west. The ratio of infants and children to adults is 21%. These graves were poorly-endowed with offerings. For the men, there was an average of 5.2 ceramic vessels, with a maximum of 15. These were generally placed in groups beyond the head and the feet. Women had an average of 5.1 vessels, numbers ranging from 1-13. Only three marble bangles were present with men and there were none with women. Twenty-three trochus shell bangles were found with men, the most with any individual being 11. However, one woman wore 46 trochus shell bangles and another, 17. Shell disc beads were very rare when compared with Bronze Age 2 and 3A, there being only 40 with men, and 39 with women. One person aged about 15 years at death, however, wore 858 such beads and 55 were associated with the infants. Pig bones were found only with men and the 15-year old, and only five bivalve shell were recovered from all the graves. One infant might have been interred wearing a single copper-base bell.

Group D comprises the graves of three men, eight women and 12 infants. Again, the group as a whole was not wealthy in terms of mortuary offerings. Eight pottery vessels were found with the men, and one wore 10 trochus shell bangles. One man wore 470 of the 554 shell disc beads found in association. The eight females were associated with 35 pottery vessels, 11 being the most with any one individual. There were also three marble bangles and five of trochus shell. Shell disc beads were notably rare, one person having 193 of the 197 recovered. Thirty pots were found with the 12 infants, together with 409 shell disc beads. The presence of red and grey deposits of clay might presage the transition to Bronze Age 5. This is supported by the copper-base arrowhead with burial 414, which is similar in form to two found with Bronze Age 5 burial 215.

Group E is located in the northeastern part of the excavated area. There are seven men, three women and eight infants aged from newly born to nine years at death. The members of this group are decidedly poor. The average number of ceramic vessels with adults is only three. Just six shell bangles and 69 shell disc beads were associated with these people. Infants were slightly better endowed. There is an average of three ceramic vessels, but also a marble bangle and 238 disc beads.

There was thus a sharp fall in the mortuary wealth at Ban Non Wat at the transition from BA3A to 3B that demands explanation. It is first stressed that only a small fraction of this site has been excavated, and we do not know what the rest contains. Thus, the relative poverty of the later Bronze Age at Ban Non Wat might well be illusory. Perhaps another social group at the site assumed

social prominence, and their cemetery awaits discovery. Again, each Bronze Age settlement in the upper Mun Valley might have harboured a dominant social group initially, with a levelling of the need to display prominence as copper and tin production surged and their rarity diminished.

Irrespective of how future research unfolds, at least one site has now revealed a sustained period of great wealth and ritual complexity with the initial Bronze Age. It is conceivable that these aristocrats held the reins of power, and controlled the ownership of valuables that symbolised high status. This is unlikely to have been a unique event across the many Bronze Age settlements that remain to be identified in the Mun Valley. These leaders might, briefly, have come close to establishing a sustained heritable hierarchy that exercised political power and economic control. However, I revert to my suggestion of 1989, that the attainment of high status was then flexible rather than fixed (Higham 1996). At Ban Non Wat, we see that elite status reached a far higher degree of expression than hitherto realised, and was achieved by successive generations over a period of nearly two centuries. But it remained flexible within a system in which a lack of elite dominance over production did not negate restricted and privileged access to exotic symbols of status. The dazzling wealth of the early Bronze Age was followed by a decline in mortuary display. Why did the mortuary rituals for this lineage become so much the poorer with BA3B and 4?

Answering this question is for the future and at present, hypotheses must suffice. A major objective in modern feasting is to attract allies in the event of a social setback, a lineage disaster according to Hayden. This might result from crop failure, illness and disease, accusations of sorcery, or the lack of charismatic individuals to lead. There is no guarantee of social success, and a sudden falling away in social prestige is never far away. Again, Clark and Blake stress that it takes special circumstances for a lineage of aggrandizers to achieve permanent elite status. A slackening of control over symbols of status, the development of new trade routes, success through charismatic leadership of a rival group, crop failure, all singly or in conjunction, can spell disaster.

It is possible, therefore, that our lineage during Bronze Age 2-3A attained an elite status, but then fell from favour with the rise of another. It is equally possible, that the prestige and wealth of this community as a whole waned under the competitive pressures inherent in Bronze Age society. But what, in fact, happened during BA3B-4? Wealth displayed in death rituals certainly fell away, but the procedure remained the same: marble and marine shell were still available albeit in reduced quantities. Pottery vessels for food and drink were still placed in the graves. Pigs' limbs accompanied the dead. Despite the presence of a man interred with multiple clay moulds for casting bangles and anklets, bronzes were now vanishingly rare.

Bronze Age 5

Bronze Age 5 is defined on the basis of two criteria. The ceramic vessels found in these graves, while retaining the earlier preference for a cord-marked lower body and a red slipped upper part, were distinguished by form. There was a preference for much larger open bowls, large globular vessels with a small everted rim, and pots with cylindrical rather than flared necks. Burials containing such vessels congregate in the centre of the excavated area, and invariably overlie those ascribed to BA4.

There are 25 adult burials in this group and four infants. This represents a sharp fall in infant mortality, assuming that all members of this community were interred in the same cemetery. The basic mortuary tradition continued, with the grave orientated on an approximate north to south axis, although in some cases, the body faced to the south rather than to the north. One hundred and six pots were found with the adults, an average of just over four each. The most with any burial was ten. These were now ranged round the head, and in some cases, over the upper body. Few were placed beyond the feet. Another innovation was the placement beyond the head of spindle whorls and grey clay. Ten adults were accompanied by the former, and six with the latter. Five of those with the clay were also buried with the spindle whorls. Clay can be used to dye cloth, and spindle whorls are used to process a raw material into a filament for weaving. There is a strong likelihood that this community developed a special interest in the production of cloth. With the advent of the historic period in Southeast Asia, we find that cloth was an important item for production, trade and the creation of wealth.

Shell ornaments declined steeply. The average number of beads for each adult is just 13, with a maximum of 295. There are two shell bangles. Marble disappeared in mortuary contexts. Unlike the immediately succeeding Iron Age, bronze ornaments were absent and from all the burials of this phase, only two bronze arrowheads were found.

However, we find that pig's limbs, cattle bones and fish were placed with the dead. Fish skeletons were to assume considerable prominence during the Iron Age, often filling pots placed with the dead. It is considered likely that the long tradition of mortuary feasting that such offerings surely reflect, was maintained and possibly increased during Bronze Age 5.

The four children in this group ranged in age from 2-11 years of age at death. They were accompanied by an average of 2.5 pots each, but this might increase slightly if all were found intact. Two were buried with spindle whorls, and one with pig's limb bones.

The third mortuary phase at Ban Lum Khao presents a virtual carbon copy to BA5 at Ban Non Wat. The pottery vessels are indistinguishable in form between the two sites. We find the dead associated with spindle whorls and clay. Complete fish skeletons and the articulating foot bones

of pigs were placed in the graves. Again, ornaments were rare, just 11 shell beads were found with a two-year old. No bronze was encountered.

If the two exposures of late Bronze Age cemeteries are typical of the upper Mun Valley sequence as a whole, then there is no evidence in the treatment of the dead for the existence of the social elites that so dominated the area three centuries earlier. The impression is rather of a society in which all individuals marched at ground level. The principal development was the association of spindle whorls and grey clay with the deceased, as if in both sites, the production of yarn and subsequently, the weaving of cloth were seen as important activities. That there was still an element of feasting during the rituals of death is seen in the regular association of pig bones in graves, and the placement of pottery vessels containing whole fish.

However, these sites are very large and the excavated areas are small. Only future research can reveal whether or not, elsewhere in these settlements, there are areas set aside for the burial of aggrandizer elites of the terminal Bronze Age.

THE IRON AGE

The importance of the horizontal stratigraphy that characterizes the transition into the Iron Age in the Ban Non Wat cemetery lies in the fact that it illuminates the cultural changes that took place as iron working was introduced. We find that there was no evidence for sudden or dramatic change. To this background, we find that while the basic ritual, orientation of the graves and mortuary goods continued into Iron Age 1, there was a new range of offerings. These included iron weaponry, tools and ornaments, together with rare ornaments of glass, agate and carnelian. There were more bronzes than during the later Bronze Age, with demanding lost wax castings of bangles and anklets, and bronze sockets to iron bladed spears. The practice of placing complete fish in pottery vessels continued, and there are also the limb bones of domestic water buffalo and cattle. Pig limbs were encountered often, and in two cases, an entire pig had been placed with the deceased. This, in conjunction with the presence of butchering floors, suggests that mortuary feasting continued, some of the food being consigned to the dead during the burial ceremonies.

In this context, it is noted that the animals represented on the butchering floors correspond to those recovered from the Iron Age burials. Domestic water buffaloes, pigs and cattle are present with the buffaloes particularly prevalent on the butchering floor in square D9.

It is not possible to relate this large mortuary assemblage with the earliest Iron Age burials at Noen U-Loke where only a handful of graves were uncovered, none having glass, carnelian or agate ornaments. However, they did include iron ornaments and spears, bronze bangles and neck rings, similar pots, fish and pig limbs.

The course of events following the early expression of the Iron Age at Ban Non Wat are best traced at Noen U-Loke. In the second phase there, we encounter the first glass, agate and carnelian ornaments, and a proliferation of complex bronze castings. The interment of the dead in a grave filled with burnt rice was a major change in the rituals of death. Even a newly-born infant was found covered in rice within a mortuary vessel. This rise in the complexity of burials and the range of offerings reached its climax in the following phase, when the graves were not only filled with rice, but also lined and capped with clay. The quantity of bronze ornaments was now unprecedented before or after at this or any other known site in the region. One man was interred with 150 bronze bangles, three belts with sophisticated clasps, 61 finger rings some with spiral embellishments and four toe rings. He also wore ear lobe inserts of silver and gold. This surge in ornamental bronzes harmonises with the contemporary rise of output in the main production centres in the Khao Wong Prachan valley and the recently identified Iron Age copper mining complex at Sepon in Laos. It was also during IA3 and 4, that the moats and banks were constructed. The rise of elite individuals, as represented by the outstandingly rich men and women of Iron Age 3, dovetails neatly with the social organization of labour that would have been involved in the construction of these water control measures

The final mortuary phase is represented at all three sites. We find rich infants interred in lidded ceramic vessels, the presence of iron sickles, a rise in the number of iron points, and in one case, a young man who had been killed when an iron arrow severed his spinal column. Although the quantity of exotic ornaments declined from its previous heights, there remained an impressive quantity of bronzes, glass and agate beads and pendants.

These moated sites clearly harboured in the later Iron Age, individuals of considerable wealth and status. They were also centres for the production of cloth, iron tools, the casting of bronzes and the manufacture of very high quality Phimai Black pottery vessels. The many small mounds that surround the moated centres evidence the production of salt. The moats themselves could have been multi-purpose (Higham 2011). Boyd (2007) has suggested that the later Iron Age was a period of increasing dryness. The sites were preferentially located next to stream channels, and the construction of banks permitted water to be controlled and retained in the immediate surrounds of each settlement. Water is essential to life in the dry season of Northeast Thailand. The broad moats not only assured the water supply, but also augmented the availability of fish and shellfish. They would also have been at least a deterrent to surprise attacks from rival groups. The presence of iron weaponry leaves little doubt that conflict was on the rise, although the evidence is not as clear cut as for the contemporary site of Phum Snay in northern Cambodia, where the many skeletons discarded by looters bear the

scars of fighting (O'Reilly 2010).

Appreciating the deep-seated cultural changes that took place with the advent of the Iron Age in the Mun Valley, and on a wider focus, in Southeast Asia as a whole, can be more intimately appreciated by referring to cases in the more recent past, where new exchange contacts were established. Brenner (1988), for example, has described the impact of European settlement in New England in the 17th century, on the native Americans. Essentially, the presence of exotic new settlers presented the indigenous peoples with opportunities to acquire a new range of prestige goods, to develop new trading relations, gain access to new forms of weaponry and engage in new forms of economic activity. Traditionally, ownership of *wampum*, sacred white shell beads, was used to project wealth and status. To this could now be added beads of glass, iron weaponry, brass ornaments, European clothing and many other novel and desirable objects. These combined to create stress and instability as the new opportunities were sought by leaders and they competed for elevated status, authority and power. We encounter, in their burial grounds, clear evidence for the deployment of the new status symbols in the rituals of death. Thus, the successful new aggrandizers were interred with large quantities of shell and glass beads, ornamental rings, iron weapons and even boxes to contain trinkets and desirable objects such as keys.

Such changes have been seen in other instances of new cultural contacts. Alpers (1969), for example, noted how coastal trade stimulated the rise of powerful male leaders in Malawi. Again, it was the control of access to coastal trade that allowed ambitious inland men to rise rapidly in wealth and power through their ownership of exotic valuables, and ability through distributing some, to attract supporters and followers. Ekholm has echoed these developments in the context of Central Africa. Here, we find that in her words "power relations are established, consolidated and maintained through the control of prestige articles" (Ekholm 1977:119). These included salt, copper and shells.

It is therefore possible to integrate a series of factors in the Mun Valley that would have encouraged a sharp rise in social complexity as well as increased stress caused by competition. These include the introduction of a new range of desirable but exotic valuables control of which would have conferred increased social standing: gold, silver, iron, carnelian, glass and agate. There was the potential to concentrate wealth through the production and exchange of salt, rice, domestic water buffaloes, pigs, cloth and fine ceramics. Competition over valued or scarce resources can be inferred from their selective presence in elite graves. The concentration of sites in the best agricultural land and strategic riverine trade routes likewise would have fostered competition, and increasing conflict would have encouraged investment in leadership. However, the final phase saw a marked decline in the wealth placed with the dead, and an end to the tight nucleation of graves in what were surely kin groups. Talbot (2007) has suggested that by this period, social stress and competition within this settlement might have subsided and with it, the need to advertise status so overtly. This possibility must be considered relative to the chronological span of 400-600 AD for IA4, for this was the period within which early states were forming in the Mun River Valley.

THE IRON AGE: FUNAN AND CHENLA

The archaeological landscape of the Iron Age in Southeast Asia has been transformed by the results of recent research in Peninsular Thailand. At the large port settlement of Khao Sam Kaeo, excavations have revealed the early impact of a maritime trading network that linked China, Southeast Asia and India, beyond to the Mediterranean world (Bellina 2001, 2002, 2007, Bellina and Silapanth 2006, Bellina-Pryce and Silapanth 2006). This site flourished during the 4th-2nd centuries BC, that is contemporary with IA1-2 in the upper Mun Valley.

Khao Sam Kaeo was a hive of industrial activity. One of the hallmarks of the Iron Age in Thailand, was the growing popularity of hard stone beads, particularly those made from carnelian and agate. The long history of such bead making in India has provided a false trail, for it has been assumed that these beads, when they appear in Iron Age contexts, represent long distance trade with South Asian sources. In a detailed analysis of their shape and manufacturing techniques, however, Bellina has convincingly demonstrated that as with glass, the Thai carnelians are distinguishable from their Indian counterparts (Bellina 2001; 2007). Local elites, she has suggested, had their own preferences and the market satisfied them. Actually making carnelian beads is no easy task. The stone measures 6.5 on the Mohs scale for hardness, and the stages in shaping, polishing and boring a hole for suspension take a long apprenticeship to master. There is, therefore, a strong likelihood that Indian craftspeople were involved at Khao Sam Kaeo in establishing the site as a production centre.

The same Indian craftspeople may have also influenced glass bead production at Khao Sam Kaeo as one of the peculiarities of this site in terms of glass material is the presence of beads shaped with techniques used for stone ornaments. At least two areas in the site comprised workshops for manufacturing glass ornaments. Hitherto, the discovery of glass in Iron Age Thai sites was seen as evidence for trade with India. But at Khao Sam Kaeo, it is possible that Indian techniques of glass bead and bracelet production were established locally. The sudden establishment of glass working facilities suggests that specialists came to Khao Sam Kaeo, and their only logical point of departure is India, but further research is needed before this can be confirmed. The chemical composition of the glass confirms this point, for there are very few specimens with an Indian signature. Indeed, by examining beads from other sites, it seems that some of the Khao Sam Kaeo

production found its way into Vietnamese and other Thai sites (Lankton *et al.* 2006).

Khao Sam Kaeo was also a focus for metal production (Pryce *et al.* 2006). The iron forges concentrated in particular areas, and much evidence for smithing has been identified on Hill 3. By at least the mid third century BC, the smiths were fashioning spears, chisels, knives and arrowheads just as their contemporaries were doing in Central and Northeast Thailand.

The establishment of coastal entrepot ports where emerging elites attracted and patronised foreign craft specialists presents the conditions for rapid and pervasive social change. While this had its earliest expression in such favoured coastal sites as Khao Sam Kaeo, it also provided a new range of exotic imports for inland communities, such as those of the upper Mun Valley. Therefore, it is hardly surprising that when a Chinese mission came to Southeast Asia in the third century AD, they encountered large coastal settlements whose rulers had the title *fan*, who administered a taxation system, had learned the rudiments of writing an Indian script, and whose settlements incorporated craft specialists skilled in the manufacture of jewellery. They called this polity, which was probably located just north of the Mekong Delta, Funan. When, in the mid 6th century, the number of Chinese trade missions visiting Southeast Asia declined markedly, Funan too lost its source of wealth, and a series of chiefdoms in the interior began to seek a place in the sun, now based more on agrarian wealth than foreign trade. These the Chinese texts name Chenla, and they date from AD 550-802. The Iron Age in the Mun Valley cannot be properly interpreted without relating its sequence to Khao Sam Kaeo, Funan and Chenla. Iron 1 and 2 were contemporary with Khao Sam Kaeo, while IA 3-4 developed during the periods of Funan and early Chenla.

EARLY CHIEFDOMS

Iron Age 3-4 in the Mun Valley have been dated between AD 200-600, a span which overlaps that of the period in Cambodia and Northeast Thailand known as Funan and Chenla. Both are illuminated by a series of texts inscribed on stone in Khmer and Sanskrit languages. Their subject matter resonates with the archaeological record of the late Iron Age, for essentially, we are dealing with the same people separated by little more than a century.

Rice production and land tenure are central issues, and these are linked with the presence of reservoirs and water control. Land boundaries were often defined by the location of *travan*, that is, reservoirs. Occupational groups included spinners, and weavers of several different types of cloth (Jacob 1979). There were also herdsmen, rice field workers, leaf sewers, grinders, musicians, singers, basket makers and cooks. There is mention of iron, copper, gold, silver, bracelets, and decorative bands worn round the waist. Areas relevant to agriculture include fields prepared by burning, pasture land, an enclosure for animals, and ricefields. It is through such terms that the late Iron Age of the Mun Valley emerges into early history.

Vickery (1998) has exhaustively analysed the approximately 230 available texts, presenting a radically different perspective on the foundation of first chiefdoms and then early states to that which has traditionally stressed the seminal importance of Indic influence. An early and particularly important inscription from the vicinity of Wat Phu does not include a date, but belongs stylistically to the late 5th century AD, a context that corresponds with the late Iron Age in the Mun Valley as a whole. Wat Phu is a strategic location near the confluence of the Mekong and Mun rivers, and one which was to play an important role in the history of the Angkorian kingdom due to the dominant presence there of a mountain with a natural *linga* on the summit. The text refers to Devanika, who is described as a *maharajadhiraja*, or supreme king of kings, who having won innumerable victories, came from afar to found a kingdom and offered rich tributes to his temple foundation (Higham 2004b).

Between AD 550-600, we can trace through a series of brief inscriptions, military incursions up the course of the Mun River as far west as our study area, by Bhavavarman and his brother, Citrasena-Mahendravarman. This was clearly a period of territorial expansion by ambitious leaders.

Most of these leaders during the early Chenla period were known as *pon*, but over time a range of Sanskrit royal titles were adopted. The terms *pon* and *fan*, the latter found in early Chinese records describing the leaders of Funan, are surely the same. In the inscriptions, *pon* were usually associated with a community commanding a reservoir. They are indications that their status was augmented by descent from an ancestor deity. He owned ricefields, and had the right to assign land to followers. It is evident that surpluses of rice and cloth were accumulated by *pon*, who could then exchange prestige valuables with their contemporaries. The community temple was a vehicle for economic transactions and the deployment of surpluses. It was served by women who were probably of high status themselves and related to the *pon*.

The texts also indicate that the *pon* exercised control over labour. There was a group known as *knum*, a word cognate with the modern Khmer word for slave, and some have seen Chenla society as incorporating slave workers. Vickery, however, prefers to translate the word as a social junior. And in these rare and informative texts, we find them labouring in the rice fields, herding cattle and water buffaloes, and forging iron. They were spinning and weaving, sewing leaves for house walls or roofing and casting metal. These activities generated the surpluses that the *pon* used for hospitality, assigned to the temple, or used as prestige items to exchange with other leaders. The characteristics that emerge from the surviving texts are a remarkable reflection of the principal techniques identified

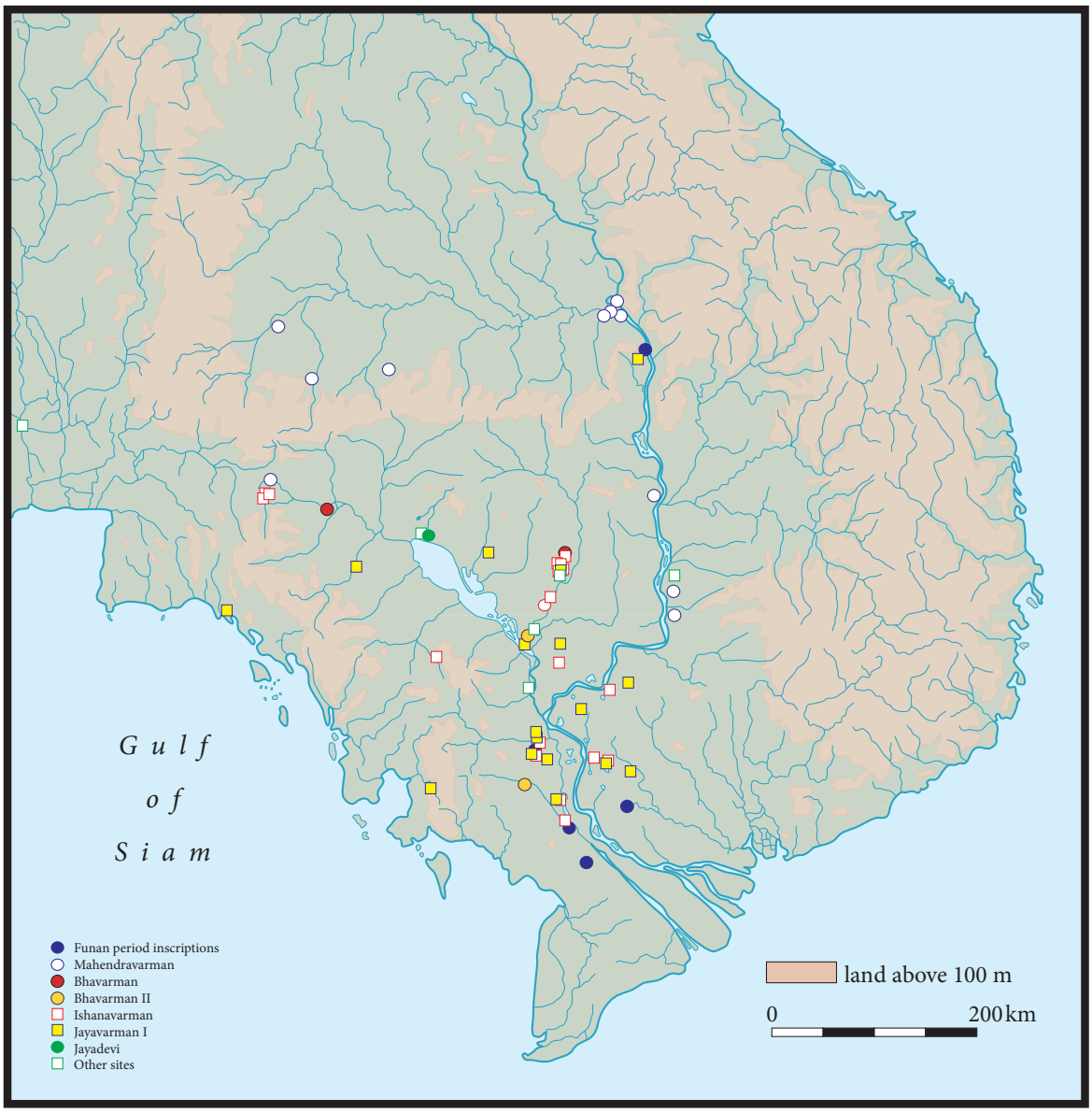


Fig. 19:4 The distribution of inscriptions dating to the period of Chenla (AD 550-802)

by Hayden and Villeneuve (2010) in the role of aggrandizers fostering social change. Particular significance is attached to self-serving role of ideology. Claiming descent from deified ancestors gave aggrandizers the leverage to control land ownership, and the manipulation of surpluses to their own advantage.

The texts add a historic veneer to Iron Age 3-4 at Noen U-Loke, Non Muang Kao and Ban Non Wat. The archaeological record for the first six centuries AD reveals with considerable clarity, the presence of demarcated sets of graves with varying wealth. Take, for example, clusters A-D at Noen U-Loke. Here we find men wearing bronze belts, multiple bronze ornaments, gold, silver and agate ornaments. Cluster A included an elite woman wearing gold, silver and agate jewellery. Yet cluster B people were markedly poorer, save for the presence of many spindle whorls. Significantly, one man was interred with a heavy socketed iron spade at the same time as we find earthworks being constructed round settlements to retain water. Rice played a prominent part in mortuary rituals, and at the edge of the site, there was a pound or enclosure to secure domestic cattle and water buffaloes. Rivalry between these communities, whose large settlements shared the same watercourses and were concentrated cheek by jowl in an area noted for its rich deposits of salt, engendered conflict. All these factors, I argue, are symptomatic of what we might term a proto-*pon* society. Indeed, one could go a stage further and argue that *pon* were established and flourishing in the Mun Valley during IA 3-4. By establishing this thread linking pre- and protohistory, we can trace the prehistoric foundations of the civilization of Angkor itself.



FIG. 19:5 A chief or early king, perhaps Isanavarman himself, looks out from his palace depicted on one of the temples at Isanapura

CHENLA: AD 550-802

We have reached the point where the Mun Valley and by inference, much of lowland Cambodia was populated by large and often moated settlements that harboured wealthy elites. The increasing frequency of iron weaponry in their graves suggests a competitive social milieu. Flannery (1999) has succinctly distilled a set of behavioural changes that encourage the transition from competing chiefdoms into states under such circumstances, which he divides into agency and process. We have already identified the presence of Bronze Age aggrandizers, and agree with Flannery's conclusion that "Aggressive human agents are born in all cultures in all epochs" (Flannery 1999). To illustrate test cases, he identifies five examples of human agency in the rapid development of an early state, from Shaka and Andrianimpoinimerina in Africa to Kamehameha in Hawaii. These have led him to suggest a list of instructions on state formation for the would-be aggrandizer: be an alpha male, with aggressive ambitions, become a skilled military commander, and seek competitive advantages over rivals. Shaka was all three of these. As your power grows, use corvee labour to increase production, so that you can sustain your followers, delegate authority over newly gained territory to trusted relatives, and claim special powers by changing the current ideology.

These recommendations reflect the processes listed by Carneiro (1992) for state formation, which involve the defeat of rivals, the taking of slaves, placement of close supporters over conquered territory, the requirement of tribute payments and the maintenance of the forces of destruction, that is, a well equipped soldiery.

To what extent does the archaeological and epigraphic record evidence these processes and can we identify the agents responsible? The largest and most detailed corpus of written records comes from a line of rulers based in or near the Sen River valley, a river that flows southwards to join the Tonle Sap River just below its junction with the Great Lake of Cambodia. Here, we find the elite centre of Isanapura, a site that may well be that described in a Chinese text seen in the 13th century compilation of earlier records by Ma Duanlin. There was here a king who gave audiences every third day in a hall containing a wooden throne, embellished by columns of inlaid wood and fine fabrics. He wore a crown, and was protected by armed guards. Courtiers and officials prostrated themselves at the end of the audience. One can see images of such a court

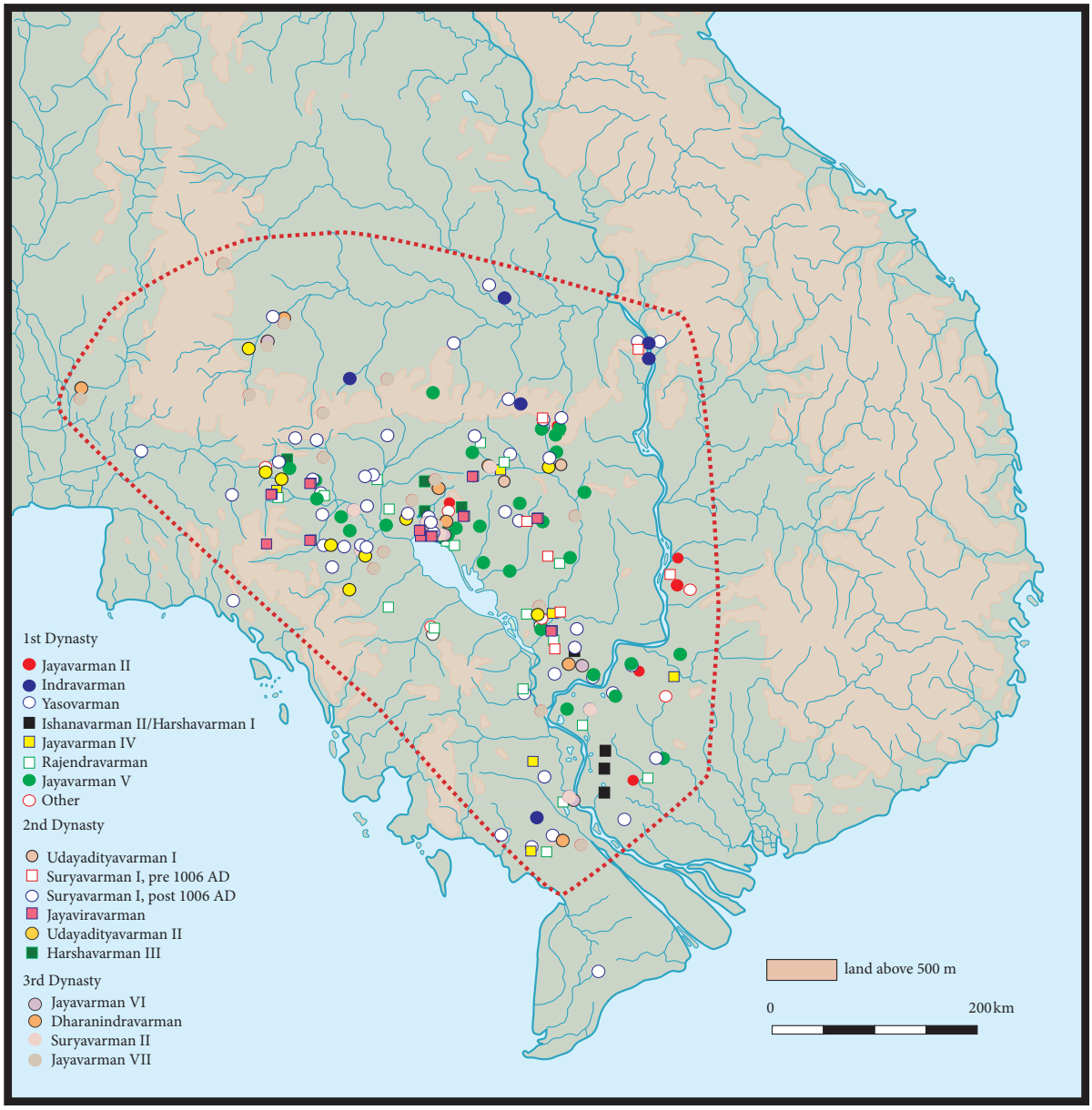


Fig. 19:6 The distribution of inscriptions dating from the first three dynasties of Angkor, showing the extent of the kingdom.

on the brick facades of the temples at Isanapura (Fig. 19:5). It is, however, the contemporary inscriptions rather than Chinese reports that lead us to the processes that led to the establishment of such a regal centre in the early 7th century. The inscriptions tell us that there was a royal dynasty of several generations. These begin with one Viravarman, who was succeeded by his sons Bhavavarman, who was reigning in AD 598, and Mahendravarman, he who led a military expedition from the Mekong River westward up the Mun Valley, leaving a series of inscriptions in his wake. Further south, a ruling family at Adhyapura acknowledged him as their overlord.

His son, Isanavarman, who gave his name to his capital centre, was also a military leader. One of his texts described how he "extended the territory of his parents", and another boasts of his defeating a rebellious prince. He appointed relatives to rule over conquered territory. His son Sivadatta was appointed governor of Jyesthapura, and Narasimhagupta who ruled at Indrapura was one of his vassals. He appointed the governor of Tamandarapura. It is possible to identify here three tiers of political authority, from the king in Isanapura, to the ruler of Tamrapura and on to his three dependent officials of Cakrankapura, Amoghapura and Bhimapura. Vickery (2001:337), while acknowledging Isanavarman's authority over some conquered dependencies, also notes the presence of "autonomous local chiefs" in his political orbit. There is little doubt that members of this dynasty were regularly involved in expansionary conflict, and bent on expanding their control over newly won territory.

However it is with the reign of a later ruler, Jayavarman 1st between approximately 635-680, that we find a considerable strengthening of the trends identified as seminal in state formation. His texts, for example, reflect growing central authority based on military power. There was now a chief of the elephants, animals used in warfare. There is a description of his going to war in the autumn, when his enemies moats are dry. One officer had command over 1000 men. The king's edicts were obeyed by numerous vassal kings, and Jayavarman himself was described as the "conqueror of the circle of his enemies". On the domestic front, he appointed an overseer of the royal grain stores, he ordered specific titles of land ownership and taxation relief or payments on, for example, the transport of salt.

One of the most significant findings of this period is the attention given to exalting royal ancestors. As Hayden and Villeneuve (2010) have stressed, social leverage to gain preferential access to land and other assets is facilitated when the populace at large recognises and adopts the special powers of aggrandizer ancestors. This is a recurrent theme in both Chenla and Angkorian texts. Jayavarmen not only named his ancestors with divine titles, and was the first king to claim divine status during his lifetime.

In assessing events during the critical 6th-7th century AD, it is also important to stress that the Isanapura dynasty was not the only one documented from the inscriptions. A lineage of four rulers, first a king and then three queens, ruled in northeastern Cambodia during the 8th century. K949, an inscription from the upper Mun valley itself, describes a ruler named Bhagadatta, and his descendants who ruled a polity called Sri Canasa. They were successively Sundaraparakrama, his son Sundaravarman, then his sons Narapatisimhavarman and Mangalavarman. As Vickery has noted, the name ending in -datta in Cambodia was normally assumed by *pon*. We do not know the date of Bhagadatta himself, but it probably belongs to at least the 7th century if not earlier still.

There are other inscriptions in the Mun Valley which tell the same story, of local rulers with Sanskrit names, ruling over groups who probably spoke Khmer. At Hin Khon, 35 km south of Nakhon Ratchasima, an overlord called Nripendradhipativarman, who ruled in a city called Sro Vraah, erected four *sema* stones during the 8th century, and made the meritorious gift of rice fields, slaves, flowers, fruit, cattle, gold and silver utensils, and an elephant and betel trees to a Buddhist temple (Weeraprajak 1986). Two further inscriptions also record the names of rulers: Indravarman, Soryavarman and Jayasinhavarman, and a capital called Tamran. Further to the east, there is an inscription from Wat Ban Song Puay in Yasothon which mentions a King Pravarasena and his capital Sankhapura (Jacques 1989).

Vickery has concluded that the Isanapura magnates up to and including Isanavarman ruled only a limited territory, and still appointed kinsmen to control conquered groups. Thus, he has described Isanavarman more as a particularly powerful chief rather than the king of a state. It was with Jayavarman 1st that we encounter intensified central and royal authority, the appointment of officials not necessarily related to the ruler, and the presence of a "*rajasabhadhipati*" which can be translated as president of the royal council. The continuation of this polity into the reign of his daughter Jayadevi takes us into the 8th century, when the number of inscriptions falls away, and we are left with a gap in our evidence. However, there is sufficient to be able to conclude that the line of rulers that began at least with Viravarman in the 6th century and ended with Jayadevi were well aware of the processes for state formation indicated by Carneiro and Flannery, and that Jayavarman 1st may join Shaka and Kamehameha as an aggressive aggrandizer who through military prowess and a new ideology in favour of deifying the ruling line, made the transition from a chiefdom into a state.

ANGKOR

The rarity of 8th century inscriptions is in part compensated for by the number of texts inscribed over two centuries later in which grandee families set out their genealogies, rights to land, and early history. That from Sdok Kak Thom is most significant in this respect, for in it, the nobleman Sadasiva describes how a ruler named Jayavarman 2nd required his ancestor Sivakavalya and his entire family to follow him move from their base in Southeastern Cambodia on a long journey that ended on the northern shore of the Tonle Sap. Other grandee families tell the same story. This exodus, according to an inscription of AD 1069, involved much conflict and the taking of new territory. Jayavarman 2nd must have wielded considerable force, and his followers were rewarded with grants of land. He finished this journey in a location that was to become the great centre of Angkor. The northern shore of the Great Lake is watered by perennial rivers issuing from the Kulen Hills. The lake itself teems with fish. To the west, there is the gateway to the Central Plains of Thailand, while the lake and the Tonle Sap river provide access to the Mekong. There are also accessible and high quality iron ore deposits.

Having established himself at his new capital at Hariharalaya, Jayavarman 2nd called on the high priest Hiranyadama to consecrate him *cakravartin*, supreme lord of the lower earth, in an impressive ceremony that probably took place on the Kulen upland, in AD 802, the date attributed by modern scholars to the beginning of the reign of Jayarman 2nd. Hence, we can again extract from the few relevant texts and the foundations of temple mountains such as Ak Yum and Rong Chen, a reiteration of the policies of his Chenla predecessors. Jayavarman 2nd secured land by right of conquest. He settled trusted followers with land rights. He called on corvee labour to construct impressive temples and developed new rituals to advertise his supreme and elite status and indeed, deification. His dynasty endured for two centuries, but its roots can now by traced back for over two millennia.

BIBLIOGRAPHY

Adams, J. 1996. Archaeology in Tuscon: the people behind the rocks. *Newsletter for the Centre for Desert Archaeology* 10:1-8.

Adams, R. 2004. An ethnoarchaeological study of feasting in Sulawesi, Indonesia. *Journal of Anthropological Archaeology* 23:56-78.

Alpers, E.A. 1969. Trade, state and society among the Yao in the nineteenth century. *Journal of African History* 93:405-520.

Arnold, J. 1992. Labour and the rise of complex hunter-gatherers. *Journal of Anthropological Archaeology* 12:75-119.

Baxter, M.J. 1994. *Exploratory Multivariate Analysis in Archaeology*. Edinburgh: Edinburgh University Press.

Bellina, B. 2001. *Témoignages Archéologiques d'Échanges entre l'Inde et l'Asie du Sud-Est, Morphologie, Morphométrie et Techniques de Fabrication des Perles en Agate et en Cornaline (VIe siècle Avant Notre Ère – VIe Siècle de Notre Ère).* Mémoires de DEA, Université Sorbonne-Nouvelle, Paris III.

Bellina, B. 2002. Le port protohistorique de Khao Sam Kaeo en Thaïlande péninsulaire : lieu privilégié pour l'étude des premières interactions Indiennes et sud-est asiatiques. *Bulletin de l'Ecole Française d'Extrême-Orient* 89:329-43.

Bellina B. 2007. *Cultural Exchange Between India and Southeast Asia. Production and Distribution of Hard Stone Ornaments (VI c. BC–VI c. AD).* Paris: Editions de la Maison des Sciences de l'Homme, with the participation of l'Ecole Française d'Extrême-Orient and Epistèmes.

Bellina, B. and Glover, I. 2004. The archaeology of early contact with India and the Mediterranean world, from the fourth century BC to the fourth century AD. In Glover, I. and Bellwood, P. (eds.) *Southeast Asia: From Prehistory to History* 68-87. New York: Routledge Curzon.

Bellina, B. and Silapanth, P. 2006. Khao Sam Kaeo and the upper Thai peninsula: understanding the mechanisms of early trans-Asiatic trade and cultural exchange. In Bacus E.A., Glover I.C. and Pigott V.C. (eds.) *Uncovering Southeast Asia's Past* 379-92. Singapore: NUS Press.

Bellina-Pryce, B. and Silapanth, P. 2006. Weaving cultural identities on trans-Asiatic networks: Upper Thai-Malay peninsula – an early socio-political landscape. In Bellina-Pryce, B. (ed.) The archaeology of prehistoric trans-Asiatic exchange: technological and settlement evidence from Khao Sam Kaeo. *Bulletin de l'Ecole Française d'Extrême-Orient* 93:257-93.

Binford, L. 1978. *Numamuit Ethnoarchaeology*. New York: Academic Press.

Bishop, R.L. and Rands, R.L. 1982. Mayan fine paste ceramics: a compositional perspective. In Sabloff, J.A. (ed.) *Analyses of Fine Paste Ceramics. Excavations at Siebal* 283-314. Cambridge Mass.: Memoirs of the Peabody Museum.

Blitz, J. 1993. Big pots for big shots: feasting and storage in a Mississippian community. *American Antiquity* 58:80-117.

Boyd, W.E. 2007. The geoarchaeology of Ban Non Wat and Non Muang Kao. In Higham, C.F.W. and Thosarat, R. (eds.) *The Origins of the Civilization of Angkor. Volume 1. The Excavation of Noen U-Loke and Non Muang Kao* 29-54. Bangkok: Fine Arts Department.

Brenner, E. 1988. Sociopolitical implications of mortuary ritual remains in seventeenth century native southern New England. In Leone, M. and Potter, P. (eds.) *The Recovery of Meaning: Historical Archaeology in the Eastern United States* 147-81. Washington: Smithsonian Institution.

Brill, R. 1999. *Chemical Analyses of Early Glasses*. New York: the Corning Museum of Glass.

Brill, R., Tong, S. and Dohrenwend, D. 1991. Chemical analysis of some early Chinese glasses. In Brill, R. and Martin, J. (eds.) *Scientific Research in Early Chinese Glass*. Proceeding of the Archaeometry of Glass Sessions of the 1984 International Symposium on Glass, Beijing, September 7, 1984 21-26. New York: The Corning Museum of Glass.

Bronk Ramsey, C. 2001. Development of the radiocarbon calibration program OxCal. *Radiocarbon* 43(2A):355-63.

Cameron, J. 2002. *Textile Technology in the Prehistory of Southeast Asia.* PhD thesis, Australian National University.

Cameron, J. 2011. Iron and cloth across the Bay of Bengal: new data from Tha Kae, central Thailand. *Antiquity* 85:559-68.

Cameron, J. 2012. The spinning tools. In Higham, C.F.W. and Kijngam J. (eds.) T*he Origins of the Civilization of Angkor, Volume 5: The Excavation of Ban Non Wat. Part III: the Bronze Age* 497-504. Bangkok: Fine Arts Department.

Carneiro, R.L. 1992. Point counterpoint. Ecology and ideology in the development of New World civilizations, in Demarest, A.A. and Conrad, G.W. (eds.) *Ideology and Pre-Columbian Civilizations* 175-203. Santa Fe: School of American Research Press.

Carter, A., 2011 Trade and exchange networks in Iron Age Cambodia: preliminary results from a compositional analysis of glass beads. *Bulletin of the Indo-Pacific Prehistory Association* 30: 178-88

Cawte, H.J. 2008. *Smith and Society in Bronze Age Thailand.* PhD dissertation, University of Otago.

Chang, C. 1988. Nauyalik fish camp: an ethnoarchaeological study in activity-area formation. *American Antiquity* 53:145-57.

Clark, J.E. and Blake, M. 1996. The power of prestige: competitive generosity and the emergence of rank societies in lowland Mesoamerica. In Brumfiel, E.M. and Fox, J.W., (eds.) *Factional Competition and Political Development in the New World* 17-30. Cambridge: Cambridge University Press.

Clarke, M 1998, *Feasting among the Akha of Northern Thailand,* unpublished MA thesis, Archaeology Department, Simon Fraser University.

David, N. and Kramer, C. 2001. *Ethnoarchaeology in Archaeology.* Cambridge: Cambridge University Press.

De, P.K. 1939. The role of blue-green algae in nitrogen fixation in rice-fields. *Proceedings of the Royal Society of London. Series B, Biological Sciences* 127:121-39.

Deer, W.A., Howie, R.A. and Zussman, J. 1966. *An Introduction to the Rock-Forming Minerals.* London: Longmans.

Dietler, M. and Hayden, B. 2001. *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics and Power.* Washington: Smithsonian Institution.

Domett, K. M. 2004. The people of Ban Lum Khao. In Higham, C.F. W. and Thosarat, R. (eds.) T*he Origins of the Civilization of Angkor, Volume 1: The Excavation of Ban Lum Khao* 113-58. Bangkok: the Thai Fine Arts Department.

Dussubieux, L. 2001. *L'Apport de l'ablation laser couplée a l'ICP-MS à la caractérisation des verres: Application a l'étude du verre de l'océan Indien.* Ph.D. dissertation, Université d'Orléans, Orléans, France.

Dussubieux, L. and Gratuze, B. 2010. Glass in Southeast Asia. In B. Bellina, B., Bacus, E. Pryce, and Wissman Christie, J. (eds.) *50 Years of Archaeology in Southeast Asia. Essays in honour of Ian Glover* 247-60. Bangkok: River Books.

Dussubieux, L. and Gratuze, B. 2012 in press. Glass in South Asia. In Janssens, K. (ed). *Modern Methods for Analysing Archaeological and Historic Glass.* New York: Wiley and Sons.

Dussubieux, L., Gartuze, B. and Blet-Lemarquand, M.2010. Mineral soda alumina glass: occurrence and meaning. J*ournal of Archaeological Science* 37:1646-55.

Dussubieux, L., Robertshaw, P. and Glascock, M. 2009. LA-ICP-MS analysis of African glass beads: Laboratory inter-comparison with an emphasis on the impact of corrosion on data interpretation. *International Journal of Mass Spectrometry* 284:152-61.

Ekholm, K. 1977. External exchange and the transformation of central African social systems. In Friedman, J. and Rowlands, M.J. (eds.) *The Evolution of Social Systems* 115-36. London: Duckworth.

Feinman, G. M., Kowalewski, S. A. and Blanton, R. 1984. Modelling ceramic production and organizational change in the Pre-Hispanic Valley of Oaxaca, Mexico, in van der Leeuw, S. and Pritchard, A.C. (eds.) *The Many Dimensions of Pottery* 297-337. University of Amsterdam, Albert Egges van Griffin Instituut voor Prae en Protohistorie, Cingula VII, Amsterdam.

Flannery, K. 1999. Process and Agency in Early State Formation. *Cambridge Archaeological Journal* 9(1):3-21.

Francis, P. Jr., 1990. Glass Beads In Asia Part 2: Indo-Pacific Beads. *Asian Perspectives* 29(1):1-23.

Francis, P. Jr., 2002. *Asia's Maritime Bead Trade. 300 B.C. to the Present.* Honolulu: University of Hawai'i Press.

Fukui, H. 1993. *Food and Population in a Northeast Thai Village.* Honolulu: University of Hawaii Press.

Fuller, D.Q, Sato Y.-I., Castillo, C., Qin, L., Weisskopf, A.R., Kingwell-Banham, E.J., Song, J., Ahn, S.-M. and van Etten, J. 2010. Consilience of genetics and archaeobotany in the entagled history of rice. *Archaeological and Anthropological Science* 2:115-31.

Gilbert, A. and Steinfeld, P. 1977. Faunal remains from Dinkha Tepe, Northwestern Iran. *Journal of Field Archaeology* 4:329-51.

Gleba, M. 2008. *Textile Production in Pre-Roman Italy. Ancient Textile Series 4.* Oxford: Oxbow Books.

Gratuze, B. 1999. Obsidian characterization by Laser Ablation ICP-MS and its application to prehistoric trade in the Mediterranean and the Near East: sources and distribution of obsidian within the Aegean and Anatolia. *Journal of Archaeological Science* 26:869-81.

Green, R.L. 1997. *Merina.* New York: Rosen

Greenland, D.J. 1997. *The Sustainability of Rice Farming*. Wallingford: CAB International

Habberfield-Short, J and Boyd, W E 2007. Geoarchaeological landscape model of he Iron Age settlements of the upper Mun River floodplain. In Higham, C F W and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 1-28. Bangkok: the Fine Arts Department.

Habberfield-Short, J and Boyd, W.E. 2007a. The geoarchaeology of Noen U-Loke and Non Muang Kao. In In Higham, C F W and Kijngam, A. (eds.) T*he Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 29-51. Bangkok: the Fine Arts Department.

Habberfield-Short, J and Boyd, W.E. 2007b. The geoarchaeological development of Noen U-Loke and Non Muang Kao. In Higham, C F W and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 55-74, Bangkok: the Fine Arts Department.

Harvey, E.L. and Fuller, D.Q. 2005. Investigating crop processing using phytolith analysis: the example of rice and millets. *Journal of Archaeological Science* 32:739-52.

Hayden, B. 1995. Pathways to power: principles for creating socio-economic inequalities. In Price, T.D. and Feinman, G. (eds.) *The Foundations of Social Inequality* 15-86. New York: Plenum Press.

Hayden, B. 2001. Richman, poorman, beggarman, chief: the dynamics of social inequality. In Feinman, G. and Price, T.D. (eds.), *Archaeology at the Millenium: A Sourcebook* 231-272.Kluwer Academic/Plenum Publishers: New York.

Hayden, B. 2009. Funerals as feasts. Why are they so important? *Cambridge Archaeological Journal* 19:29-52.

Hayden, B. and Maneeprasert, R. 1996. *Feasting among the Akha: the 1996 Report.*

Hayden, B. and Villeneuve, S. 2010. Who benefits from complexity? A view from Futuna. In Price, T.D. and Feinman, G. (eds.) *Pathways to Power. New Perspectives on the Emergence of Social Inequality* 95-147. New York: Springer

Henderson, J. 2000. *The Science and Archaeology of Materials. An Investigation of Inorganic Materials.* London: Routledge.

Henderson, J., Evans, J. A., Sloane, H. J., Leng, M. J. and Doherty, C. 2005. The use of oxygen, strontium, and lead isotopes to provenance ancient glasses in the Middle East. *Journal of Archaeological Science* 32:665-73.

Higham, C.F.W. 1989. *The Archaeology of Mainland Southeast Asia: From 10,000 B.C. to the Fall of Angkor*. Cambridge: Cambridge University Press.

Higham, C.F.W. 1996. *The Bronze Age of Southeast Asia*. Cambridge: Cambridge University Press.

Higham, C.F.W. 2002. *Early Cultures of Mainland Southeast Asia*. Bangkok: River Books.

Higham, C.F.W. 2004. The Artefacts. In Higham, C.F.W. andG. Thosarat, R. (eds.) *The Origins of the Civilization of Angkor: The Excavation of Ban Lum Khao* 191-216. Bangkok: the Fine Arts Department.

Higham, C. F. W. 2004. Mainland Southeast Asia from the Neolithic to the Bronze Age. In Glover, I. and Bellwood, P. (eds.) *Southeast Asia: from Prehistory to History* 41-67. New York: Routledge Curzon.

Higham, C.F.W. 2004b. Before Devanika. Social change and state formation in the Mekong Valley. In Cherry, J., Scarre C. and Shennan, S. (eds.) *Explaining Social Change. Studies in Honour of Colin Renfrew* 203-14. Cambridge: the McDonald Insitute.

Higham, C.F.W. 2005. Ban Non Wat: lessons from the field. In Paz, V. (ed.) *Southeast Asian Archaeology. Wilhelm G. Solheim II Festschift* 491-503. Quezon City: the University of the Phillippines Press.

Higham, C.F.W. 2011. The Iron Age of the Mun Valley, Thailand. *The Antiquaries Journal* 91:1-44.

Higham, C.F.W. 2011a. The Bronze Age of Southeast Asia: new insight on social change from Ban Non Wat. *Cambridge Archaeological Journal* 21(3):365-89

Higham, C.F.W. and Higham, T.F.G. 2009. A new chronological framework for prehistoric Southeast Asia, based on a Bayesian model from Ban Non Wat. *Antiquity* 82:125-44.

Higham, C.F.W. and Kijngam, A. (editors) 1984. *Prehistoric Excavations in Northeast Thailand: Excavations at Ban Na Di, Ban Chiang Hian, Ban Muang Phruk, Ban Sangui, Non Noi and Ban Kho Noi*. British Archaeological Reports, International Series 231(i-iii), Oxford

Higham, C.F.W. and Kijngam, A. (editors) 2009. *The Origins of the Civilization of Angkor.* Volume III. *The Excavation Ban Non Wat, Introduction.* Bangkok: the Fine Arts Department of Thailand.

Higham, C.F.W. and Kijngam, A. (editors) 2011. *The Origins of the Civilization of Angkor.* Volume IV. *The Excavation Ban Non Wat, The Neolithic Occupation*. Bangkok: the Fine Arts Department of Thailand.

Higham, C.F.W. and Kijngam, A. (editors) 2012. *The Origins of the Civilization of Angkor, Volume 5: The Excavation of Ban Non Wat. Part III: The Bronze Age*. Bangkok: the Fine Arts Department.

Higham, C. F. W., Kijngam, A. and Talbot, S. (editors.) 2007. *The Origins of the Civilisation of Angkor Volume II: The Excavation of Noen U-Loke and Non Muang Kao*. Bangkok: the Thai Fine Arts Department.

Higham, C. F. W. and Thosarat, R. 1998. *Prehistoric Thailand: From Early Settlement to Sukhothai*. Bangkok: River Books.

Higham, C.F.W. and Thosarat, R. 2005. *The Origins of the Civilization of Angkor.* Volume 1: *The Excavation of Ban Lum Khao*. Bangkok: the Fine Arts Department.

Hockett, B. 1998. Socio-political meaning of faunal remains from Baker Village. *American Antiquity* 63:289-302.

Hodder, I. 1982. *Symbols in Action*. Cambridge: Cambridge University Pre

Jacob, J. 1979. Pre-Angkor Cambodia: evidence from the inscriptions in Khmer concerning the common people and their environment. In Smith, R.B. and Watson, W. (eds.) *Early South East Asia* 406-26. Oxford: Oxford University Press.

Jacques, C. 1989. The Khmers in Thailand: what the inscriptions inform us. *SPAFA Digest* 16-24.

Junker, L. 1999. *Raiding, Trading, and Feasting, the Political Economy of Philippine Chiefdoms*. Honolulu: University of Hawaii Press.

Kantner, J. 1996. Political competition among the Chaco Anasazi of the American Southwest. *Journal of Anthropological Archaeology* 15:41-105.

Kim, S., Antonaccio, C., Lee, Y., Nelson, S., Pardoe, C., Quilter, J. and Rosman, A. 1994. Burials, pigs, and political prestige in Neolithic China. *Current Anthropology* 35:119-41.

Kooyman, B. 2006. Boundary theory as a means to understanding social space in archaeological sites. *Journal of Anthropological Archaeology* 25:424-35.

Lankton, J. and Dussubieux, L. 2006. Early glass in Asian maritime trade: a review and an interpretation of compositional analysis. J*ournal of Glass Studies* 48:121-44.

Lankton, J. and Dussubieux, L. 2012. In press. Early glass in Southeast Asia. In Janssens, K. (ed.) *Modern Methods for Analysing Archaeological and Historic Glass.* New York: Wiley and Sons.

Lankton, J., Dussubieux, L. and Gratuze, B. 2006. Glass from Khao Sam Kaeo: transferred technology for an early Southeast Asian exchange network. *Bulletin de l'Ecole Française d'Extrême-Orient* 93:317-51.

Lankton, J. and Lee, I. 2006. Treasures from the Southern Sea: glass ornaments from Gimhae-Yangdong and Bokcheondong, compositional analysis and interpretation. In Yogo Kim Pyongmo (ed.) *Archaeology: Traces of Time and Space. Studies in Honor of Kim Byung-Mo* 329-54. Seoul: Hagyon Munhwasa.

Lertcharnrit, T. and Carter, A. 2010. Recent research on Iron Age glass and stone beads from Promtin Tai, Central Thailand. *Muang Boran Journal* 26(4):53-68.

McCaw, M. 2007. The faunal remains. In Higham, C.F.W. and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 495-521. Bangkok: the Fine Arts Department.

Mirti, P., Pace, M. Malandrino M. and Negro Ponzi, M.2008. Sasanian glass from Veh Ardasir: new evidences by ICP-MS analysis. *Journal of Archaeological Science* 36:1061-9.

Mishra, U. and Pabbi, S. 2004. Cyanobacteria: a potential biofertilizer for rice. *Resonance* 9:6-10

Monkhonkamnuanket, N. 1992. *Ban Prasat. An Archaeological Site* (in Thai). Bangkok: Fine Arts Department.

McGrath, R. J. and Boyd, W. E. 2001. The chronology of the Iron Age 'moats' of northeast Thailand. *Antiquity* 75:349-60.

Mudar, K. 1997. Patterns of animal utilization in the Holocene of the Philippines: a comparison of faunal samples from four archaeological Sites. *Asian Perspectives* 36:67-105.

Nitta, E. 1997. Iron smelting and salt making industries in Northeast Thailand. *Bulletin of the Indo-Pacific Prehistory Association* 3:153-60.

O'Connell, J., Hawkes, K. and Jones, N. 1991. Distribution of refuse- producing activites at Hadza residential base camps: implications for analyses of archaeological site structure. In Kroll, E. and Price, D. (eds.) *The Interpretation of Archaeological Spatial Patterning.* New York: Plenum Press.

O'Connor, T. 2000. *The Archaeology of Animal Bones*. Stroud: Sutton Publishing Limited.

O'Reilly, D.J.W. 1998 The ceramic analysis. In Higham, C.F.W. and Thosarat, R. (eds.) *The Excavation of Nong Nor: A Prehistoric Site in Central Thailand* 97-118. Oxford. Oxford: Oxbow Books.

O'Reilly, D.J.W. 1999, *A Diachronic Analysis of Social Organisation in the Mun River Valley*. PhD thesis, University of Otago, Dunedin.

O'Reilly, D.J.W. 2000. From the Bronze Age to the Iron Age in Thailand: applying the heterarchical approach. *Asian Perspectives* 39:1-19.

O'Reilly D.J.W. 2007. Non Muang Kao in a regional perspective. In Higham, C.F.W. and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 575-88. Bangkok: the Fine Arts Department

O'Reilly, D.J.W. 2010. History in their bones: A diachronic, bioarchaeological study of diet, mobility and social organization from a Cambodian skeletal assemblages. Paper read at the 13th International Conference of the European Association of Southeast Asian Archaeologists, Berlin, September 2010.

Owens, D'A and Hayden, B. 1997. Prehistoric rites of passage: a comparative study of transegalitarian hunter-gatherers. *Journal of Anthropological Anthropology* 16:121-61.

Pilditch, J. 1992. The glass beads of Ban Bon Noen, Central Thailand. *Asian Perspectives* 31(2):171-81.

Pongpanich, B. 2009. *Beyond Beads*. Bangkok: Matichon Publishing House.

Potter, J. 2000. Pots, parties, and politics: communal feasting in the American Southwest. *American Antiquity* 65:1-23.

Pryce, T.O., Bellina-Pryce, B. and Bennett, A.T.N. 2006. The development of metal technologies in the upper Thai-Malay peninsula: initial interpretation of the archaeometallurgical evidence from Khao Sam Kaeo. Bellina-Pryce, B. (ed). The archaeology of Prehistoric trans-Asiatic exchange: technological and settlement evidence from Khao Sam Kaeo. *Bulletin de l'Ecole Française d'Extrême-Orient* 93: 295-315.

Reimer, P. J., Baillie, M. G. L., Bard, E., Bayliss, A., Beck, J. W., Bertrand, C. J. H., Blackwell, P. G., Buck, C. E., Burr, G. S., Cutler, K. B., Damon, P. E., Edwards, R. L., Fairbanks, R. G., Friedrich, M., Guilderson, T. P., Hogg, A. G., Hughen, K. A., Kromer, B., McCormac, G., Manning, S., Bronk Ramsey, C., Reimer, R. W., Remmele, S., Southon, J. R., Stuiver, M., Talamo, S., Taylor, F. W., van der Plicht, J., and Weyhenmeyer, C. E. (2004). IntCalo4 terrestrial radiocarbon age calibration, 0-26 cal kyr BP. *Radiocarbon*, 46(3):1029-58.

Reitz, E. and Wing, E. 1999. *Zooarchaeology*. Cambridge: Cambridge University Press.

Rice, P.M. 1981. Evolution of specialized pottery production: a trial model. *Current Anthropology* 23:219-40.

Rice, P.M. 1987. *Pottery Analysis: a Sourcebook*. Chicago; University of Chicago Press.

Rice, P.M. 1991. Specialization, standardization and diversity: a retrospective, in Bishop, R.I. and Lange, F.W. (eds.) *The Ceramic Legacy of Anna O. Sheppard* 257-79. Niwot: University Press of Colorado.

Rispoli, F. 2007. The incised and impressed pottery style of mainland Southeast Asia. Following the path of Neolithization. *East and West* 57:235-304.

Roger, P.A. and Kulasooriya, S.A. 1980. *Blue-Green Algae and Rice.* Manila: IRRI.

Rosenswig, R. 2006. Beyond identifying elites: feasting as a means to understand early Middle Formative society on the Pacific Coast of Mexico. *Journal of Anthropological Archaeology* 26:1-27.

Saadatnia, H. and Riahi, H. 2009. Cyanobacteria from paddy fields in Iran as a biofertilizer in rice plants. *Plant Soil Environ*. 55:207–12.

Sahlins, M. 1972. *Stone Age Economics*. Chicago and New York: Aldine-Atherton.

Saitowitz, S.J., and Reid, D.L. 2001. Physical and chemical analysis of glass beads and glassy slag from Iron Age sites in Northeast Thailand: preliminary findings. In Jones, M. and Sheppard, P. (eds.) *Australasian Connections and New Directions: Proceedings of the 7th Australasian Archaeometry Conference, University of Auckland* 307-27: Auckland: University of Auckland.

Sarjeant, C. 2011. Bronze Age mortuary ceramics: fabric characterisation, in Higham, C.F.W. and Kijngam, A. (eds.), *The Origins of the Civilization of Angkor. Volume V. The Bronze Age* 445-50. Bangkok: the Fine Arts Department

Sayavongkhamdy, T., Chang, N., Viengkeo, S. and Cawte, H. 2009. The archaeology of Sepon, Lao PDR: archaeometallurgy, unexploded bombs and collaborations. Paper read at the 19th Congress of the Indo-Pacific Prehistory Association in Hanoi, Vietnam, 29th November to 5th December 2009.

Sayre, E.V. and Smith, R.W. 1961 Compositional categories of ancient glass. *Science* 133(3467):1824-6.

Sayre, E.V. and Smith, R.W. 1967 Some materials of glass manufacturing in antiquity. In Levey, M. (ed.) *Archaeological Chemistry, a Symposium, Third Symposium on Archaeological Chemistry* 279-312. Philadelphia: University of Pennsylvania Press.

Schortman, E. M. and Urban, P.A. 2002. *Quiriguá Reports II Papers 6-15.* Philadelphia: University of Pennsylvania Museum.

Schortman, E. M. and Urban, P.A. 2004. Marching out of step: early classic Copan and its Honduran neighbors. In Bell, E. E., Canuto, M. A., and Sharer, R. J. (eds.) *Understanding Early Classic Copan* 319-36. Philadelphia: University of Pennsylvania Museum.

Solheim, W. G. 1965 A preliminary report on a new pottery complex in Northeastern Thailand. In Dhaninivat Sonakul (ed.) *Felicitation Volumes of Southeast Asian Studies presented to His Highness Prince Dhaninivat Kromamun Bridhyakorn: on the Occasion of his Eightieth Birthday* 249-63. Bangkok: the Siam Society.

Solheim, W. G. and Ayres, M. 1979, The late prehistoric and rarly historic pottery of the Khorat Plateau with special reference to Phimai in Smith, R.B. and Watson, W. *Early South East Asia* 63-77. New York and Kualar Lumpur: Oxford University Press.

Stark, M. and Dussubieux L. 2002. Paper presented at the 17th Congress of the Indo-Pacific Prehistory Association 9-15 September, 2002, Taipei, Taiwan.

Suchitta, P. 1992. Early Thai iron smelting. In Glover, I. C., Suchitta, P., and Villiers, J. (eds.) *Early Metallurgy, Trade and Urban Centres in Thailand and Southeast Asia* 25-40. Bangkok: White Lotus.

Summerhayes, G.R. 2000. *Lapita Interaction*. *Terra Australis* 15. Canberra: ANH Publications and The Centre for Archaeological Research, Australian National University.

Sung, Z. 1997. Mortar and pestle. *Chinese Historical Museum Agricultural Archaeology* 3:1-12.

Talbot, S. 2002. *From the Iron Age to Angkor in Northeast Thailand.* PhD. Thesis, University of Otago, Dunedin.

Talbot, S. 2007. The analysis of the mortuary record. In Higham, C.F.W. and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 305-53. Bangkok: the Fine Arts Department

Talbot, S. and Janthed, C. 2001. Northeast Thailand before Angkor: Evidence from an Archaeological Excavation at the Prasat Hin Phimai. *Asian Perspectives* 40:179-94.

Tayles, N G, Halcrow, S and Domett, K 2007. The People of Noen U-Loke. In Higham, C.F.W., Kijngam, A. and Talbot, S. (eds.) *The Excavation of Noen U-Loke and Non Muang Kao* 244-304. Bangkok: the Thai Fine Arts Department.

Theunissen, R. 2007. The agate and carnelian ornaments. In Higham, C.F.W., Kijngam, A. and Talbot, S. (eds.) *The Excavation of Noen U-Loke and Non Muang Kao* 359-78. Bangkok: the Thai Fine Arts Department.

Theunissen, R., Grave, P. and Bailey, G. 2000. Doubts on diffusion: challenging the assumed Indian origin of Iron Age agate and carnelian beads in Southeast Asia. *World Archaeology* 32(1):84-105.

Thosarat, R. 2004. The fish remains. In Higham, C.F.W. and Thosarat, R. (eds.) *The Origins of the Civilization of Angkor: The Excavation of Ban Lum Khao* 171-90. Bangkok: the Fine Arts Department.

Thosarat, R. 2007. The fish remains. In Higham, C.F.W. and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume 2: the Excavation of Noen U-Loke and Non Muang Kao* 1-28. Bangkok: the Fine Arts Department.

Tite, M. S. 1999. Pottery production, distribution, and consumption – the contribution of the physical sciences. *Journal of Archaeological Method and Theory* 6:181-233.

Turner, W.E.S. 1956. Studies in ancient glasses and glassmaking processes. Part III. The chronology of glassmaking constituents. *Journal of the Society of Glass Technology* 40:39-52.

Vickery, M. 1998. *Society, Economics and Politics in Pre-Angkor Cambodia*. Tokyo: The Centre for East Asian Cultural Studies for Unesco.

Vincent, B.A. 1988. *Prehistoric Ceramics of Northeast Thailand, with special reference to Ban Na Di.* Oxford: British Archaeological Reports (International Series).

Vincent, B.A. 2004. *The Excavation of Khok Phanom Di, a Prehistoric Site in Central Thailand. Volume VI: The Pottery, Other Ceramic Materials and their Cultural Role*. London: Society of Antiquaries of London, Research Report LXX.

Voelker, J.C. 2002. *Ceramic Production in Northeast Thailand.* Ph.D. thesis, Department of Anthropology, University of New York at Buffalo.

Voelker, J.C. 2007. The Ceramics. In: C.F.W. Higham, Kijngam, A. and Talbot, S. (eds.) *The Origins of the Civilisation of Angkor, Volume Two, The Excavation of Noen U-Loke and Non Muang Kao* 487-93. Bangkok: The Fine Arts Department.

Volkman, T. 1985. *Feasts of Honour: Ritual and Change in the Toraja Highlands*. Chicago: University of Illinois.

Watson, P. 1979. *Archaeological Ethnography in Western Iran.* Tuscon: University of Arizona Press.

Weeraprajak, K. 1986. I*nscriptions in Thailand* (in Thai). Bangkok: Fine Arts Department.

Welch, D.J. 1984. Settlement pattern as an indicator of subsistence and political organization in the Phimai region, Thailand. In Bayard, D. (ed.) Southeast Asian Archaeology at the XV Pacific Science Congress. Papers Presented in Symposium K.1.e.: *The Origins of Agriculture, Metallurgy and the State in Mainland Southeast Asia* 129-151. University of Otago Studies in Prehistoric Anthropology Volume 16.

Welch, D.J. and McNeill, J.R. 1990. Excavations at Ban Tamyae and Ban Non Kham, Phimai Region, Northeast Thailand. *Asian Perspectives* 28:99-123.

Welch, D.J. and McNeill, J.R. 1991a. Regional and interregional interaction in the Khorat Plateau. *Bulletin of the Indo-Pacific Prehistory Association* 10:327-40.

Welch, D.J. and McNeill, J.R. 1991b. Settlement, agriculture and population changes in the Phimai region, Thailand. *Bulletin of the Indo-Pacific Prehistory Association* 10:210-28.

Welch, D.J. and McNeill, J.R. 2004. The original Phimai Black site: a new look at Ban Suai, Phimai, Thailand. In Paz, V. (ed.) *Southeast Asian Archaeology* 522-43. Quezon City: University of the Philippines Press.

White J. 1982. *Ban Chiang: Discovery of a Lost Bronze Age.* Philadelphia: the University Museum.

White, J. and Pigott, V. 1996. From community craft to regional specialisation: intensification of copper production in pre-state Thailand. In Wailes, B. (ed.). *Craft Specialisation and Social Evolution: In Memory of V. Gordon Childe* 151-175. Philadelphia: University Museum Monograph 93.

Wichakana, M. 1991. Prehistoric sacrifices at Noen-U-Loke (in Thai). *Muang Boran* 16(4):69-79.

Wilson, J.T., Green, S. and Alexander, M. 1979. Effect of interactions among algae on nitrogen fixation by blue-green algae (Cyanobacteria) in flooded soils. *Applied and Environmental Microbiology* 38:916-21.

Wiriyaromp, W. 2011. Neolithic ceramic motifs. In Higham, C.F.W. and Kijngam, A. (eds.) *The Origins of the Civilization of Angkor Volume IV. The Neolithic Occupation* 93-106. Bangkok: The Fine Arts Department.

Wright, R.V.S. 1991. *Doing Multivariate Archaeology and Prehistory.* Sydney: Department of Anthropology.

Yellen, J. 1977. *Archaeological Approaches to the Present: Models for Reconstructing the Past*. New York: Academic Press.

Zaitseva, G.I., Chugunov K.V., Bokovenkoi, N.A., Dergachev, V. I., Dirksen, V.G., Van Geel, B., Koulkovai, M.A., Lebedeva, L.M., Sementsov, A.A., Van Der Plicht, J.., Scott, E.M., Vasiliev, S.S., Lokhov K.I. and Bourova, N. 2005. Chronological study of archaeological sites and environmental change around 2600 bp in the Eurasian steppe belt (Uyuk valley, Tuva Republic). *Geochronometria* 24:97-107.

Zhang Chi and Hsiao-Chun Hung. 2010. The emergence of agriculture in southern China. *Antiquity* 84:11-25.

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