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Identity and fear – burials in the Upper Palaeolithic

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ABSTRACT – *Ritual burials probably appeared when human beings became aware of their existence not only at a given moment, but also in the future. Death then became something to be feared, since it annihilated the identity of the deceased. Consequently, a belief appeared that rituals at the time of death and proper handling of the corpse could preserve the identity of the dead, so that they only enter a different 'world', an afterlife, where life and personality continue in some way. Since finds of deformed and damaged skeletons in Upper Palaeolithic graves are relatively frequent, it may be possible to conclude that people at that time were particularly cautious with the bodies of those who, for a variety of reasons, had deviated from normal in their lifetime.*

KEY WORDS – *Upper Palaeolithic; burial practices; identity; relics*

Identitete in strah – pokopi v mlajšem paleolitiku

IZVLEČEK – *Ritualni pokopi so se verjetno pojavili, ko se je človek zavedel, da ne obstaja samo v danem trenutku, temveč tudi v prihodnosti. Smrt je takrat postala nekaj, česar se je potrebno bati, saj je izničila identiteto umrlega. Zato se je pojavilo verovanje, da zaradi obredov v času smrti in primernega ravnanjem s truplom, smrt človeka ne izniči, temveč oseba le preide v drugačen 'svet', v onostranstvo, kjer se življenje in osebnost na nekakšen način nadaljujeta. Ker so najdbe deformiranih in poškodovanih skeletov v mlajšepaleolitskih grobovih relativno pogoste, bi morda lahko sklepali, da so posebej previdno ravnali s trupli oseb, ki so v času življenja iz različnih razlogov odstopale od normale.*

KLJUČNE BESEDE – *mlajši paleolitik; pokopne prakse; identiteta; relikvije*

Introduction

Upper Palaeolithic burials are rare events (*Riel-Salvatore, Gravel-Miguel 2013.304*), which could indicate that they were not the main practice of disposing of corpses. It seems that it was primarily those individuals who had visible physical deformities who were buried (*Formicola 2007; Trinkaus, Buzhilova 2018.7*) or were treated in some other way special, while corpses of 'normal' people were probably treated differently. There are many strategies and manners of treating the dead; they originate from different ideological, religious, social, and other factors. If we generalise, we could say that deceased individuals who were 'normal' and lived 'normally' (therefore in accordance with the norms of a group) were treated differently from those who 'stood out'.

A good ethnological illustration is the contemporary East African Samburu tribe, who treat their deceased in different ways (*Straight 2013.119–124*). Some people, *e.g.,* murderers, 'smell' bad, so their personality has to be annihilated, and even in death, completely eliminated from human society. On the other

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hand, with those who 'smell' good, these are primarily the elders of the tribe, some aspects of their personality can be preserved. Death is more dangerous for the living if a person dies in a particular period of life, in particular circumstances or in a particular place. Considering the level of danger that the death of an individual gives rise to, they decide in which manner the corpse, to which death clings like an infectious disease ready to spread, needs to be separated from the living. The majority of people, with the exception of old people and infants, are laid out under the trees. To prevent death from spreading to the living, the corpses have to be eaten, or at least thoroughly gnawed by hyenas. If these predators ignore the body, a goat is slaughtered nearby to attract them. Deceased children who were no longer breast-fed by their mother are also laid out under trees, away from the settlement. Since the death of a child is always bad, their jewellery and clothes are buried, not with them, but in a different place. In this way, the child is completely annihilated. Since he did not grow up and have children of his own, he leaves nothing to the living, and it is as if he never existed. The older a person is, the closer to the settlement they are buried, because the power of death clinging to a person lessens with age and becomes increasingly less 'contagious'. Old people are frequently buried inside the settlement or even in the house where their descendants live, because they influence the living beneficially. Children inherit jewellery and other possessions from their parents and grandparents, since their belongings do not pose a threat, and they can be remembered safely through these objects. Unmarried men and unmarried warriors together with their partners are considered dangerous people. The danger they present is so great that they even have to die far away from the settlement, and that is where their corpses remain. Their corpses are not stripped of clothing, and their jewellery is not taken, as is the habit with 'non-dangerous' deceased. Almost every aspect of the burial practices of the Samburu tribe is directed towards successfully 'cutting off' the dead from the living.

Burial practices in the Upper Palaeolithic

Similarities with such burial practices are revealed in certain burials in the Upper Palaeolithic. In the well-known triple burial from the site of Dolní Věstonice, the middle skeleton was highly deformed (*Klima 1988.834; Formicola* et al. *2001*). Three young men (*Mittnik* et al. *2016*) were buried in the grave in an unusual position. Their skulls were impregnated with red ochre, while the earth around the skulls was also red. The middle skeleton also had ochre sprinkled over its pelvis. In addition to the red pigment, the grave included pendants of pierced teeth and beads made of mammoth ivory (*Klima 1988. 834–835*). All three persons, who might have belonged to the same family (*Alt* et al. *1997*), were probably buried simultaneously (*Klima 1988.835*). The middle person was laid in the grave first, followed by the persons to the left and right. Pieces of charred wood were found on the skeletons and around the grave, which led to the conclusion that the grave was covered with branches that were burned during the ritual burial. Since the skeletons were not burned, the fire had to be put out quickly (*Klima 1988.835*). During his lifetime, the middle person in the grave was probably marked as different due to his deformities and could have even enjoyed a special status in society (*Mittnik* et al. *2016.5*). Both of the side skeletons displayed injuries (*Pettitt 2011. 192*), so it is possible that both young men were sacrificed upon death because they were related (*Alt* et al. *1997; Mittnik* et al. *2016.5*) or in some other way connected to the middle person. Other members of the group could have been afraid that they both were 'infected' by the death of the deformed individual and, therefore, they had to join him in the grave. It is possible that by lighting a fire above the bodies, the area was ritually cleansed in order to prevent death from spreading among the living.

The child's grave in the Portuguese rock-shelter of Lagar Velho was also cleansed with fire before the corpse was placed inside (*Pettitt 2011.169*). The skeleton is another example of deviation from the norm, since some believe that the child was a close descendant of interbreeding between modern humans and Neanderthals (*Duarte* et al. *1999*), while others suggest that he was a very robust representative of modern humans (*Tattersall, Schwartz 1999*). The child's appearance was probably very unusual and this could be the reason he was buried. The exceptional nature of the event is indicated by the fact that no other Palaeolithic burials are known from the territory of Portugal and, hence, burial was probably not the regular practice of corpse disposal.

Another triple burial from the Upper Palaeolithic is known, from the cave of Barma Grande. The grave included the skeletons of an adult man and two adolescents, probably female (Fig. 1).

The skeletons were sprinkled with ochre, and ornamented with jewellery made of pierced shells, red deer teeth, fish vertebrae, and mammoth ivory. The

grave also included stone tools (*Giacobini 2007*). The similarity with the burial at Dolní Věstonice is in the number of people interred, the fact that in Barma Grande all three individuals were also buried simultaneously, and that the person in the middle was placed in the grave first (*Pettitt 2011.182*). Even though the male skeleton reveals a certain pathology (*Formicola, Holt 2015.79*), it is possible that in this case the burial was dictated by inappropriate social behaviour which, similarly to a physical deformation, 'stigmatised' individuals as socially dangerous. Nevertheless, the burial practices in each case could have been quite different, and the similarity between these two burials merely coincidental.

Pathological deformations are also known on skeletons from other Upper Palaeolithic burials. This leads us to believe that congenital deformation or later prolonged illness was one of the reasons such individuals were buried (*Formicola* et al. *2001*) and thus placed under the ground, to make others safe from them. It is possible that deformed people had a special status during their lifetime, which could be concluded from the find of the skeletons of two adolescents in the extremely rich grave at the Russian site of Sunghir. A boy of 12 to 13 years of age and a girl between 9 and 10 years old were buried in a shallow grave. They were positioned in such a way that their skulls were touching. Both skeletons were highly decorated and surrounded with numerous grave goods. They were buried simultaneously. The girl's skeleton was deformed from illness; the signs of illness were most prominent upon her birth and subsided with age, enabling the girl to live an active life (*Formicola, Buzhilova 2004; Trinkaus* et al. *2014.18*). Despite being deformed, the girl survived through childhood, but was treated differently from other members of the group upon her death, since she was buried. This could indicate that she was privileged in the society; on the other hand, it could also indicate the desire to remove her from the world of the living as successfully as possible. The adolescent male skeleton also had deformities (*Trinkaus, Buzhilova 2018.11–12*) and might even have suffered perimortem trauma (*Trinkaus* et al. *2014.282–283*). They were buried with all their belongings, despite the effort put into the production of the artefacts, because their property became dangerous to the living and, rather than being preserved, was buried and eliminated from the life of the group.

Separation from the living is also evident in the burial at the Czech site of Brno, where a partial skeleton of a man who suffered from periostitis was dis-

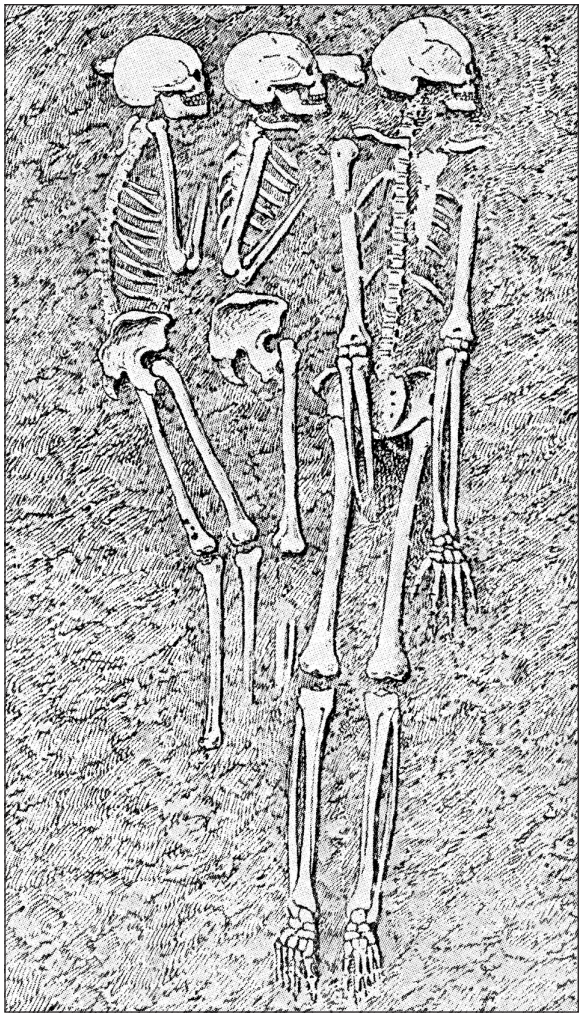

Fig. 1. Triple burial from the Barma Grande cave in Italy (*Verneau 1900.Fig. 5*).

covered. The inflammation was chronic and the man probably endured pain for several years. The skeleton was sprinkled with red ochre and possibly covered with mammoth scapula. Numerous grave goods were also found in the grave. It is interesting that the grave was located far away from any Palaeolithic settlement. The grave goods and the isolated position of the grave indicate that this is the burial of a special individual, possibly a shaman (*Oliva 1999*). He was probably considered a powerful and dangerous person, so he was buried far away from the settlement. Some groups of people who still practice shamanism today also bury or expose those shamans they fear far outside the settlement, and avoid that place thereafter. Occasionally, the hide of their drum is pierced, since the drum is the means that enables shamans to travel. With the act of destroying the drum, the shaman is prevented from returning to the community (*Vitebsky 2001.95*). Some also believe that a shaman is 'infectious' during his lifetime, since he unintentionally sucks the life from the

people close to him, who are therefore sickly and die young (*Vitebsky 2001.22*).

Another example of the distinctive difference of a deceased person was found in the Italian rock shelter of the Riparo del Romito. An adult woman and an adolescent dwarf were buried in a shallow grave; it is not completely clear whether the burial was simultaneous. Three auroch bulls were engraved on a rock near the grave, while the grave included two fragments of this animal's horn. The adolescent dwarf was perhaps stigmatised as different since his birth. There is little doubt that he stood out by his appearance, since this is the only known example of dwarfism in the Palaeolithic. He could have been feared or, on the other hand, he might have had high status in the society because of his deformity (*Frayer* et al. *1988.549–550,* with references; *Giacobini 2007.14; Pettitt 2011.244–245*).

In addition to illnesses, severe injuries could also have made members of a community contagious and dangerous, since bad luck and injury could spread to others. If people died of injuries outside the settlement, they were probably left at the place of death. If they died later on, surrounded by members of the community, they might be buried together with all their belongings, due to danger spreading from them and their property. This could be suggested for the case of a burial in the Arene Candide cave in Italy. Owing to the rich grave goods, this burial was named 'Il Principe'. A young man was buried in the grave. A part of a mandibula was missing, but the void had been filled with a great amount of ochre, which was in direct contact with the broken bone, as if someone had tried to hide or heal the injury that caused the death of the young man – a hunter who was at the peak of his strength. The skeleton was placed on a bed of ochre and had hundreds of perforated shells and teeth around the head, which were originally probably fixed to some sort of cap. Mammoth ivory pendants and four perforated batons were found beside the skeleton, while the right hand held a flint blade (*Mussi 2001.257; Pettitt 2011.182*). The man was probably buried with all his belongings, which had in this way disappeared from the world of the living together with him. Prior to the burial, the wound on the jaw could have been symbolically healed with ochre, so that the injury would not present a reason for him to 'return' among the living and harm them. The adult man from the rich grave in Sunghir also died violently (*Trinkaus* et al. *2014. 274; Trinkaus, Buzhilova 2018.9*) and might have been buried for similar reasons as 'Il Principe'.

The combination of disease and injury is evident on one of the children's skeletons from the Italian site of Grotta dei Fanciulli. The grave of two children, who were lying in a shallow pit one next to the other, was found there. One of the children had a flint point stuck in a vertebra, which probably caused his death. The skeletons of both children show traces of periostitis, and one also bore rachitic lesions. The grave did not contain red ochre, but several hundred pierced shells decorated the area of the children's waist and pelvis. They could have originated from a garment which covered this part of their bodies (*Henry-Gambier 2001.105–111; Giacobini 2007.5–6; Pettitt 2011.243–244*). This indicates that the children might have been buried in their clothes to erase all traces of their existence among the living.

The situation with the Early Upper Palaeolithic burial at Kostenki 14 (Markina gora) is somewhat different. The skeleton of an adult man was found within the settlement, in a grave that was marked by red pigment. The body was buried in an extremely retracted position, the knees being pulled up to the chest. It is possible that he was buried tied up. The clenched fists of both hands, one of which was stuck in the mouth, indicate that the man suffered severe pain prior to his death (*Sinitsyn 2004.238; Pettitt 2011.201*). It could be that the man was violently executed due to his inappropriate deeds, and was then buried within the settlement as an example to others. This could also indicate that burial was a punishment, and was reserved for those who, for any reason, including, a moral one, deviated from the norm.

In the Upper Palaeolithic, people started recognising death as the annihilation of identity. This became possible only with the development of the episodic memory, which enabled humans to know that they would or would not exist in the future (*Petru 2017. 403–404*). With a realisation that someday the annihilation of the identity would happen, there arose the need for a belief in the afterlife in which the identity would be preserved at least to some extent. In a community, the identity of the deceased was preserved by the memory of the living, which was stimulated by the presence of his relics.

In the Vilhonneur cave in France, the partial skeleton of a young adult male was discovered; a hand stencil was outlined on the cave wall in the same chamber (*Henry-Gambier* et al. *2007*). The presence of the hand stencil could reflect the awakening of self-

recognition, since the handprint (Fig. 2) is probably one of the first documented signs of the recognition of personal identity and acceptance of the body as an integral part of this identity. Impressions or outlines of hands on the wall, just like burials or manipulation of human relics, express a desire for lasting the preservation of identity, which is not annihilated by death. Everyone has a different handprint, which is therefore linked to a particular individual, who wants to record his existence permanently and express his uniqueness within a group. Since identity is best expressed through the body, body parts assumed the identity of the deceased and became lasting objects kept through several generations. Thus, the deceased remained with their descendants not only in memory, but also physically.

The highest frequency of manipulation of the human body remains appears in the Magdalenian (*Pettitt 2011.217*). Modified skulls, which were probably used as skull-cups, are known from this period from Gough's Cave, where numerous fragmented human remains that belong to at least five to seven persons were found in layers dated to 14 700 BP. The bones indicate that the flesh was removed from them and that they were cracked to extract the bone marrow. Traces of human teeth are also present on them. Special attention was focused on skulls, since they were not only crushed to remove the brain, but were also modified into vessels. At least one such skull-cup was probably brought to the site from elsewhere. This kind of behaviour indicates that cannibalism was a ritual activity at this site, not a survival strategy. Skull-cups have also been found at the French sites of Le Placard (Fig. 3) and Isturitz, and in the El Castillo cave in Spain (*Bello* et al. *2015; Straus* et al. *2011.1163*). This could indicate that ritual cannibalism was part of funerary practices in the Magdalenian (*Bello* et al. *2015*). The focus on the head is also clear from the remains in the Maszycka cave in Poland. Several crushed skulls with traces of cannibalism were found there. These are probably the remains of two or three families that were killed, had their skulls crushed, and brain eaten. Other bones of their skeletons were found near the cave entrance, mixed with animal bones (*Pettitt 2011.215–216,* with references).

Fig. 2. A handprint as a lasting preservation of identity.

Secondary burials are also a reflection of the manipulation of human remains. In recent times, some Australian Aborigines have practiced such burials. They exposed the dead bodies for so long, that only the bones remained. Afterwards, the clean bones were ritually buried. Prior to burial, the remains were coloured with red ochre, since the red colour represents life (*Jones 2000.261*).

A Magdalenian secondary burial was found in the El Mirón cave in Spain, where the partial skeleton of a young adult was buried near a large block which had fallen from the cave roof. The wall near the human remains and the fallen block were engraved. Part of the block was stained with ochre, as were the skeletal remains and some of the stones covering the bones. A large quartz crystal was found in the context of the secondary burial, so it is possible that it was intentionally deposited with the bones. All of this indicates that the cleaned human remains were ritually buried (*Straus* et al. *2011*). The presence of the quartz crystal as a possible grave offering could mean that the remains were of a person with special powers which were embodied in the crystal. Today's Central American Indian Huichol tribe believe that quartz crystals represent the souls of deceased shamans (*Vitebsky 2001.23*).

An unusual secondary burial from the same period is known from the Brillenhöhle site in Germany. The human remains include 38 fragments of a skull and skeleton on which traces of human manipulation can be seen. Parts of the skeleton were placed inside the skull-cup, which seems to be a transport-container. In this container, human remains might be stored in some other place or transported by the group for a longer period prior to the secondary burial. The burial is approximately contemporary with finds from Gough's Cave (*Orschiedt 2002*), and confirms the special, probably ritual, significance of Magdalenian skull-cups.

Multiple inhumations were more frequent in the Gravettian than later in the Palaeolithic, which could

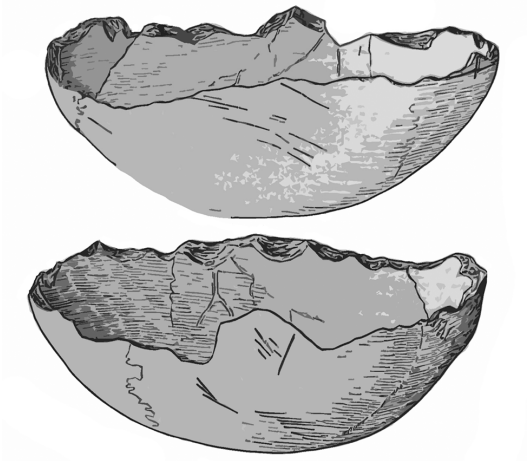

Fig. 3. Skull-cup from the Upper Palaeolithic at Le Placard in France (adapted from* Macalister 1921. Fig. 113*).

mean that views of personhood and social relations had changed with time (*Riel-Salvatore, Gravel-Miguel 2013.326*). At the end of the Palaeolithic, this perception probably changed even more. The first 'necropolis' at the Italian site of Arene Candide is preserved from this period. It includes at least 20 buried individuals of different genders and ages. They were placed in a layer imbued with ochre. Two of the burials are double. Some partial skeletons are damaged due to subsequent burials, and some of them seem to be secondary burials. Therefore, two types of handling of human remains were probably present in Arene Candide. Rich grave goods were added to those skeletons which were laid in the grave pit in an anatomical position, while secondary burials revealed no grave goods. Adults and children are found in the graves and representatives of both genders, but there are fewer women than men. The cave was used as a burial site in at least two periods; graves were possibly marked with stone blocks, and the cemetery area decorated with reindeer antlers. (*Giacobini 2007.8; Pettitt 2011.251–253,* with references). The ritual killing of pebble tools might also have been part of complex funeral ceremonies at this place (*Riel-Salvatore* et al. *2018*).

A group burial from the Moravian site of Předmostí, in which a larger number of skeletal remains were preserved, is much older than the 'necropolis' at Arene Candide. In this case, people were buried along the impressive rock at the edge of the settlement. There are two interpretations of what was happening at the time of the inhumations. According to the first, it was a catastrophic event; according to the other, burials under the rock had been taking place for a long period, which could be interpreted as the first burial ground (*Svoboda 2008*). From the same site, the human manipulation of the remains of domesticated dog is known. A fragment of mammoth bone was between the jaws of one of the three specimens that were found at the site. The bone was placed there posthumously, which indicates that the act probably had a ritual meaning (*Germonpré* et al. *2012*).

The increasingly important role of dogs at the end of the Palaeolithic is reflected in the burial of a dog from the Siberian site of Uški I. The dog was lying on its left side along the hearth inside a dwelling. Along its back was a blotch of ochre, in which a side-scraper, an obsidian blade and a grindstone were found (*Dikov 2004.39*). This burial indicates that dogs started to be perceived as persons, and were included in the human community. Humans are the only species capable of something like this. Such an expansion of identity probably happened in the Upper Palaeolithic, but dogs were even more present in people's lives later, in the Mesolithic. Other animals also became part of the community and were given an important place in social life and religion. Even today, the boundary between humans and animals is still very loose among some indigenous people, and animals can even assume the role of ancestral beings.

Identity in the Upper Palaeolithic spread from people not only to animals, but also to certain objects, which acquired special powers. An example of such 'strong' objects are female figurines which were buried inside dwellings at Russian sites (*White 2003. 138–141,* with references), probably in order to protect them.

Many Upper Palaeolithic skeletons lacked jewellery or other grave goods (*Riel-Salvatore, Gravel-Miguel 2013.333*), which means that the dead were not all treated the same. At the time, numerous groups probably existed which did not believe in the afterlife, since even today some groups like the !Kung San from South Africa or East African Masai do not have a concept of life after death in their belief system (*Dunbar 2004.194–195*). Palaeolithic people who did not believe in the continuation of existence after death probably felt no need to enage in ritual burials; if they buried their dead, they did so for hygienic or safety reasons, since the bodies could attract predators.

Conclusion

It is possible that the practice of burials started differently than we generally imagine today. It might be that in the Upper Palaeolithic, it was not indivi-

duals with high status that were buried, but rather people who were physically or mentally handicapped and were thus feared. It could be that they also buried those who broke social norms, and individuals with special 'powers', whose corpses they did not want nearby due to fear. As suggested by Paul Pettitt (*2011.212*): "*Perhaps human relics reflected 'good' deaths, and burials 'bad'.*"

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The Epipalaeolithic-Neolithic as the pivotal transformation of human history

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ABSTRACT – *The objective of this paper is to set the Epipalaeolithic-Neolithic transformation (ENT) within the truly long-term of human evolutionary history. The Epipalaeolithic-Neolithic transformation takes us out of the world of Palaeolithic mobile foraging into a new world, in which the scale and organisation of the social group and the tempo of socio-cultural evolution were transformed. The scale and diversity of cultural innovation and social organisation can be seen to be linked in co-evolutionary feedback loops that have been characterised as 'cumulative culture', 'ratcheting' effects, or 'runaway' cultural evolution. The up-scaling of communities and the intensification of their interaction and networking enabled the emergence of super-communities that became the first large-scale societies, an inflection point on an accelerating curve of complex cultural, social and economic development, en route to emergent socio-political hierarchies, urbanism, kingdoms and empires.*

KEY WORDS – *Epipalaeolithic; Neolithic; Southwest Asia; cultural evolution; cumulative culture; cultural niche construction*

Prehod med epipaleolitikom in neolitikom kot ključna preobrazba v zgodovini

IZVLEČEK – *Namen članka je umestitev preobrazbe v času med epipaleolitikom in neolitikom znotraj dejansko dolgoročne zgodovine človekove evolucije. Ta preobrazba je pomenila spremembo iz paleolitskih lovcev in nabiralcev v nov svet, v katerem sta se spremenila tako obseg kot organizacija družbene skupine kot hitrost družbeno-kulturne evolucije. Obseg in raznovrstnost kulturne inovacije in družbene organizacije je lahko povezana s co-evolucijskimi povratnimi zankami, ki so označene kot 'kumulativna kultura', učinek 'zobnikov' ali kulturna evolucija 'pobega'. Povečanje skupnosti in njihovih interakcij in mreženj je omogočilo pojav super-skupnosti, ki so postale prve družbe velikega obsega oz. točka preloma na krivulji hitrosti kompleksnega kulturnega, družbenega in ekonomskega razvoja, na poti k nastajajočim hierarhijam, urbanizmu, kraljevinam in cesarstvom.*

KLJUČNE BESEDE – *epipaleolitik; neolitik; jugozahodna Azija; kulturna evolucija; kumulativna kultura; konstrukcija kulturne niše*

Introduction

It has been the conventional wisdom that the first development of farming economies was the most important moment in history, serving as the foundation on which civilisations have been formed and on which the formation of our modern world is ultimately dependent. It is beyond question within the international community of Near Eastern Epipalaeolithic and Neolithic specialists that our 'Neolithic revolution' constitutes the most important research field in prehistoric archaeology. However, the Epipalaeolithic-Neolithic transformation (hereafter the ENT) is in an awkward situation. It is not at the transition between prehistory and history: for people concerned with historical periods, the Neolithic is

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remote prehistory, the province of archaeologists, potsherds, flints and animal bones, while for those concerned with the long-term questions of human evolution or Palaeolithic archaeology, the Neolithic is a brief postscript, the equivalent of 'the end of history'.

Many non-archaeologists think of the ENT as the pivot of human history in some way. To take just one example, the economic and social historian Paul Seabright (*2004*) has explored how our vast contemporary societies can function when we each live in The Company of Strangers. On the first page he writes: "*Our teeming, industrialised, networked existence is not some gradual and inevitable outcome of human development over millions of years. Instead we owe it to an extraordinary experiment launched a mere ten thousand years ago. No-one could have predicted this experiment from observing the course of our previous evolution, but it would forever change the character of life on our planet.*" The 'extraordinary experiment' is the Neolithic of Southwest Asia. He contrasts the time before the Neolithic with the time since, amazed at how the sedentary farming populations of the Neolithic "*with barely a pause for breath in evolutionary time ... had formed social organizations of startling complexity. Not just village settlements but cities, armies, empires, corporations, nation states, political movements, humanitarian organizations, even internet communities*".

Paul Seabright is exceptional in that he has appreciated that there was much more to that period than simply the formulation of effective farming practices. For many non-archaeologist authors of general accounts of long-term human history, the domestication of plants and animals and the beginnings of farming are the significant advance of the Neolithic of Southwest Asia. If we find that non-archaeologists mistreat or misunderstand our Neolithic, it can only be because archaeologists have not been sufficiently clear and have failed to communicate their work and their ideas to the wider world, both among academics or other disciplines and the interested public. There are at least two ways to ensure that communication to a wider public is more effective: (a) we should set aside the kind of fact- and jargon-filled style that we use when writing for each other, and (b) adopt a framework for our narrative that is widely used beyond archaeo-logical circles. In this essay I want to try to set the ENT of Southwest Asia in a wider, evolutionary context, one that is based in the archaeology of the period, but is framed in terms that will be familiar because it has been developed and adopted by scientists from other disciplines.

While most research effort has been devoted to the identification of the when and where of domestication of plants and animals and the adoption of farming, and many in the wider public have learned that the transition from hunter-gatherer to farmer is the central issue in the Neolithic, I want to broaden the focus beyond the origins of agriculture. The progressive changes that led from classic Upper Palaeolithic hunting and gathering subsistence strategies to the effective farming strategies of the later aceramic Neolithic were obviously important and unprecedented, but they are one element in a larger, more complex process. My starting point in this paper is the observation that the general characteristic of the ENT is the accelerating pace of events that can be calibrated in the classification of the archaeological record. Through the approximately fifteen millennia of the Epipalaeolithic and Neolithic of Southwest Asia, the pace of cultural innovation and accumulation increased dramatically. At its simplest, using the characteristics of cultural assemblages to distinguish archaeological periods and sub-periods, Palaeolithic specialists work in terms of hundreds of thousands of years for the earliest periods, and tens of thousands of years in the more recent Palaeolithic. The pace quickens in the Epipalaeolithic of Southwest Asia, the Levant in particular: the early, middle and late sub-periods of the Epipalaeolithic each account for two or three millennia. Differentiating subphases within the late Epipalaeolithic Natufian, specialists begin to count in terms of one or two thousand years for an early, late, and final sub-phase. The sub-periods of the early Neolithic are counted in centuries, and the scale of archaeological periods continues to quicken in the following periods.

For that reason, I have become interested in graphs that depict accelerating change in human history or human evolution. Such upward curving graphs come at very different scales. A classic example that caught my eye some time ago, and which I at first misread, related to the Industrial Revolution in England (*Clark 2007*). In the late 18th century, an almost flat line at the bottom of the graph began to curve upward, and, through the decades of the early 19th century, it rapidly approached a cliff-like, near vertical acceleration. I was interested in the accelerating population density of the ENT, and this, I thought, could be a graph of the population explosion that accompanied the Industrial Revolution; in fact, it graphed over a few decades the growth of British

household income. Industrialised production, a revolution in transport infrastructure, a rapid growth of population, the growth of household income, and the expansion of markets for all sorts of new products, and the ideas of Enlightenment thinkers (*Mokyr 2009*) were just some of the interacting elements in the Industrial Revolution that interacted upon one another in a complex of positive feedback loops.

Acceleration and accumulation

There have been accelerating curves of other kinds and on quite different scales earlier in human evolutionary history. Robin Dunbar, for example, has graphed the accelerating growth of the hominin brain and its pre-frontal cortex relative to the scale of the hominin body (Fig. 1). Dunbar was able to relate the neo-cortex ratio of the brain to social group among living primates (*Dunbar 1997; 1998*), and from that, to extrapolate the increasing scale of social groups across the three million or so years of human evolution. This is the basis of his 'social brain hypothesis', relating brain size and cognitive sophistication to the size of hominin social groups, arguing that these have co-evolved. Dunbar has also argued that gossip and chatting in small groups (that is, language) must have evolved to take over the role of one-to-one grooming. Although I do not think that Dunbar defines it as such, what he has been describing is a series of complex, cumulative, gene-culture co-evolutionary feedback loops that involve extended human infancy, the plasticity of the human brain, the expansion of its cognitive capacities, the increase in human social group size, and language as the mode of communication and socialisation that kept groups together and cohesive. Just as Clark's graphing of the explosive growth of family income represents one element in the complex of the industrial revolution, so Dunbar's graphing of the accelerating expansion of the hominin neo-cortex ratio also represents one element in a complex of evolutionary interactions.

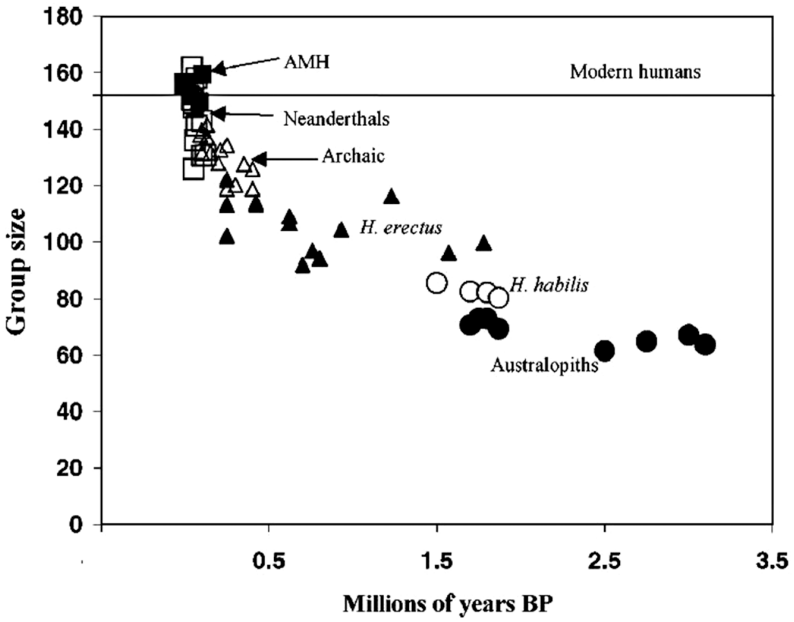

Fig. 1. Dunbar's representation of the increasing scale of the neo-cortex of the hominin brain. The timescale is in millions of years (and runs from right to left). The graph shows how increasing neo-cortex ratios relate to increasing social group size.

Dietrich Stout and a French colleague, Thierry Chaminade, have taken a somewhat different route through the evolutionary complex. They argue for the co-evolution of cognitive skills, language and the ability to accumulate a sophisticated cultural package of stone tool-making skills (*Stout, Chaminade 2009; 2012*). Again, their graph (Fig. 2) shows an accelerating curve through the long term of the Pleistocene, but what is graphed here is the increasing flexibility of tool-making technology. This research adds practical and conceptual cultural knowledge to the equation of co-evolution of cognition, scale of social group, language and culture.

In his book The Evolved Apprentice Kim Sterelny, a philosopher interested in (human) evolutionary theory, traces the long-term development of cooperation, and the evolution of social and cognitive skills embedded in a cultural niche adapted for cultural transmission (*Sterelny 2011*). Sterelny is a leading figure among those who have been developing the idea that the human cultural niche evolved to support increasingly large-scale cooperation and increasingly effective social learning. Certainly, by the time of Homo sapiens, young people had become very adept at working out who were the best teachers from whom to learn advanced cultural skills, and there were cultural norms that enabled skilled and experienced older people to transmit their skills – what Sterelny calls apprentice learning. Considering how sophisticated and complex Homo sapiens cultures were by the Upper Palaeolithic, Sterelny at that time found it difficult to think how to account for the sudden and dramatic changes

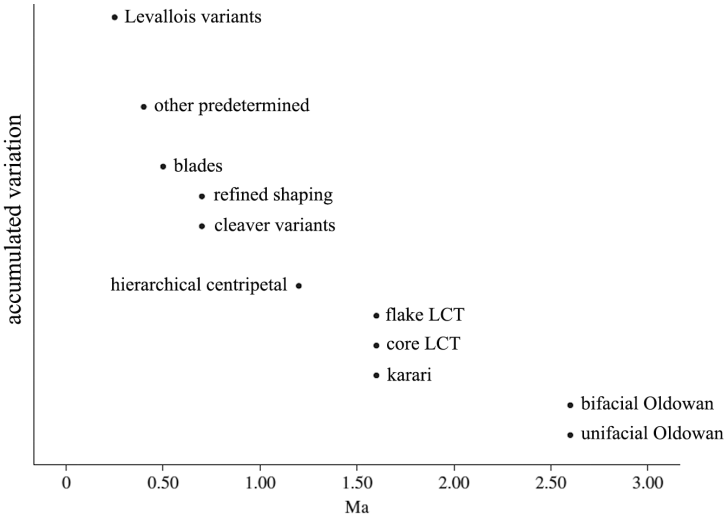

Fig. 2. Stout and Chaminade graph the accumulation of technical variation in the making of stone tools over time. The timescale runs from right to left in millions of years.

that marked the Holocene period. Since then, he and I have collaborated on exploring how cultural niche construction theory can begin to help us understand the ENT (*Sterelny, Watkins 2015*).

On the basis of collaborative research, ethnographic fieldwork and laboratory experiments, Joe Henrich argues similarly for the power of the cultural learning niche for the safe inter-generational transfer of complex knowledge and diverse skills (*Henrich 2015*). He introduces his book, written after twenty years of research, as a waymark of his current understanding of the story of human evolution. He summarises the central argument of his book as "*about 2 million years ago, we crossed this evolutionary Rubicon, at which point cultural evolution became the primary driver of our species genetic evolution. This interaction between cultural and genetic evolution generated a process that can be described as autocatalytic, meaning that it produces the fuel that propels it*" (*Henrich 2015.57*). He shows that the cultural accumulation of innovations is dependent on the existence of very cohesive social groups and a cultural niche that provides for the tutoring, acquisition and practice of complex skills. There is a demographic component in this advanced cultural learning niche: there must be relatively large numbers of people if there are to be several wise and experienced practitioners of complex skills, such as, for example, building a kayak, making a harpoon, and engaging in hunting seals in the Arctic Ocean. The Upper Palaeolithic societies, made up of small, scattered, forager bands that were the constituents of larger scale societies, were remarkably successful; Clive Gamble refers to their ability to network, and to belong to a wider community as the 'release from proximity' (*Gamble 1998; 1999*). But they were at the limits of their cultural capacity to sustain sufficiently large numbers of people who could maintain meaningful contact with one another.

Kevin Laland is Professor of Behavioral and Evolutionary Biology, and, like Henrich, has recently published a book that summarises decades of collaborative research, describing many years of observation and simulation experiments that illustrate the importance in human evolution of skills in cultural innovation and the capacity for cumulative culture within the cultural niche (*Laland 2017*). Like Henrich, Laland highlights "*the significance of accelerating cycles of evolutionary feedback, whereby an interwoven complex of cultural processes to reinforce each other in an irresistible runaway dynamic that engineered the mind's breathtaking computational power*" (*Laland 2017. 3*). He has worked with archaeologist Mike O'Brien, and together they have written on the beginnings of agriculture as a case-study in the context of cultural niche construction theory and gene-culture co-evolution, but in neither paper were they considering specifically the example of our ENT (*Laland, O'Brien 2010.315–318; O'Brien, Laland 2012*). Laland (*2017. 240–241*) appreciates that "*hunter-gatherers are effectively trapped in a vicious cycle that severely constrains their rate of cultural evolution*"; hence the significance of developments that he notes, and which can be documented in the Epipalaeolithic of Southwest Asia, such as reduced mobility, the storage of food resources, and reduced birth spacing for accelerating population growth as well as increasing the opportunities for refining and expanding the toolkit. While he discusses in some detail examples of gene-culture evolution among herders and cultivators, such as lactose tolerance and enhanced capacity for digesting starchy cereal-based foodstuffs, he is much less concerned with the social and cognitive demands of living together in large, permanently co-resident communities.

Transforming the scale of the human cultural niche

It should by now be apparent that the evolutionary context within which I wish to set the ENT involves cultural niche construction theory and the idea of

cumulative culture, in which the authors mentioned in the previous paragraphs are leading figures. After Gordon Childe's 'oasis theory' attributed the beginnings of farming to a supposed desiccation of much of Southwest Asia following the end of the Ice Age, the standard account was established in the 1960s by processualist archaeologists who sought to develop an evolutionary-ecological framework, in which human populations responded to environmental pressures, turning to farming either because of increasing population pressure on finite wild resources, or because of climatic effects (prompted by the discovery of the sudden Younger Dryas phase in the final millennium of the Pleistocene), or because the stability of the warmer, moister, early Holocene climate made agriculture practicable. These are all variants of a view of cultural evolution as adaptations that are responses to environmental pressures. But evolutionary theory has moved on.

By contrast with the mid-twentieth century's so-called modern synthesis or neo-evolutionary theory, recent evolutionary developments are referred to as the forming of an 'extended evolutionary synthesis' in which niche construction plays an important role (*Laland* et al. *2015*). The publication by the evolutionary biologist Richard Dawkins of his notion of the extended phenotype signified the beginning of a major development of evolutionary theory (*Dawkins 1978; 1982*). As examples of the extended phenotype, Dawkins cited the capacity of animals to modify their environment, such as the protective house formed by the caddis, or the behaviour of beavers in building dams and lodges. He also discussed how organisms of one species may manipulate organisms of another species, such as the manipulation by the cuckoo chick of the host birds that feed it. At very much the same time, several scientists began to use the term co-evolution, and in particular gene-culture coevolution (*e.g., Lumsden, Wilson 1981; Durham 1991*), or 'dual inheritance theory' (*Cavalli-Sforza, Feldman 1981; Boyd, Richerson 1985*). The most frequently cited example of human gene-culture coevolution is lactase persistence among some human farming and pastoralist groups that depend on milk in their diet (*e.g., Gerbault* et al. *2011*).

The extended evolutionary synthesis mentioned above refers to these various ideas concerning the extended phenotype and gene-culture coevolution, but the group of leading thinkers who authored that article (*Laland* et al. *2015*) are agreed that niche construction theory is the most significant advance. Niche construction places emphasis on the changes that organisms bring about in their own selective environments (*Laland* et al. *2001; Odling-Smee* et al. *2003*). Niche construction is defined as "*the process whereby organisms, through their metabolism, their activities and their choices, modify their own and/or each other's niches*" (*Odling-Smee* et al. *2003.419*; see also *Laland, Sterelny 2006*). Many species of animals manufacture nests or burrows, spiders build webs, and so on: humans modify their environments by cultural means in ways that mean that the niche becomes the effective evolutionary environment in which their descendants grow up and learn how to live, and to which they are genetically adapted.

Humans have throughout the evolution of the genus Homo employed cultural means to modify the human niche in many ways, whether through the control of fire, through cooking their food, or making clothing that has enabled them to live in climatically harsh environment. Granted that niche construction theory grew up among biological scientists, it is not surprising that the aspect of cultural niche construction that has received much attention is the role of the domestication of plants and animals and the effects of that culturally modified niche on the domesticates themselves, as well as the reciprocal influences on humans, such as the transfer of diseases from domesticated animals to humans, or changes in the digestive system in response to changes in diet (*Perry* et al. *2007; Smith 2016; Zeder 2012; 2016; Zeder* et al. *2006*). But, as Henrich (*2015*), Laland (*2017*), Sterelny (*2011*) and others make clear, the human cultural niche is also constructed to facilitate social learning, the transmission of cultural knowledge and skills, and the apparently unique human capacity for cumulative culture. Michael Tomasello (*1999.80*) has remarked the capacity of human cultures to accumulate changes over generations, resulting in complex, culturally transmitted knowledge and behaviours that no single human individual could invent on their own. Henrich (*2004; 2015*) argues persuasively that the capacity to sustain a cultural package across generations, to learn information and techniques from others, and to refine and grow the cultural package over generations (cumulative cultural evolution) began at the beginning of the genus Homo. While cultural accumulation may have been almost imperceptibly slow for much of human evolution, it has become more and more rapid, making human minds and lives radically different from those of other animals (*Heyes 2012; 2018*).

The interplay between population numbers, social organisation, physical resources and cultural package are characteristics of human cultural niche construction. For humans, cultural niche construction creates not only an ecological but also a cultural inheritance. I think that it is helpful to see the Epipalaeolithic-Neolithic transformation as a dramatic quickening of the transformation of population numbers, social organisation and cultural package that make up the human cultural niche. Compared to the graphs produced by Dunbar and by Stout and Chaminade (Figs. 1 and 2), we are now concentrating our attention on the acceleration of evolutionary change within the relatively recent history of Homo sapiens. These changes took place over such a short time-scale, and, in the context of hominin evolution, so recently, that no significant evolution within the human brain has played a part. Rather, we are in the realm of rapid cultural innovation and accumulation at work in the context of social evolution. The changes in society, in culture, and in the economic basis of society that characterise the Epipalaeolithic-Neolithic, by contrast with the preceding millennia of the Palaeolithic period, represent a rapid transformation away from the world of Palaeolithic mobile foraging into a new world. I would characterise what emerged as: the first large-scale societies, formed on the back of a demographic explosion, and supported by labour-intensive, delayed return subsistence strategies that over time developed into efficient farming economies, accompanied and facilitated by the extensive diversification and expansion of complex material and non-material culture. These interlinked developments led to further, equally dramatic developments: in particular, the rapid colonisation of new territories within Southwest Asia and far beyond, the rapid diversification of cultural adaptations and the increasingly rapid rate of further social, cultural and economic innovations, so that, only two or three millennia after the Neolithic, we can observe the emergence of urban societies, at the centres of hierarchically organised landscapes, writing and accounting systems, kings, armies, merchants *etc*.

We can get a proxy handle on population by means of occupation sites and settlements. Anna Belfer-Cohen and Nigel Goring-Morris (*2011.Tab. 1*) brought together the data on the number of sites in different parts of southwest Asia between the beginning of the Upper Palaeolithic (around 50 000 years ago) and the late Neolithic (around 8000 years ago) (Fig. 3). While they have collected data for different regions within Southwest Asia, the best data come from the southern Levant, where there has been most work over at least a century. To take account of the different durations of the cultural periods, numbers of sites were normalised relative to the duration of each period. Their graph shows an apparently steady increase, period by period, in the number of sites for the south Levant. If one changes the bar-chart to a graph in which the x-axis is scaled to the shorter and shorter archaeological sub-periods of the Epipalaeolithic and Neolithic, their straight line becomes an accelerating upward curve in the number of sites, implying a crescendo of increasingly dense population.

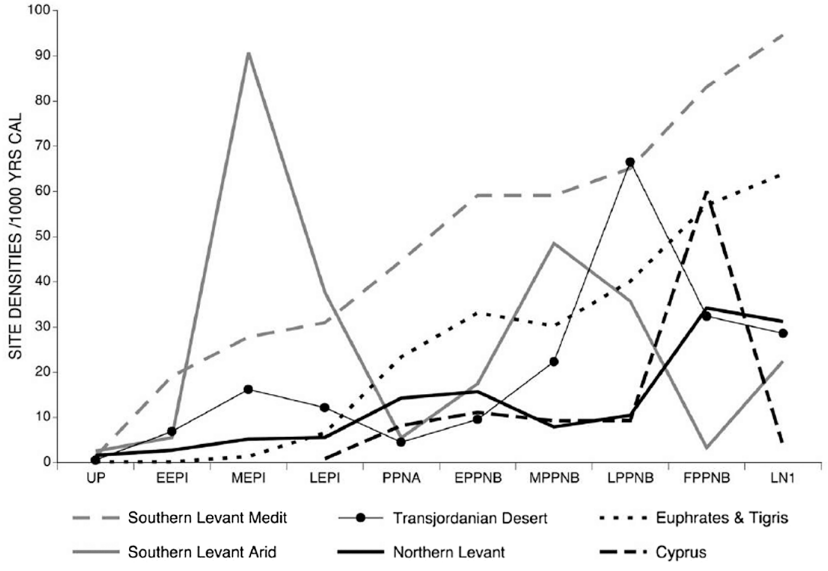

Fig. 3. Goring-Morris and Belfer-Cohen assembled data on the number of occupation and settlement sites from different regions within southwest Asia. The data from the Mediterranean woodland zone of the southern Levant shows a steady increase in settlements period by period.

This curve underplays actual population growth, because over the ENT, sites became larger, were occupied more permanently, and were more intensively built up with increasingly complex buildings. From the data he collected on the size of Neolithic settlement sites in the southern Levant, Ian Kuijt (*2000*) showed that the number and the average size of settlements increased across the sub-periods of the pre-pottery Neolithic; the largest settlements for each period increased in size exponentially. He also showed that the density of buildings on settlement sites chang-

ed dramatically through the aceramic Neolithic At the end of the Epipalaeolithic period, roofed structures were scattered, and there was more open space than roofed space; in the final sub-phase of the Pre-Pottery Neolithic, there was limited open space between buildings, and settlements consisted of approx. 75–85% roofed space. Without attempting to assess how many buildings were domestic residences, or estimating the size of social unit occupying each house, it is clear that over the Epipalaeolithic and Pre-Pottery Neolithic, there was a massive acceleration in the growth of population, with larger and larger numbers of people living together in increasingly densely built-up settlements in an increasingly densely inhabited landscape. Related to this process of increasing numbers of people living together in larger settlements, there were progressive developments in the intensification of subsistence strategies. The rate of cultural innovation and change increased through the 10 000 years of the Epipalaeolithic period (the late Epipalaeolithic Natufian is more diverse and elaborated than early Epipalaeolithic cultural packages), but increased much faster through the shorter 4000 years of the Neolithic (notably in the elaboration of symbolic material culture and practices).

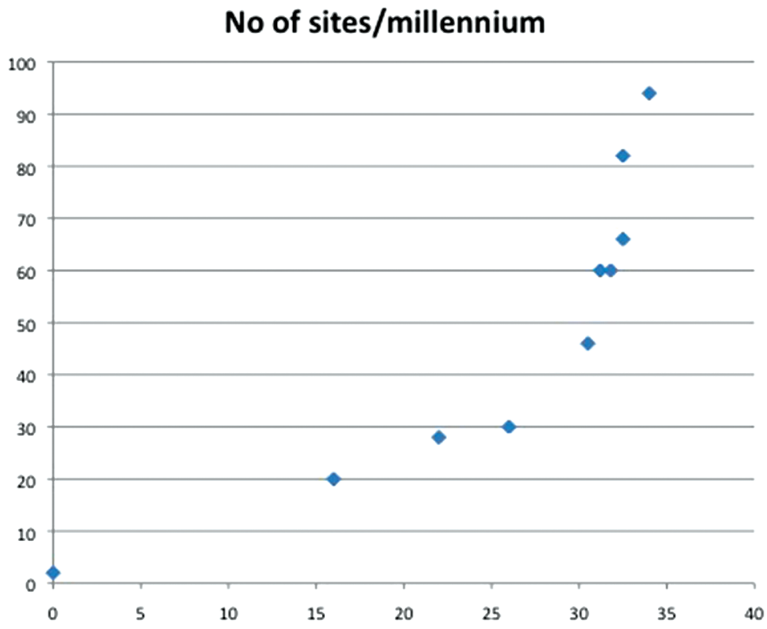

Fig. 4. Using the data for occupation and settlement sties in the Mediterranean woodland zone from Goring-Morris and Belfer-Cohen (2011), the graph plots the numbers against the time-scale of shorter and shorter archaeological periods, starting from the Upper Palaeolithic.

The costs and benefits of cumulative culture in the ENT

The benefits of expanding social group size, living in stable, permanent settlements, and increasing and intensifying the networking of sharing and exchange were the potential of a richer, more diverse cultural package, greater capacity for innovation, stability and resilience. The costs were considerable: the demand for various forms of additional labour (tending crops, management of domestic animals, the creation and maintenance of public buildings, terracing of the settlement site); the additional risks (risks of disease, risks through dependence on a progressively narrower spectrum of resources, crop failure, animal disease); the demands of cooperation and trust within a large community where any individual knows personally only a small proportion of their fellow-citizens, and the need to submit to costly rules and norms of behaviour.

An essential component in the expansion of social group size was the expansion and intensification of networks of sharing and exchange in which the new, large, permanent communities invested (*Watkins 2008; in press*). Windows on the working of the extensive regional and supra-regional networks are offered through the medium of a variety of goods and materials, but the classic case is the distribution of central and east Anatolian obsidian. We have had the general outline of the distribution of obsidian since the 1960s (*Renfrew, Dixon 1968; 1976; Renfrew* et al. *1966*), but now we know a good deal more, and it is very interesting. We know that the connections that made up this extensive network were already in existence in the Epipalaeolithic period (*e.g., Richter* et al. *2011*), and the steady crescendo in the amount of obsidian and the range of other materials in the network can be charted. But recent work by a Spanish group takes us much further (*Ibañez* et al. *2015; Ortega* et al. *2014*). Ortega, Ibañez and colleagues have simulated exchange networks, and shown that simple 'down-the-line' trading of obsidian based on the assumption that each group kept some of the obsidian that they received, and exchanged some with partners down the line does not work; 'down-the-line' exchange through a network of settlements that extended more than 800km from the sources would require that each group kept only a tiny amount, exchanging onwards almost all of the obsidian received (*Ortega* et al.

2016.14). Instead, they found that a 'small-world network', in which some participants accessed 'distant links', exchanging with partners up to 120km from home in the early Pre-Pottery Neolithic and up to 180km in the later Pre-Pottery Neolithic, worked much better. The best fit to the archaeological distribution map for the later pre-Pottery Neolithic is a form of 'optimised distant link' networking, in which certain communities emerge as significant distribution centres specifically for obsidian, and these distribution centres obtain their obsidian directly from other centres that were nearer the Anatolian sources. The researchers also observe that the largest amounts of obsidian relative to flint in the later Pre-Pottery Neolithic occur at the largest settlements in the southern Levant (*Ortega* et al. *2016.12–13*, especially Table 3).

What Ortega and his colleagues are pointing to is something that has been known since the middle of the twentieth century, but, so far as I am aware, has not been the subject of serious study. They have produced diagrams that illustrate the emergence in the Levant in the later Pre-Pottery Neolithic of a sophisticated network in which there are distribution centres that correspond to a map of known settlements in which the relative size of settlements is indicated. By the later Pre-Pottery Neolithic, there was a wide spectrum of settlement site size. The Spanish group is proposing that there were increasingly complex and hierarchical systems of supra-regional interaction and exchange of symbolically important materials, genes (through exchange of marriage partners), and the pooling of ideas, innovations and experience. If it were not dated to the later Pre-Pottery Neolithic, the hierarchy of settlements by size and by importance as distribution centres could be mistaken for a map of a Bronze Age urban settlement and economy.

Something else was new in the Neolithic, emerging out of Epipalaeolithic prototypes: monumental community architecture. The way of life in new, large, permanently co-resident communities that developed through the late Epipalaeolithic and began to flourish in the early Pre-Pottery Neolithic required stronger and materialised modes of cooperation and sharing. Because of its recent publication, Jerf el Ahmar offers the best example (*Stordeur 2015; Stordeur* et al. *2000*). This small settlement site beside the Euphrates in north Syria was never occupied after the early Pre-Pottery Neolithic. Danielle Stordeur was therefore able to expose most of the settlement over the several centuries of its existence. In an early phase of its life, there was a massive subterranean construction at the centre of the cluster of buildings. It was 7m in diameter and dug 2m deep into the ground. At the end of its life, after being reconstructed or remodelled at least twice, the wooden roof support posts were pulled out, and the roof timbers were set on fire, causing them to collapse onto the floor of the cell-like chambers, where the remains of wheat, barley and lentils were carbonised. We may infer that the cells had served as a storage facility for the community. Around the communal storage building were several communal kitchen buildings equipped with multiple grinding stones. The houses of the community were smaller, simpler buildings that clustered around a central communal area. Although the community was larger than a typical mobile forager band, and although they were engaged in the cultivation of crops, the community seems to have continued the sharing ethic of hunter-gatherer societies. Indeed, their communal food storage was monumentalised in this massive central building. What happened in the open area, with its carefully arranged beaten earth platforms, we do not know. But, as part of the symbolic rituals that accompanied the 'death' of the building, and before the remains of the structure were set on fire, a detached human head was placed in a socket vacated by a roof support post, and the decapitated body of a young woman was thrown onto the floor from the trapdoor in the roof that was the main access to the building. This massive subterranean building was one of a series of similar structures at Jerf el Ahmar, but the later versions were simpler in internal plan; there was a large, circular floor, and a stone-built 'bench' around the foot of the wall. Like the building just described, it seems that each building in the series was deliberately and carefully deconstructed and obliterated at the end of its life.

Jerf el Ahmar was not unique. Similar large, circular, subterranean buildings were found at the nearby contemporary settlement of Tell 'Abr 3 (*Yartah 2016*), and a massive mud-brick built circular, subterranean structure with three internal buttresses was partly excavated at a third early Pre-Pottery Neolithic settlement in the Euphrates valley at Dja'de; the mud plaster on the inner faces of the wall and buttresses were decorated with panels consisting of intricate geometric designs executed in red, black and white paint (*Coqueugniot 2014*). Across the upper parts of both the Euphrates (Çayönü) and the Tigris basins (Hallan Çemi, Hasankeyf Höyük, Gusir Höyük) early Pre-Pottery Neolithic settlements also had communal buildings, some of them on a monu-

mental scale (*Atakuman 2014; Kornienko 2009*). In the southern Levant, the site of WF16 in southern Jordan had a very large, circular, semi-subterranean structure of complex design, around which were small circular buildings that have been interpreted as communal storage facilities for cereals and/or pulses (*Finlayson* et al. *2011a; 2011b; Mithen* et al. *2011*).

The most dramatic example of monumental architecture and sculpture is the site of Göbekli Tepe, on a bare limestone mountain ridge near the city of Urfa in southeast Turkey (*Schmidt 2010; 2011*). The now famous large, circular, subterranean enclosures of the earlier phase at the site date to the early Pre-Pottery Neolithic, contemporary with settlements like Jerf el Ahmar that have similarly monumental communal buildings. Göbekli Tepe seems to have functioned as a 'central place' – the excavator, the late Klaus Schmidt, compared it to the neutral ceremonial meeting place of an ancient Greek amphictyony. This was the socio-cultural 'central place', where people from many communities in the region demonstrated the reality of their super-community. A series of huge, circular enclosures – up to 30m in diameter – are embedded into the main mound, and each is populated by a pair of centrally placed T-shaped monoliths and ten or twelve somewhat smaller monoliths around the perimeter wall. Some of the T-shaped monoliths are explicitly anthropomorphic. The central pair of monoliths in Enclosure D, the tallest monoliths so far discovered at 5.5m tall, have human arms and hands. In common with several other monoliths, this pair wear a collar with a pendant at the throat. Each also wears a decorated belt with an elaborate buckle, from which hangs the skin of a fox. Like all the other T-monoliths, the head is a completely faceless, rectilinear block.

Many of the T-monoliths have wild animals (mostly dangerous species and males), large birds, or reptiles, insects, scorpions or spiders carved in raised relief. There are also many other, smaller stone sculptures, many of them consisting of schematised human heads. Many questions about this unique site are still to be resolved, although the dating to the early Pre-Pottery Neolithic and the beginning of the later Pre-Pottery Neolithic is now clear (*Dietrich* et al. *2013*, but many more radiocarbon dates are close to publication). We also now know that there are indications of large-scale feasting (for what must have been a large-scale work-force) on the meat of wild cattle and gazelle, accompanied by beer, and rituals that involved the treatment of the dead (*Dietrich* et al. *2012; 2017; Notroff* et al. *2015; Pöllath* et al. *2017*).

There are sculpted T-shape monoliths at a number of sites around Göbekli Tepe in southeast Turkey, but most sites remain unexcavated or undated. The somewhat later settlement site of Nevalı Çori, to the northwest of Göbekli Tepe, possessed a rectangular, semi-subterranean structure that was originally populated by a pair of T-shaped sculpted monoliths in the centre of its stone-paved floor, surrounded by a series of smaller monoliths set into a stone bench around the walls (*Hauptmann 1993; 2011*). The building is quite unlike the houses of the settlement, and it seems to be a communal building. Nevalı Çori and its communal building is dated to the early part of the later Pre-Pottery Neolithic. Similar rectangular semi-subterranean buildings with a pair of T-shaped monoliths have been found at Göbekli Tepe, where they post-date the massive circular enclosures of the earlier Pre-Pottery Neolithic.

Subterranean or semi-subterranean communal buildings on a monumental scale, T-shaped monoliths, and some of the motifs that are sculpted on the Göbekli Tepe monoliths have been found at other sites in northernmost Syria and southeast Turkey. But there is another class of object that has now been recognised at several settlements in the region. The first to be published were found at Jerf el Ahmar; they are small stone plaques, flat on both surfaces, of a size that would fit easily in the palm of the hand. In one way they are like a class of stones, that are flat on one surface, with a groove running the length of the longer axis. Some of these grooved stones are decorated on the upper surface; they are characteristic of the end of the Epi-palaeolithic and the beginning of the Pre-Pottery Neolithic. But the plaques are different. They have motifs incised on both faces. Some of these motifs are repeated on plaques from different sites, and some of the motifs, like the wriggling snake with the triangular head, are frequently seen on monoliths at Göbekli Tepe. We now have examples of these small stone plaques from a number of early Pre-Pottery Neolithic settlement sites in north Syria and southeast Turkey. It seems that the motifs are signs that are elements in a 'semasiographic' (or ideographic) sign system.

Scripts in pre-Columban Mesoamerica and the Andes were semasiographic (as opposed to glottographic); the proto-cuneiform accounting tablets of late fourth millennium BC southern Mesopotamia, referring to quantities and commodities, were similarly semasio-

graphic. The philosopher and historian of science Peter Damerow, who had worked with Hans Nissen and Robert Englund on the proto-cuneiform tablets (*Nissen* et al. *1990; 1993*), analysed how such semasiographic systems can function effectively for a community that shares the 'cognitive frame' within which the signs function: "*A body of knowledge shared between the partners in a communication process provides cognitive frames that are triggered by the communication process, instantiated by the given incomplete information, and finally complemented by default assumptions about the subject which are retrieved from memory as an effect of the assimilation of this subject to the frame*" (*Damerow 1999.3*). I believe that we can say that there were regional networks of communities in the early Pre-Pottery Neolithic whose shared 'cognitive frames' made their groups of carved signs meaningful, just as groups of mathematicians or theoretical physicists share the 'cognitive frame' that enables them to have a meaningful discussion around a blackboard covered in signs and symbols.

The cognitive-cultural niche and the shared community identity

I seek to argue that these related modes of material symbolism constituted a significant development of the cultural-cognitive niche, because they facilitated the storing and sharing of ideas and knowledge, directing and constraining the cognition of those who belonged to the community that shared them. While the ability to create meaningful images was, of course, not new, the complex structuring of images, sculptures, and architectural settings, and the emerging evidence of how the elements were created, moved, and reshaped, plus the evidence of the formalised activities at the site represent a major development in the formation of highly affective cognitive niches.

What we see, at least from the beginning of the early Pre-Pottery Neolithic, is a new capacity to form and sustain permanent communities, both at the level of the individual settlement, and at higher levels as regional and even supra-regional communities. The formation of this new kind of symbolic cultural niche involved developments in cognition: the cultural niche interacted with cognition. The idea of a cognitive niche is not new and is certainly not my invention. Two distinguished philosopher-psychologists have written about the cognitive niche. In both cases, they were excited by the way that language materialises thought in words, creating structures that are themselves proper objects of perception, manipulation, and (further) thought. Andy Clark, a leading philosopher interested in the philosophy of mind, talks of language as a kind of self-constructed cognitive niche (*Clark 2006.370*). He argues that words materialise thoughts that "*create structures that are themselves proper objects of perception, manipulation, and (further) thought.*" The eminent psychologist Steven Pinker, who has worked on language, cognition and mind, similarly talks of the cognitive niche (*Pinker 2010*). He argues that the distinctive feature of the cultural niche of Homo sapiens is the way that human intelligence, sociality, and language have co-evolved. Here we are not concerned with human language per se; I refer to these distinguished scholars for their views on the co-evolution of human cognition within the human cultural niche, in support of the way that I wish to unfold the accelerating cumulative cultural evolutionary process through the ENT (*Watkins 2016*). I want to emphasise that there was not only a complex gene-culture co-evolutionary process within the human cultural niche (through the cultivation and domestication of plants and herding of animals, with reciprocal effects on the biology of human populations), but also a cultural-cognitive evolutionary development.

Clark and Pinker do not differentiate between spoken and written language, as Merlin Donald emphatically does (*Donald 1991; 1993; 2001*). Donald labels as 'theoretic culture' the third stage in his account of the evolution of human culture and cognition. Although he was thinking primarily – as a good academic should – in terms of written texts as the prime form of 'external symbolic storage', a medium for the storage and transmission of all kinds of knowledge, he discusses the capacity of art and architecture to serve as shared external symbolic storage, and sees the beginning of the emergence of external symbolic storage systems in Upper Palaeolithic art. In describing the power of systems of 'external symbolic storage', Donald, who began as a neuro-scientist before concentrating on psychology, remarks that the overwhelming influence of symbolic culture in its various forms deeply affects the continual development of our brains and minds to such an extent that cultural changes can actually remodel the operational structure of the cognitive system. What Donald says refers to the capacity of humans to make something like a Byzantine period church, full of mosaics and frescoes, that frames the movements, gestures, words, and the very feeling and thinking of those involved in the liturgy. It is a co-evolutionary feedback loop between symbolic

material culture – whether carved and built in stone, or inscribed on clay tablets – and the cognitive capacities of those who are members of that community.

Conclusion

Over a few thousand years – a very brief period on the evolutionary timescale – mobile foraging groups living in rich and favourable environments found ways to create larger and more cohesive communities, transcending by cultural means the biological limits of their inherited brains. We can chart the increasing population density, see something of the increasing size of the co-resident social group, and recognise the increasing scale, intensity and cultural-cognitive modes of their networked super-communities. But what we know of the mechanisms that sustained human social networks is still rudimentary; we can see the expansion of Upper Palaeolithic networks of exchange, and recent fieldwork is showing us sites that were occupied seasonally, where people built permanent structures. From the early Epipalaeolithic, there was a new kind of occupation site in the form of huge aggregation sites, where large numbers of people with somewhat different cultural traditions gathered for seemingly lengthy stays (*Jones* et al. *2016; Maher 2017; Maher* et al. *2012*). Networks of inter-personal and inter-group relationships were expanded, but could not be expanded without the further development of the symbolic cultural means to sustain large-scale communities. Around the end of the Epipalaeolithic and through the early Pre-Pottery Neolithic, permanent, sedentary communities began to operate within sophisticated networks that constituted super-communities, sharing prized materials, technical know-how, cultural innovations, styles, tastes, and acknowledging that they shared stories and beliefs about the world expressed in symbols and images. Most significantly, these communities and super-communities were constructed as vertically nested, complex identities, something that we can recognise as being fundamental to our own, contemporary experience of complex, nested identities.

There is a rapidly growing body of literature that puts forward evidence that larger social groups are better able both to sustain a complex cultural heritage, to innovate and incorporate innovations, and to withstand competition. I accept the central thesis of Joe Henrich's (*2015.57*) recently published book on the human facility for cumulative culture: "*cultural evolution became the primary driver of our species' genetic evolution*". Henrich argues that the key features of human cultural and social evolution have been to ensure that there are sufficient numbers in the population, with effective interconnectedness: the larger and more complex the body of cultural knowledge, ideas, and behaviours, the greater the scale of population that is required to support it, and the greater the need for intensive sociality and social interaction within that population. Robert Boyd offers the same conclusion: that the facility for cultural accumulation depends on the size and interconnectedness of populations (*Boyd 2018.53–58*), based on the analysis of ethnographic evidence (*e.g., Kline, Boyd 2010*) and on laboratory simulations (*Derex, Boyd 2015; 2016*). Further, the experimental work and simulations of Maxime Derex and Boyd show that large populations made up of partially connected groups work best, which is surely what we see in the regional and supra-regional networks of sharing exchange of the early Neolithic.

In the course of the Epipalaeolithic-Neolithic transformation, small-scale, mobile forager band society, a cultural niche that had been highly successful in its own terms (it had supported a massive expansion of population and the spread of Homo sapiens around the diverse environments of Africa, Eurasia and Sahul), was transformed to become a dynamic new kind of niche, based on the first large-scale, permanently co-resident communities that operated within sophisticated networks that constituted socio-cultural super-communities (what Gordon Childe had termed 'cultural groups', or 'cultures'). Within these regional super-communities, people shared prized materials, technical know-how, cultural innovations, styles, tastes, ideas/stories/beliefs/images/symbols. People were no longer bound by 'horizontal' ties between individuals (family, kin, neighbours, those who shared the same settlement, those they knew or encountered every day), but were also invested in vertically nested, complex identities. From this pivotal moment, the pace and scale of social, economic and cultural evolution increased in an ever steeper curve.

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Contextualising Karaburun: a new area for Neolithic research in Anatolia

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ABSTRACT – *Recent surveys led by Ege University in the Karaburun Peninsula discovered multiple prehistoric sites. This article introduces one of the Neolithic sites, Kömür Burnu, in this marginal zone of coastal western Anatolia. The site offered various advantages to early farmer-herders, including freshwater and basalt sources as well as proximity to agricultural lands, forested areas and marine resources. The material culture suggests that a local west Anatolian community lived here around 6200–6000 cal BC. P-XRF characterisation of obsidian pieces from Kömür Burnu revealed that they were acquired from two geographically distant sources (Melos-Adamas and Göllüdağ). These constitute the first evidence of the participation of Karaburun early farmer-herders in exchange networks of Neolithic Anatolia and the Aegean. Notably, the different technological features of these pieces fit well with the dual obsidian mobility model suggested by Marina Milić for the western Anatolian Neolithic.*

KEY WORDS – *Anatolia; Neolithic; Karaburun Peninsula; obsidian mobility; survey data*

Kontekstualizirati Karaburun: novo območje raziskav neolitika v Anatoliji

IZVLEČEK – *Univerza Ege je nedavno izvedla površinske preglede na polotoku Karaburun, ki se nahaja na obalnem predelu v zahodni Anatoliji, in odkrila številna nova prazgodovinska najdišča. V članku predstavljamo eno od neolitskih najdišč, in sicer najdišče Komur Burni. Najdišče se nahaja na območju, ki je bilo ugodno za poselitev prvih poljedelcev in živinorejcev, saj ima dostop do sveže pitne vode, do naravnih surovin (bazalt) in do kmetijskih površin, gozda in morja. Materialna kultura kaže, da je bilo to območje poseljeno ok. 6200–6000 pr. n. št. Analiza P-XRF je pokazala, da so obsidian iz najdišča Komur Burnu pridobivali iz dveh geografskih območij (Melos-Adamas in Gollu-dag). To je prvi dokaz o tem, da so bili prvi poljedelci in živinorejci na polotoku Karaburun v času neolitika že vključeni v sistem menjav med Anatolijo in otoki v Egejskem morju. Predvsem je opazno, da lahko te najdbe na podlagi njihovih različnih tehnoloških značilnosti dobro umestimo v model dvojne mobilnosti obsidiana kot ga je predlagala Marina Milić za zahodno Anatolijo v času neolitika.*

KLJUČNE BESEDE – *Anatolija; neolitik; polotok Karaburun; mobilnost obsidiana; površinski pregledi*

Introduction

Neolithic research in western Anatolia accelerated after the mid-1990s. Previously known only through few survey projects conducted by David French (*1965; 1969*) and Recep Meriç (*1993*), new excavations, notably around the modern city of Izmir, enriched our knowledge of the first farmer-herders and their life ways from the early 7th to the mid 6th millennium BC (*Çilingiroğlu* et al. *2012; Sağlamtimur 2012; Derin 2012; Horejs 2012*). Recognition of a locally developed Neolithic culture due to an increas-

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ing number of published reports and publications led to the better identification and dating of survey materials from the region, contributing to an improved understanding of the distribution and character of Neolithic settlements (*Çilingiroğlu 2012; Horejs 2017*). One of the areas where Neolithic remains have been identified is the Karaburun Peninsula on the Aegean coast of western Turkey (Fig. 1).

In this paper, we aim to introduce and contextualise the Neolithic finds from the site of Kömür Burnu, located on the northeast of the Karaburun Peninsula, in relation to known Neolithic sites in western Anatolia and the eastern Aegean.

Pre-Neolithic sequence: is there anybody out there?

The pre-Neolithic sequence of western Turkey is scarcely known. Notably, Late Pleistocene and Early Holocene forager remains from the region have been almost entirely lacking until very recently (*Çilingiroğlu, Çakırlar 2013; Kozłowski, Kaczanowska 2014*). The total absence of data from these periods is mainly the result of the low number of prehistoric studies, inefficient research methods and the inundation of the sites due to rise in sea levels during the Early Holocene. All of these factors contributed to the lack of representation of pre-Neolithic western Turkey in the literature. In contrast, the Final Pleistocene and Mesolithic periods are very well known on the mainland Greece and Aegean islands thanks to problem-oriented survey and excavation projects (*Sampson* et al. *2012; Efstratiou* et al. *2014; Carter* et al. *2014; 2016*). However, the absence of pre-Neolithic forager sites in western Turkey makes any description of local forager material culture and their interpretation within the context of contemporary Aegean and Eastern Mediterranean cultures a complete guesswork. This research gap also led to an insufficient understanding of Neolithisation processes in western Anatolia, as it is crucial to identify Mesolithic elements in the Initial Neolithic assemblages in order to discuss any evidence of forager-farmer interactions (*Çilingiroğlu, Çakırlar 2013; Çilingiroğlu 2017*).

Luckily, new survey projects in western Turkey began to specifically target Late Pleistocene and Early Holocene sites in order to close this huge gap in our knowledge (*Özbek 2009; Özbek, Erdoğu 2014; Çilingiroğlu* et al. *2017; Atakuman 2018*). The Karaburun Archaeological Survey Project (KASP) is one of these fieldwork projects, which, by adapting pedestrian and intensive survey strategies, led to the discovery of early prehistoric camp/activity sites along the current coastline of Karaburun Peninsula. These discoveries include multiple Paleolithic as well as Epipaleolithic (Late Pleistocene) and Mesolithic (Initial Holocene) open-air sites. Most notably, KASP identified two open-air sites that are tentatively dated to the Epipaleolithic and Mesolithic periods based on the typology and technology of lithics collected (*Çilingiroğlu* et al. *2016; 2018a*).

While it is still too early to make conclusive remarks about the nature of west Anatolian pre-Neolithic foragers, new data from Karaburun and other survey projects have already demonstrated that, similarly to the other Aegean regions, many forager groups lived in the area. Also, preliminary observations concerning chipped stone suggest that, at least technologically, western Anatolia is more closely related to the Aegean Epipaleolithic (Final Pleistocene, *c.* 10th millennium BC) and Mesolithic (Initial Holocene, 9–8th millennia BC) groups than other Anatolian and eastern Mediterranean chipped stone technologies (*Çilingiroğlu* et al. *2016; 2018b*). The planned detailed study of the chipped stone from these sites will hopefully provide the first insights into the techno-

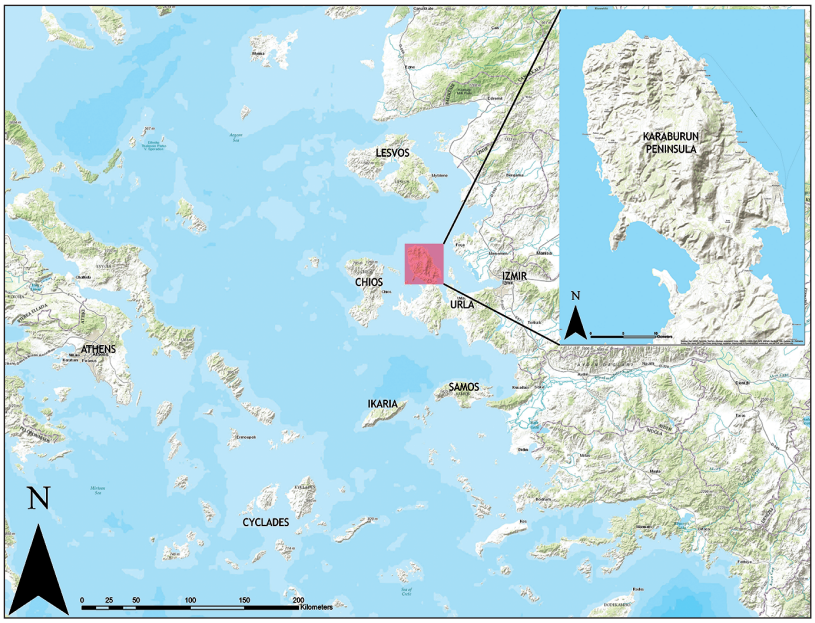

Fig. 1. Map of the Aegean and close-up view of the survey area (map by Ç. Çilingiroğlu).

logical and cultural relations of Late Pleistocene and Early Holocene foragers within western Anatolia. Furthermore, such a study will afford us the first chance to compare Initial Neolithic lithic assemblages with pre-Neolithic assemblages in order to infer possible encounters and contacts between farmer-herder and forager groups in the Early Holocene.

Neolithic groups of the Karaburun Peninsula

Although the crucial stages of early farmer-forager encounters and the establishment of the first settlements by farmer-herders are still unknown in the Karaburun Peninsula, we were able to identify one Neolithic site which provided various clues on settlement size, location, material culture, ceramic technology, and exchange activities (Fig. 2). From 2015 to 2017, KASP conducted fieldwork at a Neolithic site on the northern coast of the Karaburun Peninsula which had been previously discovered by a non-systematic reconnaissance by colleagues from Dokuz Eylül University in Izmir (*Uhri* et al. *2010*). Kömür Burnu is a multi-component prehistoric site with evidence of Paleolithic, Neolithic, Chalcolithic, Bronze Age and Roman occupations scattered over a landscape covering a total of 3.5ha (Fig. 3).

Neolithic occupation at the site was located on a slope facing south-southeast, covering approx. 0.9ha. Although the surface is densely covered with evergreen shrubs and other Mediterranean vegetation, the density and diversity of surface finds indicate permanent occupation. On the other hand, no architectural remains or evidence of thick deposits can be observed from the surface, which may indicate that the site does not contain long stratigraphic units. The archaeological material from the site, especially the fabric and morphology of the ceramics, suggest that the site was occupied during the later stages of the Neolithic sequence around 6200–6000 cal BC.

Our fieldwork at the site consisted of both random sampling and a systematic intensive survey. In order to examine the density, diversity and distribution of the Neolithic finds, as a pilot study, our team conducted an intensive survey of a limited area of 61m^2, which yielded 700+ archaeological finds from

Fig. 2. Site of Kömür Burnu from the East (photo by Ç. Çilingiroğlu).

78 dog leash units (*Çilingiroğlu* et al. *in press*). Most of the material at the site consists of ceramics and chipped stones. However polished axes, ground stone tools, stone bowl fragments and molluscs were also identified. Unfortunately, the animal bones at the site were very poorly preserved. Our survey recovered only one animal bone and various species of mollusc, which can only be tentatively dated to the Neolithic period; these include typical Aegean mollusc species, such as cardium (*Cerastoderma glaucum*), oysters (*Ostrea edulis*), *Murex* and *Glycymeris* types, which are all found locally.

Ceramic technology and relative dating

The pottery from the site has very distinctive qualities that compare well with assemblages from contemporary sites (Fig. 4). Although the preservation of the surface material is not optimal, fabrics and forms could be identified and classified in order to make comparisons for a relative dating.

The pottery (n = 40) has thin walls (mostly 4 to 7mm), medium- to poorly-fired examples with most-

Fig. 3. Different areas with archaeological finds from the Kömür Burnu site (map by Ç. Çilingiroğlu).

ly grey to dark grey pastes. Most sherds contain mineral (mica, sand, lime and small grit) and organic (chaff) inclusions in their fabric. The density of non-plastic inclusions is very high (20–30%), a distinctive characteristic of pottery from Kömür Burnu. Another typical feature is the high amount of porous surfaces, mainly due to the burning of chaff inclusions during the firing process. Outer surface colours range from red and reddish brown to brown. The distribution of colour on the outer surface is mainly even. The slip is preserved on many pieces, whereas the preservation of burnishing is very poor. Almost all pieces have matt surfaces, presumably due to the taphonomic conditions. All sherds have plain slipped and/or burnished surfaces; none bear decoration.

Fig. 4. Neolithic pottery from Kömür Burnu (photo by B. Dinçer).

The morphology of the pottery is fairly simple and homogeneous, mainly consisting of medium-size bowls and jars with flat and disc bases (Fig. 5.1–16). Simple convex bowls, hole-mouth jars, jars with short necks and flat-based jars are among the most frequently identified vessel forms at Kömür Burnu. The diameters of bowls and jars, which range between 10–26cm, and the diameter of the bases, which range between 7–18cm, indicate that large vessels were not produced by the community, which was not unusual during this period (*Çilingiroğlu 2012*). In rare cases, single knobs are added, which is another well-known feature of west Anatolian Neolithic pottery.

The general technological and morphological characteristics described above closely match those of the Neolithic pottery known from other west Anatolian sites (Fig. 6). In particular, the presence of medium quality, mineral and organic tempered pottery with plain surfaces of red, reddish brown, and brown colours is typical of the central-west Anatolian Neolithic pottery traditions of the late 7th and early 6th millennium BC known from sites such as Ulucak, Yeşilova, Çukuriçi, Ege Gübre and Dedecik-Heybelitepe (*Çilingiroğlu 2012; Derin 2012; Horejs 2012; Sağlamtimur 2012; Lichter* et al. *2008*). Closer to the Karaburun Peninsula, Neolithic ceramic assemblages from Urla province (such Tepeüstü and Çakallar; *Caymaz 2008*) as well as Agio Gala Cave on the island of Chios (*Hood 1981*), only around 30km distance from Karaburun, are likewise technologically and typologically very similar. The absence of carinated or composite vessels is another indication of pre-6000 BC dating for this site (*Çilingiroğlu 2012*). The absence of decorated pieces also suggests a rather early date, as impressed pottery appears in the

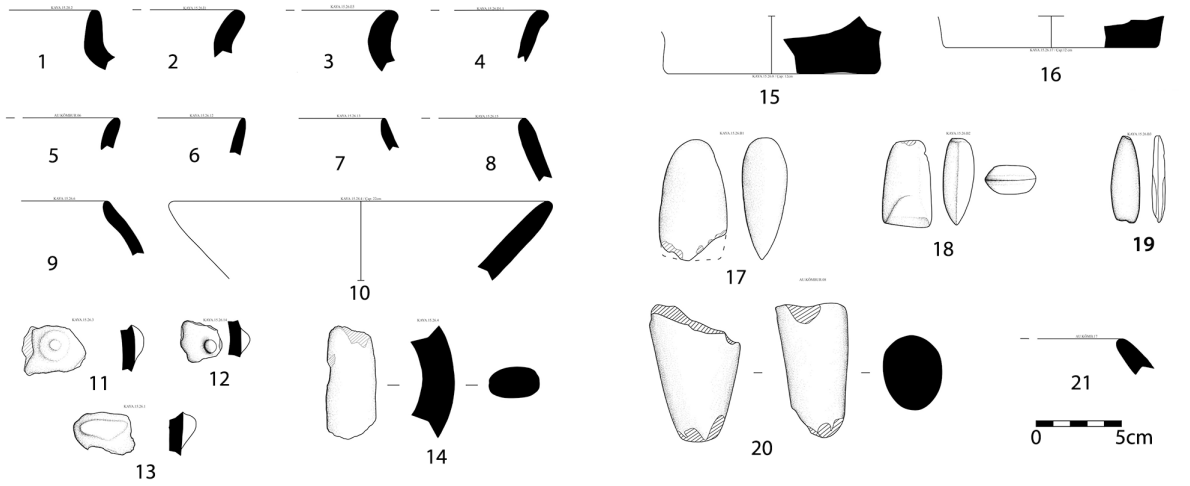

Fig. 5. Neolithic finds from Kömür Burnu. 1-16 pottery; 17-19 polished axes; 20 basalt pestle(?); 21 basalt stone bowl fragment (digital drawings by E. Sezgin, E. Dinçerler).

region only after 6000 BC (*Çilingiroğlu 2016*). On the other hand, it is somewhat surprising that vertically pierced tubular lugs and so-called 'Agio Gala lugs' (as seen in *Hood 1981.Fig. 5, 6*) are absent from the assemblage. It seems that this absence may be due to the small sample size. Yet another indication for relative dating is the use of chaff inclusions and the high content of red slipped wares (approx. 70%). These indicate that the site cannot be older than *c*. 6200–6100 cal BC, as these technological features appear in western Turkey towards the end of the 7th millennium BC (*Çilingiroğlu 2012*). In conclusion, we suggest that this site was occupied around 6200–6000 cal BC by a farmer-herder community of local origin with technological skills, preferences, storage and culinary traditions showing close similarities with contemporary Neolithic sites in the region.

Kömür Burnu community and long-distance networks

The chipped stone artefacts from the site are produced on brown and light brown coloured chert, possibly acquired from local sources, which remain unidentified so far. The blanks identified are mainly flakes with very few retouched pieces. Only one blade with typical silica gloss is known from the assemblage. The near absence of cores from the site may indicate that production took place off-site, and that the end products were brought to the settlement (*Çilingiroğlu* et al. *in press*).

Some interesting insights are provided by three obsidian pieces that were discovered during our intensive survey (Fig. 7). P-XRF analysis run by Rana Özbal found that two of these originate from Göllüdağ and one from the Adamas source on Melos[1]. The presence of Göllüdağ and Melian obsidians at Karaburun is an interesting discovery, as the involvement of Karaburun Neolithic communities in regional and supra-regional networks has not been recorded before. These comprise the first tangible evidence that Karaburun communities were actively involved in two different networks.

Previous studies in the region by Marina Milić showed that at many 7–6th millennia sites, Melian and Central Anatolian obsidians co-existed (*Milić 2014; 2016*). Also, it is a general pattern for Melian obsidian, as the closest source to west Anatolia, to make up the majority of obsidian assemblages whereas Central Anatolian pieces occur only in very limited numbers. Characterisation studies show that Melian obsidian was distributed over a wide area in the eastern Aegean, including the northern Aegean, as finds from the Neolithic site at Coşkuntepe in the Troas readily demonstrated (*Perlès* et al. *2011*). Kömür Burnu finds concur well with this pattern, and the co-occurrence of Melian and Göllüdağ obsidians demonstrate the active involvement of Karaburun communities in regional maritime networks, as well as supra-regional overland networks, despite their somewhat marginal location.

In our opinion, what is more interesting about these finds is the differing technologies and morphologies of these obsidians originating from different sources. The Melian piece from Kömür Burnu is a medial part of a possibly pressure-flaked blade (weight 0.2g).

Fig. 6. Sites mentioned in the text (map by Ç. Çilingiroğlu).

1 The analysis was conducted with Bruker Tracer IV p-XRF. I would like to thank my colleague Dr. Rana Özbal for her help.

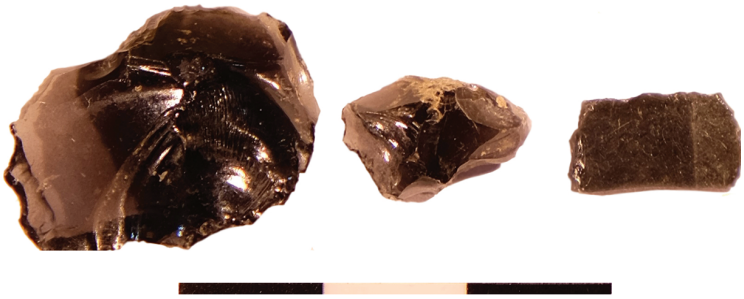

Fig. 7. Obsidian pieces from Kömür Burnu. Left and center: flakes on Göllüdağ obsidian; right: medial blade fragment on Melian obsidian (photo by G. Arcan).

On the other hand, the Göllüdağ examples are from two flakes (weight 2.01g and 0.43g), the heavier one displaying irregular retouch. Milić, who has worked on the differential character of exchange networks in Anatolian Neolithic, proposed that there were two different motivations and organisations behind the distribution of Melian and Central Anatolian obsidians. She suggests that the technological character of Melian obsidian in the eastern Aegean suggests a regular and highly organised exchange network that supplied communities with a highly demanded raw material in standard forms. It has been confirmed by the latest studies at Çukuriçi that Melian obsidian arrived in west Anatolia as prepared cores or as end products in the form of pressure-flaked blades with a high degree of standardisation (*Milić, Horejs 2017*). On the other hand, Central Anatolian obsidians are not only very rare in the assemblages, but also appear in the form of flakes and irregular pieces. Milić's (*2016*) interpretation is that demand for Central Anatolian obsidian was not economically motivated; instead, the shiny and translucent appearance of Göllüdağ obsidian (originating in this case from more than 800km away) had a symbolic and exotic value, as indicated by their tiny dimensions and irregular shapes, which could have had no economic/functional significance. The three pieces of obsidian we discovered at Kömür Burnu support the proposed dual model of obsidian mobility in western Anatolia during the Neolithic and present additional data for construing the differential nature of Neolithic networks.

Kömür Burnu as a production site during the Neolithic?

One of the features that make Kömür Burnu extraordinary is the presence of a basalt source at the site. Our fieldwork confirmed that this source was heavily exploited during the Lower Paleolithic (*Çilingiroğlu* et al. *2016; in press*). However, various finds discovered at the site seem to indicate that basalt continued to be exploited by the Neolithic group for the production of grindstones and stone bowls (Fig. 5.18–21). In fact, the presence of this source may even be one of the reasons why this place was first settled by farmer-herders. In addition, Karaburun also has a source of green serpentine which may have been directly acquired to produce polished axes such as the one demonstrated in Figure 5.17. During our work, we found polished axes, grinding instruments, pestles and stone bowl fragments that could have been produced from these locally available raw materials. Although at this moment, we have no confirmation from chemical analyses; our macroscopic observations suggest the long-term continuity of basalt production at the site. Thus, we can only speculate that the group that settled here may have developed as some sort of a production locale for basalt and serpentine objects that were valued and in demand from neighbouring communities. These may even have been exchanged in return for obsidian that arrived to the site from long distances. This suggestion can act as a working hypothesis for future work at the site.

Conclusion

In this article, we aimed to present and discuss new data on Neolithic finds from the Karaburun Peninsula in order to contextualise these new finds in Aegean and Anatolian Neolithic studies. The random sampling and intensive survey strategies conducted at the site of Kömür Burnu produced the first data about early farmer-herder groups in this part of coastal west Turkey. Located on a south-oriented slope, the site possibly offered several advantages for a Neolithic community. The proximity of fresh water, the presence of basalt, availability of marine resources, as well as agricultural lands and timber must have played a significant role in the choice of this specific location. It is also highly likely that proximity to a natural cove may have made the site accessible by water, connecting the community to other Aegean and west Anatolian groups. The material culture from the site, especially the pottery, indicates a date around 6200–6000 cal BC. More importantly, technologically and typologically the ceramics produced by the community are very similar to ceramics found at contemporary sites. There is no indication that this site was founded by a group fo-

reign to the region. Other finds from Kömür Burnu, such as the basalt and serpentine objects, may indicate that the group took advantage of local raw material sources and produced various objects, perhaps exchanging them with other extra-local raw materials such as the obsidian.

The poor preservation of faunal remains and absence of botanical remains impede any understanding of Neolithic subsistence patterns. The presence of molluscs may indicate the exploitation of marine resources during the Neolithic as a coastal settlement, but it is difficult to date these remains precisely.

The obsidians from the site shed much valuable light on the involvement of the Kömür Burnu community in regional and long-distance exchange networks, as these originated from Melian (Aegean) and Göllüdağ (Central Anatolian) sources. This comprises the first evidence of the participation of Karaburun groups in Neolithic maritime and land exchange networks. The technological and morphological features of these samples confirm the dual mode of obsidian mobility in Neolithic Anatolia (*Milić 2016*). Melian obsidian, which was valued economically, was brought to the site as prepared cores and/or pressure blades. Central Anatolian obsidian, on the other hand, had a symbolic value, as a shiny, translucent stone from distant lands, as it arrived in the region in extremely low quantities and as small irregular flakes.

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Pigs and humans in Early Neolithic Southeastern Europe: new zooarchaeological and stable isotopic data from late 7th to early 6th millennium BC Džuljunica-Smărdeš, Bulgaria

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ABSTRACT – *The Bulgarian site at Džuljunica-Smărdeš, dating to 6205–5529 cal BC, is one of the oldest Neolithic sites in Europe. Both domestic cattle and caprines are present in the zooarchaeological assemblage, but suids, in contrast, are extremely rare. It is not known if the earliest Neolithic people in Europe reared domestic pigs, practised some form of pig management, or only hunted wild boar. This research investigates human-pig relationships, using biometry, kill-off patterns and isotopic dietary analysis. With this integrated methodological approach, it might be possible to characterise human-pig relationships in this pivotal Early Neolithic site with greater accuracy. Understanding this relationship at this site contributes to the broader debate on how Neolithisation and domesticates spread through Europe, and which bio-cultural mechanisms were responsible for differential patterns of animal exploitation.*

KEY WORDS – *Neolithic; Bulgaria; zooarchaeology; pig domestication; stable isotopic analysis*

Prašiči in ljudje v času zgodnjega neolitka v jugovzhodni Evropi: novi arheozoološki podatki in analize stabilnih izotopov iz najdišča Džuljunica-Smărdeš v Bolgariji v času poznega 7. do zgodnjega 6. tisočletja pr.n.št.

IZVLEČEK – *Bolgarsko najdišče Džuljunica-Smărdeš, datirano v čas med 6205 in 5529 pr.n.št., je eno najstarejših neolitskih najdišč v Evropi. V arheozooloških zbiru najdišča prevladuje govedo in drobnica, prašiči pa so zelo redki. Ni znano, ali so ljudje v Evropu v času neolitika že vzrejali prašiče, se ukvarjali s kakšno obliko upravljanja s prašiči ali lovili le divje svinje. V članku raziskujemo odnos med ljudmi in prašiči s pomočjo biometrije, vzorcev starosti živali ob zakolu in analizo stabilnih izotopov. Z uporabo takšne integrirane metodologije lahko bolj natančno orišemo odnose med ljudmi in prašiči na tem ključnem zgodnje neolitskem najdišču. Razumevanje teh odnosov lahko prispeva k širši debati o načinu širjenja neolitizacije in domestikacije živali v Evropi in o tem, kateri biološko-kulturni mehanizmi so bili ključni za nastanek različnih vzorcev izkoriščanja živali.*

KLJUČNE BESEDE – *neolitik; Bolgarija; arheozoologija; udomačitev prašičev; analiza stabilnih izotopov*

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Introduction

The Neolithic dispersed into Europe along two main routes, the southern Maritime Route and the northern Balkan Route (*Perlés 2005; Shennan 2018*). How animal husbandry spread in Europe is still subject to debate (*e.g., Reingruber* et al. *2017*). Recent meta-analyses show inter-regional variability in the relative abundance and composition of farm animals (sheep, goat, cattle and pigs) (*Arbuckle* et al. *2014; Ethier* et al. *2017; Ivanova* et al. *2018; Orton* et al. *2016*). Interpretations of this variability diverge along palaeoclimatic, geographic, and cultural lines. *Sus* (pig and/or boar) has assumed a special place in these interpretations, partly due to the challenges of understanding its domestication, as well as the chronological and regional patterns in its subsequent distribution. Current views hold that pigs were domesticated in Southwest Asia around 10 000 years ago; the domestic pig spread subsequently into Europe, where its maternal lineage was replaced fairly rapidly by the local pig lineage through interbreeding with local wild boar (*Sus scrofa*) (*Larson* et al. *2007; Ottoni* et al. *2013*). Although Early Neolithic layers in Bulgaria contain pig specimens carrying SW Asian and European maternal genes (mt-Y1 and mt-Y2 respectively) (*Geörg 2013*), the accompanying mechanisms of human-pig interactions in the Early Neolithic (late 7th millennium/early 6th millennium cal BC; in culture-historical terms pre-Karanova I and Karanova I) Bulgaria have not been scrutinised.

In this paper, we discuss the zooarchaeological and stable isotopic ($\delta^{13}C$ and $\delta^{15}N$) data from one of the earliest Neolithic pig assemblages north of the Balkan Mountains in Bulgaria, yielded during recent excavations in Džuljunica-Smărdeš (hereafter referred to as Džuljunica) (Fig. 1). We investigate the relative abundance, morphological characteristics, mortality patterns, and foraging ecology of pigs, and make inferences on the scale of human control over the pig population that the Džuljunica assemblage represents. We then compare our results with compatible data from Neolithic and Chalcolithic Turkey, Bulgaria, and Romania, and discuss the apparent trends in terms of the 'arrival of pigs' in Europe.

The site and its environment

Džuljunica is an Early Neolithic-Copper Age settlement located in eastern Bulgaria, north of the Balkan Mountains. The Neolithic settlement has been excavated by Nedko Elenski since 2005. Twenty-two test trenches have been excavated in the Neolithic

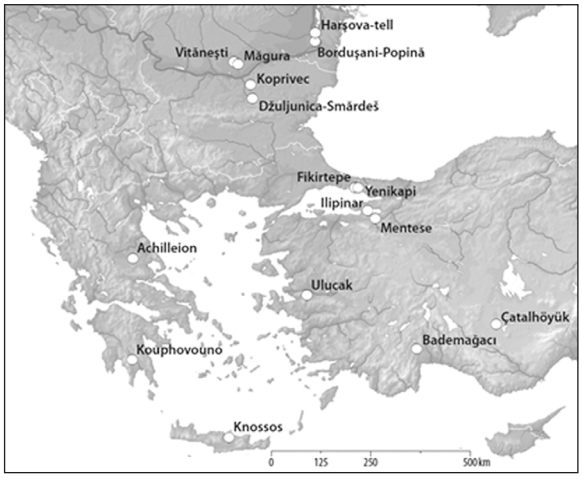

Fig. 1. Map of the sites mentioned in the text.

part of the settlement, revealing four layers, all of which have been radiocarbon dated (*Krauß* et al. *2014*) (Tab. 1). Today, the Yantra River, a tributary of the lower Danube flows 6.5km north of the site. However, some ancient watercourses suggest that the site may have been located closer to the Yantra (*Krauß* et al. *2014*). Oak is the most abundant wood species in the charcoal assemblage, but riparian species are frequent as well, indicating that the site was located at the border of riparian and oak forests (*Marinova, Ntinou 2017*).

It is clear that the inhabitants of Džuljunica were farmers, using pottery and relying on both domestic crops and animal husbandry (*Krauß* et al. *2014*). Charred seed assemblages are dominated by hulled barley. Einkorn, legumes, wild plum and hazel are also present (*Marinova, Krauß 2014*). Diachronic changes in cultivation, vegetation, and human-animal interactions at the site are subject to ongoing research.

Methods and material

So far, we have examined 6390 specimens in the hand-collected zooarchaeological assemblage of Džuljunica. In order to assess the frequency of interactions between humans and pigs, we calculated the

Layer	No. radiocarbon samples	Average range of cal BC age
I	12	6047–5930
II	7	6052–5880
III	1	6075–5920
IV	1	5670–5529

Tab. 1. The average of radiocarbon ages per layer (after* Marinova, Krauß 2014; Krauß *et al.* 2014*).

relative abundance of *Sus* in the assemblage. Since rough compatibility with regional and supra-regional datasets from the region is necessary to put our case study in regional context, we used the commonly applied NISP (= Number of Identified Specimens) counts to assess relative abundance.

To investigate size, as a proxy for the degree of interaction with humans and domestication status (*Albarella* et al. *2007; Evin* et al. *2015*), we used the Logarithmic Size Index (= LSI) method following Richard H. Meadow (*1999*). This is a logarithm of the ratio between a standard osteometric measurement and its counterpart in an animal (or animals) of known life history and size (*Meadow 1999*). This method makes it possible to compare different cranial and postcranial elements even if they are fragmented, thereby greatly increasing sample sizes. The standards for the LSI are those commonly used for assemblages of Neolithic Europe and the Near East, an Anatolian modern wild female boar for postcranial measurements (*Hongo, Meadow 2000*) and the mean of a modern Anatolian wild boar population described by Payne and Bull (*1988*) for the molars. Postcranial bones and teeth are analysed separately, since they can react differently, depending on environment, diet and management status (*Payne, Bull 1988*).

To understand kill-off patterns, we reconstructed mortality profiles based on the fusion of postcranial bones and dentition following Ximena Lemoine *et al.* (*2014*) and Melinda A. Zeder *et al.* (*2015*). To make inferences on suid diet and foraging environment, we used carbon and nitrogen stable isotopic analysis. We sampled all the suid specimens that were (logistically) available: a total of 20 specimens. Smaller samples were cut from the specimens, preserving diagnostic parts as much as possible. Most samples were taken from compact bone. Isotopic analysis was done at the University of Groningen CIO (= Centre for Isotope Research) lab, following their protocols (*Kuitems* et al. *2015*).

To avoid contamination, samples were first bathed in a HCL-solution for 20 minutes to two hours, then filtered through a 100µm filter, then rinsed with distilled water and soaked in NAOH solution to remove any humic acids, and then again filtered through a 50µm filter and rinsed with distilled water again. To remove any carbon which could have possibly reacted with the NAOH solution, the samples were rinsed with a HCL-solution once. After one more filtering and rinsing, boiled distilled water was added to the samples, and two drips of 46% HCL solution were poured in. All the samples were then put in an oven overnight. The solid material was filtered one final time over a 50µm filter, and the remaining liquid was put back into the oven for 18 hours. The solid collagen was sampled for analysis.

Some of the radiocarbon dating of the site was executed on animal bones. The $\delta^{13}C$ values have been published alongside the dates (*Krauß* et al. *2014*). The $\delta^{13}C$ values of the domestic specimens (cattle and sheep) will be used to compare with the suids. The $\delta^{15}N$ values are not available for comparison.

Results

Relative abundance

Suids make up a minor part of the zooarchaeological assemblage of Džuljunica (Tab. 2). However, their relative abundance increases slightly over time. Interestingly, the proportion of other species of large wild game (mainly cervids) seems to decrease simultaneously from Layer I to IV. Cattle become proportionally more abundant throughout the occupational layers.

Size

All postcranial measurements of Džuljunica suids are clearly larger than the modern Anatolian standard (Fig. 2). They are also larger than most suid assemblages from the 7th millennium BC Aegean, including Crete, but they compare well with the pre-6000 cal BC population from Çatalhöyük and the Marmara region (*e.g.*, Menteşe Basel, Fikirtepe (6800–6200 cal BC, unpublished data Çakırlar and Özdoğan), Ilıpınar X). In the later phases of Menteşe and Ilıpınar, suids are clearly smaller than those from Džuljunica.

NISP	Total	Artiodactyls	Cattle	%Cattle	Sheep&goat	%Sheep&goat	Sus	%Sus	Deer	%Deer
Layer I	1138	497	156	**31.4**	278	**55.9**	6	**1.2**	57	**11.5**
Layer I-II	80	23	10	43.4	11	47.8	0	0.0	2	8.7
Layer II	3432	995	324	**32.6**	592	**59.5**	27	**2.7**	52	**5.2**
Layer III	128	44	11	25	29	65.9	0	0.0	4	9.1
Layer IV	1362	559	266	**47.5**	258	**46.2**	17	**3**	18	**3.2**
Total	6140	2118	767		1168		50		133	

Tab. 2. The absolute and % NISP of cattle, sheep, goat, suid, and large game of Džuljunica.

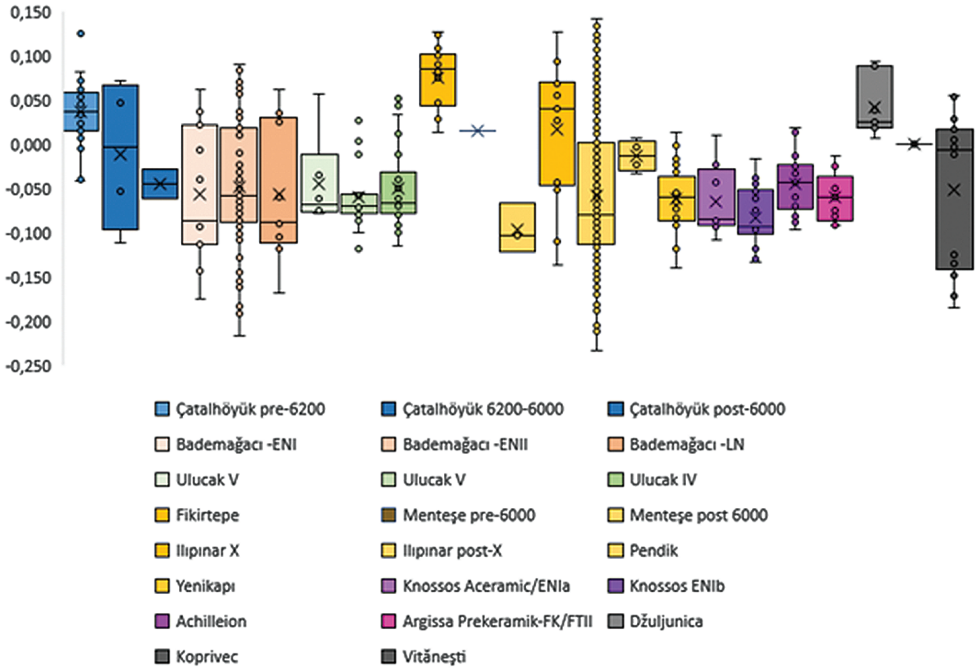

Fig. 2. Box-plot comparison of postcranial LSI's of suids from Neolithic Anatolia, Greece, Turkey, Bulgaria, and Chalcolithic Romania. Data from* Arbuckle *et al.* 2014; Balasse 2016; Manhart 1998 *and this study. See Appendix for brief site descriptions.

The overall large size and the skewed distribution of the postcranial index towards larger measurements at Džuljunica may indicate selection for males. At Fikirtepe, however, the specimens are even larger than at Džuljunica. The postcranial skeletons of the Džuljunica suids are also clearly larger than populations from later prehistoric sites in the Balkans. There is hardly any size overlap between Džuljunica and Chalcolithic (5th millennium BC) Vităneşti in Romania, where both domesticated pigs and wild boar are thought to be present (*Balasse* et al. *2016*). Also, they are larger than the specimens from contemporary Greek Neolithic sites, in which most suids are thought to be domesticated.

The patterns for cranial (*i.e.* molar) measurements are slightly different than for the size index reconstructed from postcranial osteometry. The published data on cranial dimensions of the same period and region are limited. Džuljunica molars are smaller than the molars from Fikirtepe, for example. This is unexpected, because the postcranial bones from the specimens from Fikirtepe are not much larger than Džuljunica postcranial measurements. They overlap in size with specimens from Bademağacı in southern Anatolia, which were interpreted as both wild and domestic (*De Cupere* et al. *2008*). The only measurement from Koprivec (Early Neolithic eastern Bulgaria) compares well with the molar measurements from Džuljunica.

Kill-off patterns

Fusion and dental ageing data suggest a wide range of age-at-death (Appendix Tabs. 2 and 3). Minor differences among occupational layers are present, but they are not significant. In Layer I, all specimens are adults. The specimens from Layer II are younger than the individuals in Layer I. Five specimens in Layer II

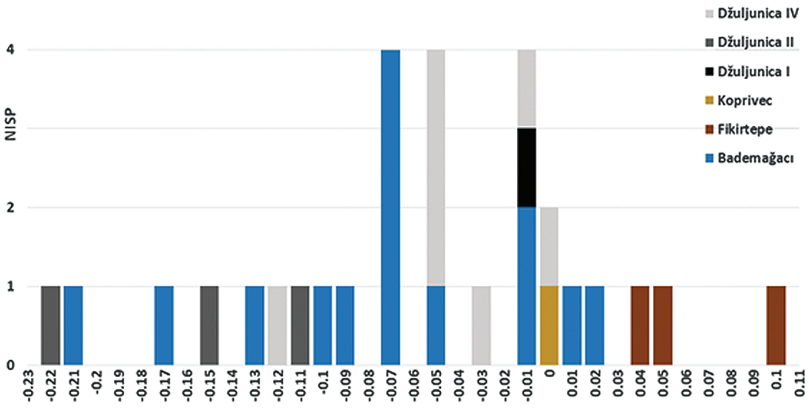

Fig. 3. LSI's based on the cranial measurement of the suids from Koprivec, Fikirtepe and Bademağacı compared to Džuljunica (data from* Arbuckle *et al.* 2014; Manhart 1998 *and this study).

represent individuals who died before 8 months of age. In the same layer, five other specimens are older than 24 months, two being older than 36 months and one even older than 96 months. In layer IV, no specimen younger than eight months was unearthed. The dental data show that the specimens were between 12–52 months when they died, one being between 18–30 months old. The fusion data from this layer also suggest that suids were slaughtered between 18 and 48 months.

Stable isotope ratios

Seventeen samples yielded collagen. All collagen samples display reliable C:N ratios (following *Ambrose 1990; Brock* et al. *2010*). Collagen yield ranged between 0.8 and 9.7% of the sampled bone weight (Appendix Tab. 4). One sample yielded only 0.8% collagen and was therefore discarded, since reliable samples must contain at least 1.0% (*Brock* et al. *2010*). The reported $\delta^{13}C$ and $\delta^{15}N$ values are averaged values based on duplicate analysis, measured as permille (‰), and calibrated respectively to VPDB and AIR.

The $\delta^{13}C$ and $\delta^{15}N$ values show no clear clusters. The $\delta^{13}C$ values are expected in a terrestrial C3 environment (Fig. 4). The $\delta^{13}C$ values of Layer II range between –23.19‰ and –20.12‰, while specimens from Layer IV have a slightly wider range, between –24.37‰ and –19.50‰. The $\delta^{15}N$ values of Layer II range between 5.26‰ and 7.06‰, while the $\delta^{15}N$ values of Layer IV have a range between 5.35‰ and 10.42‰. None of these differences between the layers are statistically significant ((t-test) differences in $\delta^{13}C$ ($t(14) = 0.23$, $p = 0.98$)) and differences in $\delta^{15}N$ ($t(14) = -1.310$, $p = -0.78$).

Herbivores tend to have higher $\delta^{13}C$ values than carnivores and omnivores. In general, the $\delta^{13}C$ ratios of terrestrial herbivores in a C3 environment are expected to vary between –26 and –20‰, and carnivores in C3 environment between $\delta^{13}C$ –25 and –18‰ (*Lee-Thorp 2008*). The variation between the specimens can be either the effect of trophic level or caused by differences in plant consumption. In general, $\delta^{13}C$ values increase with 1–2‰ per trophic level. The $\delta^{13}C$ ratios of suids differ from the $\delta^{13}C$ values of the ruminants from the site. The $\delta^{13}C$ values of radiocarbon-dated sheep fall within the range of –20.44 and –19.59‰, and the $\delta^{13}C$ values of bovids within –20.46 and –19.26‰. These are clearly lower than those of the suids, and the difference between the ruminants and the suids is statically significant ($t(19) = 4.05$ $p = 0.003$). The samples displaying the lowest $\delta^{13}C$ values possibly originate from suids that lived in dense forest or a riparian environment. Plants and trees in dense forests are more depleted in $\delta^{13}C$ than open grasslands, especially plants closer to the ground (*Drucker, Bocherens 2009*). It is possible that the lower $\delta^{13}C$ rates of the suids are the result of terrestrial diet. Another reason for lower $\delta^{13}C$ values could be the reliance on freshwater resources (*Balasse* et al. *2016*). In the botanical analysis, species expected in a riparian forest were indeed highly abundant.

$\delta^{15}N$ values are more reliable indicators for trophic levels than $\delta^{13}C$ values (*Lee-Thorp 2008*). The $\delta^{15}N$ values range within values to be expected for herbivores (5–7‰) (n = 14) and omnivores (7–9‰) (n = 2). The four suids which have $\delta^{13}C$ values within the range of the domesticated herbivores display low $\delta^{15}N$ values, which indicates that they were mainly herbivorous. The higher $\delta^{13}C$ level in these specimens cannot be the result of a higher trophic level. So, these higher $\delta^{13}C$ values are possibly the result of grazing in a more open landscape. One specimen displays a clearly higher $\delta^{15}N$ value, indicating a 'carnivorous' diet (9–11‰) (n = 1). The specimen is not a juvenile animal, so the high value cannot be due to the suckling effect (Appendix Tab. 5).

Interesting patterns arise when we compare our isotopic data to roughly contemporary neighbouring sites (Măgura, Borduşani-Popină, Harşova-tell and Vităneşti) in the riparian forests of the Danube catchment in Neolithic and Chalcolithic Romania (*Balasse* et al. *2013; 2016; 2017*) and Kouphovouno, a Greek Middle/Late Neolithic site (*Vaiglova* et al. *2014*).

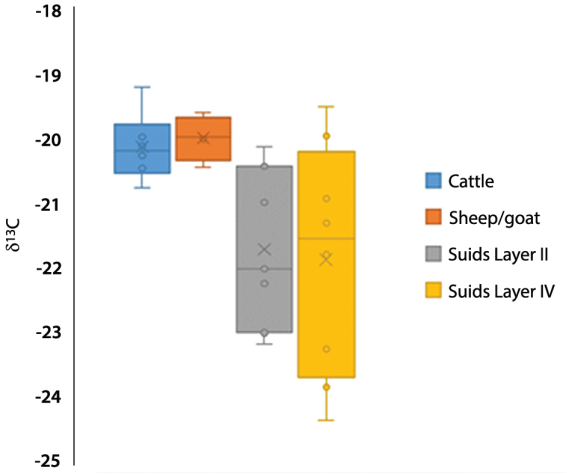

Fig. 4. The $\delta^{13}C$ values of the different taxa (cattle, sheep and suid) from Džuljunica (data of* Krauß *et al.* 2014 *and this study).

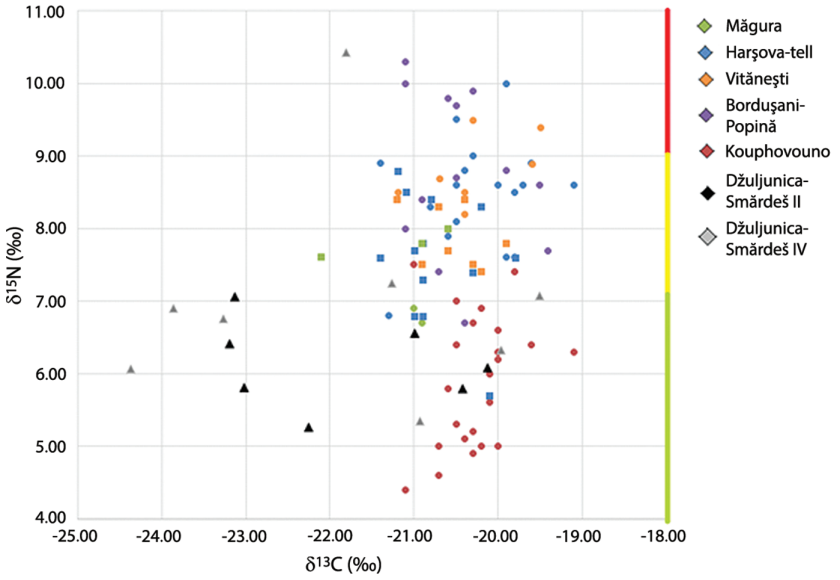

Fig. 5. δ15N and δ13C values compared. Circles (morphologically domestic suids, as identified by authors), squares (wild boar), triangles (Džuljunica specimens). The line on the right indicates the expected trophic level; green stands for herbivorous, yellow omnivorous, red carnivorous (data from* Balasse *et al.* 2013; 2016; 2017 *and this study – see Appendix Tab. 4).

The most striking observation is that the samples from the suids from Džuljunica have lower δ13C values than the suids of the compared sites (Fig. 5). However, not all specimens from Džuljunica have lower δ13C values than the compared sites; the highest δ13C values fall within the range of the δ13C values of the compared sites. The samples from suids from Măgura, the only other Early Neolithic site, also display lower δ13C values than the specimens from the other sites. No significant differences have been found between the δ13C values of the wild suids and the domestic suids from Borduşani-Popină, Harşova tell and Vităneşti (*Balasse* et al. *2016; 2017*).

The sampled specimens of Borduşani-Popină, Harşova-tell and Vităneşti have higher average δ15N values than the suids of Džuljunica. However, the highest δ15N value in the complete dataset derives from a specimen of Džuljunica. The δ15N values of morphological domestic suids of the latter three sites on average is significantly higher than the δ15N values of the wild boar. Neither the wild boar nor the morphologically domesticated specimens from Măgura show very elevated δ15N values compared to the Džuljunica specimens. The Kouphovouno specimens display even lower δ15N values than those of Džuljunica.

It has been argued that the wild boar from Borduşani-Popină, Harşova-tell, and Vităneşti may have been foraging in open environments, as well as partly in the riparian forests (*Balasse* et al. *2016*). The fact that these suids would have been grazing in an open environment/ within the settlement can explain the higher δ13C values in these suids. It is striking, however, that the morphologically wild specimens at this site also have higher carbon δ13C values than the Džuljunica specimens.

The domestic suids of Măgura are interpreted as extensively herded pigs, while the domestic suids of Borduşani-Popină, Harşova-tell and Vităneşti may have been kept in the settlement and kept on a household scale (*Balasse* et al. *2013; 2016; 2017*). These elevated δ15N values of Borduşani-Popină, Harşova-tell, and Vităneşti trophic have been interpreted as a greater consumption of human waste, such as remnants of hunted game or fish, domestic stock and dairy products or even human faeces (*Balasse* et al. *2016.33*). However, at all the Romanian sites, there is also a large overlap in the δ15N values between the morphologically wild and morphologically domesticated specimens, which is not to be neglected. The lower δ15N values of the specimens from Kouphovouno have been interpreted as a result of cereal waste fodderring of the pigs (*Vaiglova* et al. *2014*).

No specimen identified as wild boar displays a δ15N value associated with a carnivorous diet. So, the Džuljunica specimen displaying δ15N value associated with a carnivorous diet is highly exceptional, not only for this site, but also for the region.

The isotopic values from all the other assemblages show smaller ranges in δ15N and δ13C both than the Džuljunica assemblage. Even if the isotopic values of the morphologically domestic and morphologically wild suids are considered together, the ranges are not as wide as in that from Džuljunica. This is surprising, since the sample size at Džuljunica is relatively small. In cases where suids are managed and/or domesticated, isotopic signals tend to become more uniform.

Discussion

The scarcity of suids in the zooarchaeological assemblage of Džuljunica is surprising when we consider the otherwise agricultural economy of the settlement and the reconstructed environment. Oak and riparian forests are excellent environments for suids, wild or domestic, under an extensive management regime. Hence, it is highly likely that wild boar was abundant around the site. Despite the suitability of the environmental setting in the Early Neolithic before 5900 BC of the northern Balkans, suid remains are rare at all archaeological sites, representing less than 5% of the total assemblage (based on NISP), and at some sites, suids do not even make up 1% of the assemblages (*Balasse* et al. *2013; Ethier* et al. *2017* and references therein; *Greenfield* et al. *2014*), in great contrast to Greece, the Struma Valley in southwestern Bulgaria, and in central western Anatolia (*Çakırlar 2013; De Cupere* et al. *2008; Ethier* et al. *2017; Perlés 2005*). In central and north western Anatolia, suids are also present in very small quantities at the earlier sites, but they become more frequent over time (*Arbuckle* et al. *2014; Çakırlar 2013*). In this cultural context, it is plausible to suggest that although agriculture and animal husbandry were present in eastern Bulgaria at the turn of the 7th millennium, this area contrasted with southwest Bulgaria in terms of interest in Suids.

The post-cranial size of the Džuljunica specimens does not indicate that the pigs were managed, domesticated or heavily exploited. However, body size is not immediately affected at the beginning of the domestication process (*Zeder 2012*). Therefore, it could still be possible that the suids at the site were herded without any traceable influence on their appearance. On the other hand, domestication and management are not the only factors that influence body size (*Albarella* et al. *2007*). A relation between environment and suids has been attested; suids in arid areas with high temperatures tend to be smaller (*Albarella* et al. *2009; Davis 1981*). The discrepancy between large post-cranial size and smaller molar size (which is also apparent in neighbouring Koprivec) is more difficult to explain. Cranial features are expected to decrease in size at an earlier stage of the domestication process than the post-cranial body features (*Zeder 2012*). Smaller molar size in large-bodied suids in this part of Bulgaria at the end of the 7th -beginning of the 6th millennium could represent a population in the process of domestication or two co-existing populations, but it could also be a phenotypic trait prevalent in this region.

The limited ageing data are widely distributed. Starting with Layer II, kill-off patterns suggest the infrequent exploitation of suids, and that individuals of different ages were targeted mostly at random. The absence of infant and juvenile (<8 months) individuals suggests that littering and nursing was undertaken outside the settlement. In general, and especially in Layer I in which all suid specimens represent adult individuals, nothing in the ageing data indicates intensive exploitation, in agreement with the infrequency of suids in the settlement.

The $\delta^{15}N$ and $\delta^{13}C$ ratios suggest that the majority of specimens from Džuljunica were not foddered with domestic waste, as would be expected in a domestic relationship with humans. In addition, the ratios are quite dispersed. The dispersed pattern in Džuljunica indicates that the suids relied on a wide range of different food sources. So, it is clear that most suids were, if at all, only loosely managed by humans, and that humans probably had no influence on the suids' diet. It is still possible that the inhabitants controlled the diet only of some of the suids, and that other samples were hunted wild boar. If these suids were managed, humans managed them extensively in the riparian forest or in a closed forest, where pigs ate mainly plant foods and molluscs.

None of the specimens identified as wild boar at the other sites had $\delta^{15}N$ values which are associated with a mostly carnivorous diet. An unmanaged suid with such a high $\delta^{15}N$ ratio is an exception. It could have been that this specimen mainly relied on freshwater fish, which often have higher elevated $\delta^{15}N$ values (*Lee-Thorp 2008*). Although there is not much evidence at Džuljunica of fish exploitation, this is likely an artefact of hand-collection mode of excavation. Therefore, it is not possible to determine whether the suids which show an isotopic signal which may indicate a foraging in a freshwater environment could have also been foddered with the remains of freshwater resources by humans instead. $\delta^{13}C$ values from wild terrestrial animals and human remains are necessary to test this hypothesis.

To sum up, the combined results of our zooarchaeological and stable isotopic analyses suggest that humans and suids were not in a close relationship in Džuljunica. There is nothing to suggest they were an important part of the food economy. There are very few suids; they are large bodied, and they seem to have foraged in the surrounding forested landscape.

It has been argued that the earliest Neolithic people in the Balkans had to adapt considerably to the new environmental conditions (*Ethier* et al. *2017*). In contrast with Greece, Anatolia and the southern Balkans, the northern Balkans are often subject to frosty winters with heavy snow. It has been suggested that transhumance practises must have been adopted in this region to cope with stronger seasonal fluctuations (*Greenfield* et al. *2014*). Seasonally relocating is considered untypical for domestic pigs and seen as an explanation for the general lack of suids in the archaeological record of the northern Balkans in the Early Neolithic (*Ethier* et al. *2017*). However, while pig transhumance may not be practised often anymore, it was surely practised in the recent past (*Albarella* et al. *2011*).

Moreover, the reconstructed vegetation for Neolithic Džuljunica, riparian and oak forests in a well-watered landscape, indicates a perfect environment for suids, wild or managed, and the small assemblage from the site indicates that they were in the surrounding landscape. Such a discrepancy between the suitability of the environment and the role of suids in Neolithic cultures has been observed elsewhere. Suids are very scarce and morphologically wild in the earliest Neolithic layers of some sites in Central Anatolia and the Marmara region (*Arbuckle* et al. *2014*), where the environmental conditions are completely different from in eastern Bulgaria, but nevertheless suitable for suids as well. The northern Balkans is not the only region along the path of Neolithisation during the late 7th millennium without suids (*Arbuckle* et al. *2014; Evin* et al. *2015*).

All this leads us to suggest that the absence of suids may be part of a cultural trend reflecting deliberate choice in some Early Neolithic cultures, including the northern Balkans. This does not mean, however, that suids were not important in their value system.

Conclusions

Our analysis shows that humans only peripherally interacted with suids in Early Neolithic Džuljunica, despite the indications that the environmental conditions would allow a closer relationship. Regions where interactions with suids were limited in the early phases of farming during Neolithisation are along the so-called Continental Route (Central Anatolia, via the Marmara Region, the eastern and northern Balkans), whereas more intensive management of domestic pigs is observed along the Maritime Route. Our analysis does not suggest a domestic partnership between humans and suids in the northern Balkans, but this suggestion should be investigated with further research, including palaeogenomics, GMM, and other stable isotopes. Whether the 7th millennium BC suids along the Continental Route are domestic at all is an important question, because this has potential implications for the subsequent genetic history of the domestic pig originating from Southwest Asia, which later disappears through inter-breeding with local European wild boar (*Larson* et al. *2007*).

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Appendix

Tab. 1. The postcranial and cranial measurements of the suids of Džuljunica.

Faunal ID	Layer	Element	Measurement	Value (mm)
27–617	I	Radius	Bp	36.3
11–162	I	Ulna	Bfp	26.4
119–2670	II	Metacarpus III	Bd	23.4
111–2380	II	Metacarpus IV	Bp	20.1
48–2059	II	Radius	Bp	34.8
95–3149	II	Tibia	Bd	36.6
63–1157	IV	Radius	Bp	42.4
19–343	I	Maxilla	Breadth M1	15.7
48–2060	II	Maxilla	Breadth dP4	9.3
			Length dP4	13.5
			Length M2	15.3
57–1078	IV	Maxilla	Breadth M1	14.1
			Length M1	19.8
			Breadth M2	17.8
			Length M2	25.2
117–2620	IV	Maxilla	Breadth M1	12.2
			Length M1	18.2
52–1027	IV	Mandibula	Length M1	19.2

Tab. 2. The fusion stages of the postcranial elements of the suids of Džuljunica.

Element	Unfused	Fused	Fusing
Layer I			
Radius proximal		1	
Layer II			
Pelvis	1		
Scapula		1	
Radius proximal	1		
Humerus distal	1		
Tibia distal	1	2	
Metacarpus		2	
Radius and Ulna		1	
Layer IV			
Radius proximal		3	
2 Phalanx		1	
Tibia proximal	1		

***Tab. 3. The dental wear of the suids of Džuljunica following* Lemoine *et al.* 2014.**

specimen	Layer	element	dc	dp2	dp3	dp4	I1	I2	I3	C	/P1	P2	P3	P4	M1	M2	M3
Dz-19-343	I	Maxilla with teeth												10–12	13–16		
Dz-37-884	II	Maxilla with teeth					6	2									
Dz-39-898	II	Mandibula with teeth					10										
Dz-43-959	II	Maxilla with teeth						2									
Dz-48-2060	II	Maxilla with teeth	8	10–12	10–12	18										10	
Dz-117-2620	IV	Maxilla with teeth												7	11	10	
Dz-52-1027	IV	Mandibula with teeth													9		
Dz-57-1078	IV	Maxilla with teeth											10–12	10	11	10	
Dz-72-1354	IV	Mandibula with teeth					10	10	10								

Tab. 4. The results of the isotopic analysis of suids of Džuljunica.

Sample	yield (%)	%C	%N	C/N	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
DZ-57-1078	4.7	8.8	3.2	3.3	–24.37	5.57
DZ-61-1116	7.8	12.3	4.5	3.2	–23.86	6.07
DZ-63-1156	6.1	8.8	3.2	3.2	–23.27	6.91
DZ-63-1157	2.9	28.4	10.1	3.3	–21.26	6.76
DZ-69-1254	2.9	41.3	15.1	3.2	–20.93	7.25
DZ-72-1354	1.1	27.7	10.6	3.1	–19.96	5.35
DZ-83-1761	0.8	36.4	13.9	3.1	–19.50	6.32
DZ-86-1828	4.8	15.1	5.5	3.2	–21.80	7.07
DZ-95-3149	3.3	20.5	7.4	3.2	–22.25	5.26
DZ-39-898						
DZ-48-2060	3.3	6.1	2.2	3.2	–22.02	5.74
DZ-37-884						
DZ-43-959	3.0	7.1	2.5	3.3	–23.02	5.81
DZ-117-2620	8.7	16.6	6.0	3.2	–21.31	10.42
DZ-119-2670	9.7	14.1	5.2	3.1	–20.42	5.79
DZ-39-902						
DZ-48-2059	7.8	7.3	2.6	3.3	–23.19	6.41
DZ-43-953	7.6	3.7	1.3	3.4	–23.13	7.06
DZ-47-2022	5.6	8.2	3.0	3.2	–20.99	6.55
DZ-111-2380	2.8	19.8	7.6	3.0	–20.12	6.08

Sp. number	Level	Element	Size (LSI/ comments)	Age (Lemoine *at al.* age in months/ comments)	Isotopic signal $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
19–343	I	Maxilla with teeth	–0.01	52–96 months	not sampled	
DZ-27-617	I	Radius	0.03	>8 months	not sampled	
DZ-95-3149	II	Tibia	0.03	>24 months	not sampled	
DZ-39-898	II	Mandibula (male)	–	no Lemoine *et al.* stage, but clearly adult/ old	failed	
DZ-37-884	II	Maxilla with teeth	–	3–8 months	failed	
DZ-39-902	II	Radius	–	<7 months	failed	
DZ-43-953	II	Scapula	very large	–	bad quality collagen	
DZ-48-2060	II	Maxilla with teeth	–0.15, –0.21, –0.22	no Lemoine *et al.* stage, but juvenile	–22.02	5.74
DZ-43-959	II	Maxilla with teeth	–	3–8 months	–23.02	5.81
DZ-119-2670	II	Metacarpus III	0.09	>36 months	–20.42	5.79
DZ-48-2059	II	Radius and Ulna	0.01	>96 months	–23.19	6.41
DZ-47-2022	II	Tibia	0.04	>24 months	–20.99	6.55
DZ-111-2380	II	Metacarpus IV	0.02	–	–20.12	6.08
DZ-52-1027	IV	Mandibula with teeth		12–52 months	not sampled	
DZ-57-1078	IV	Maxilla with teeth	–0.05, –0.01, –0.05	18–30 months	–24.37	5.57
DZ-61-1116	IV	Tibia	–	<48 months	–23.86	6.07
DZ-63-1156	IV	Mandibula	–	–	–23.27	6.91
DZ-63-1157	IV	Radius	0.09	>8 months	–21.26	6.76
DZ-69-1254	IV	Mandibula	–	–	–20.93	7.25
DZ-72-1354	IV	Mandibula with teeth	–	no Lemoine *et al.* stage, but old	–19.96	5.35
DZ-83-1761	IV	Frontale	–	–	–19.50	6.32
DZ-86-1828	IV	Radius	–	>8 months	–21.80	7.07
DZ-117-2620	IV	Maxilla with teeth	–0.12, –0.05	18–30 months	–21.31	10.42

Tab. 5. The ageing, size and isotopic data of the suids of Džuljunica combined.

Site descriptions

Achilleion is a tell site only consisting of Neolithic layers, dating from 6500 to 5500 BC. Domestic mammals make up more than 90% of the zooarchaeological assemblage in all phases. Caprines make up the majority of the domestic species, but cattle and domestic pig become more frequent over time (*Gimbutas 1974*).

Bademağacı is an Early Neolithic mound site in Western Turkey dating. The mound consists of five early Neolithic levels dating from 6700–6200 BC. Cattle, sheep, goat and pig were all present from the earliest layers of the site onwards (*De Cupere* et al. *2008*).

Borduşani-Popină is a Gumelniţa tell site in southeastern Romania dating to the second half of the fifth millennium BC. The site was located on an island in the Danube. Pulses and wheats were both cultivated. The inhabitants relied on aquatic resources and domestic mammals. Pigs are the most represented domestic mammal based on NISP (*Balasse* et al. *2017*).

Çatalhöyük is an early Neolithic site in South-eastern Anatolia, occupied between 7300–6200 BC. Domestic caprines are the most represented domestic mammals. All aurochs in the earliest layers of Çatalhöyük are morphologically wild and no evidence indicates that they were herded. From *c.* 6500–6400 BC smaller individuals start to appear. Domestic suids are absent (*Russell 2013*).

Fikirtepe is a Neolithic site in North-western Turkey from 6500–6000 BC. It is not known whether the site was seasonally occupied or was inhabited year-round. The inhabitants relied on both animal husbandry and aquatic resources. Domestic pigs are absent in the earliest layers but introduced in later phases (*Çakırlar 2013*).

Harşova-tell is a tell site in Southeastern Romania, situated between a riparian forest and an oak forest. Diverse hulled wheats were cultivated, but wild fruits were consumed too. The inhabitants heavily relied on aquatic resources and domestic mammals. Caprines are the most common domestic mammal, followed by pigs (*Balasse* et al. *2017*).

Ilıpinar is an early Neolithic site located in Northwestern Turkey, dating to *c*. 6000–5400 BC. Domestic caprines are the most abundant domesticates in all layers, sheep dominating goat. Suids are very rare in the layers, but suid percentages in the assemblage increases over time, while the average size of the pigs clearly decreases (*Çakırlar 2013*).

Knossos was inhabited since 7000 BC and the Neolithic phase lasted for about 1500 years. Caprines are the most common domestic species in the earliest phases, but cattle becomes more important over time. Pigs also became more abundant over time (*Isaakidou 2008*).

Koprivec is an Early Neolithic site in Bulgaria dating 6100–5900 BC. 2005 animal remains have been found, mostly of domestic specimens. Cattle is the most abundant species, followed by caprines. Suids however, are very rare and make up less than 1% of the total assemblage (*Manhart 1998*).

Kouphovouno is a Middle/Late Neolithic site in Southern Greece dating to *c*. 5800–5000 BC. The botanical assemblage consists of domestic species of cereals and pulses. The faunal assemblage is dominated by domestic animals such as cattle, sheep, goats, pigs and dogs, but wild animals were found as well (*Vaiglova* et al. *2014*).

Măgura is a Neolithic site probably belonging to the initial neolithisation of Romania. Animal remains have been found dating as far back as the early sixth millennium BC. Caprines are the most represented domestic mammal. Botanical studies suggest people cultivated cereals too (*Balasse* et al. *2013*).

Menteşe is an Early Neolithic site situated in Northwestern Turkey and inhabited from 6500 until 5500 BC. Cattle and caprines are very abundant, while domestic pig is absent in the earliest phases. In later phase, domestic pig seems to be introduced (*Çakırlar 2013*).

Ulucak is an Early Neolithic site in Western Turkey inhabited from 7000 until 5700 BC. Caprines make up the majority of the zooarchaeological assemblage, but cattle and pig are both kept from the earliest layer onwards (*Çakırlar 2012*).

Vităneşti is located on the floodplain of the river Teleorman surrounded by marshlands, dating to the fifth millennium BC. A high number of domesticated taxa are represented in the zooarchaeological remains, but wild taxa (68% based on NISP), mainly large and very large mammals, predominate the assemblage (*Balasse* et al. *2016*).

Yenikapi is a Neolithic site in Western Anatolia, from *c*. 6000–5500 BC. The site consisted of a small year-round inhabited village. Domestic mammals make up the majority of the zooarchaeological assemblage, but due to sampling strategies it is unknown in what quantities the inhabitants relied on aquatic resources. Domestic pigs are absent from the earliest layers, but were introduced later (*Çakırlar 2013*).

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The ground stone industry at Pericei-Keller tag. A secondary production centre?

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ABSTRACT – *This article analyses ground stone discoveries from the late Neolithic site of Pericei in northwest Romania, in the Şimleu Depression. The combined characteristics of chisels and adzes in the working process are discussed, along with their context, especially those processes connected to stone working: the cultural layer, dwellings and pebble agglomerations. We conclude that Pericei was a centre for the production of stone chisels, and it appeared to supply demand that until then had been satisfied by the Suplac/Porţ site, which continued to produce ground stone tools for a longer period.*

KEY WORDS – *chisels; adzes; stone-working techniques; operational sequence; polished stone*

Proizvodnja glajenih kamnitih orodij na najdišču Pericei-Keller tag. Sekundarni center proizvodnje?

IZVLEČEK – *V članku analiziramo glajena orodja najdena na poznoneolitskem najdišči Pericei v severozahodni Romuniji v globeli Simleu. Razpravljamo o skupnih značilnostih in kontekstih dlet in tesel v delovnih procesih, predvsem tistih, ki so povezani z obdelavo kamna: kulturna plast, bivališče in skupki prodnikov. Sklepamo, da predstavlja Pericei center za proizvodnjo kamnitih dlet, ki je oskrboval območja, ki so bila do takrat oskrbovana iz najdišča Suplac/Port, kjer so proizvajali glajena kamnita orodja v daljšem časovnem obdobju.*

KLJUČNE BESEDE – *dleta; tesla; tehnike obdelave kamna; operacijska sekvenca; poliran kamen*

Introduction

The late Neolithic period relates to the most productive ground stone processing in Europe. It is a period in which some settlements present a large number of ground tools, especially edge tools worked for more than household needs, and we can mention here the sites at Rivannazano in northern Italy (*D'Amico, Starnini 2011; 2012; Pétrequin* et al. *2012*) and Makriyalos in Greece (*Tsoraki 2007; 2011*). In Romania, the highest frequency and number are encountered at the Suplac/Porţ-Corău site (Bihor and Sălaj county, which is why it has two names), located in the northwest of the country, in the Şimleu Depression. The discovery of 500 polished tools along with worked raw material at Suplacu de Barcău led Doina Ignat to the conclusion that ground stone processing was oriented to exchange (*Ignat 1998.32–33*). Later research at Porţ (the part of the site at Sălaj; *Băcueţ Crişan 2008; Băcueţ Crişan* et al. *2011; 2012; 2013*) over larger areas led to the discovery of 1641 pieces and raw material in diffe-

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rent working stages (*Dunca 2015; 2016b*).

The Pericei site is also in the Simleu Depression (Fig. 1). Based on the cultural traits, mainly the pottery style, it has been assigned to the Cluj-Cheile Turzii-Lumea Nouă-Iclod-Suplac (abb. CCTLNIS) cultural complex (*Băcueț Crișan 2007; 2008*) which includes several groups defined by one key site. We have two cultural and chronological assignments within this complex: as part of the Cluj group, and anterior to the Suplac group (*Lazarovici, Lazarovici 2006.413*) or as contemporary with the Suplac II phase, defined on the basis of the stratigraphy and pottery of the second layer from Suplac/Porț (*Băcueț Crișan 2008.52–53; 2007.70–72*), being a site with Suplac type pottery (*Băcueț Crișan, Pop 2014.35–36; Glascock* et al. *2016.77–78*). The second assignment will be used in this paper. We have no absolute, radiocarbon data from Pericei or Suplac/Porț. In a relative chronology, the evolution of Suplac I phase is related to the interval Tisa I-I/II-Herpály I-II- Vinča C1-C2 (*Băcueț Crișan 2013. 17*), so the Pericei site must be later, but still in the Vinča C interval, given the incised Turdaș pottery type discovered there.

Fig. 1. Maps showing sites Pericei and Porț.

Two layers had late Neolithic material, the upper one with a constant spread, and the lower one identified only at the centre of the site (*Băcueț Crișan*

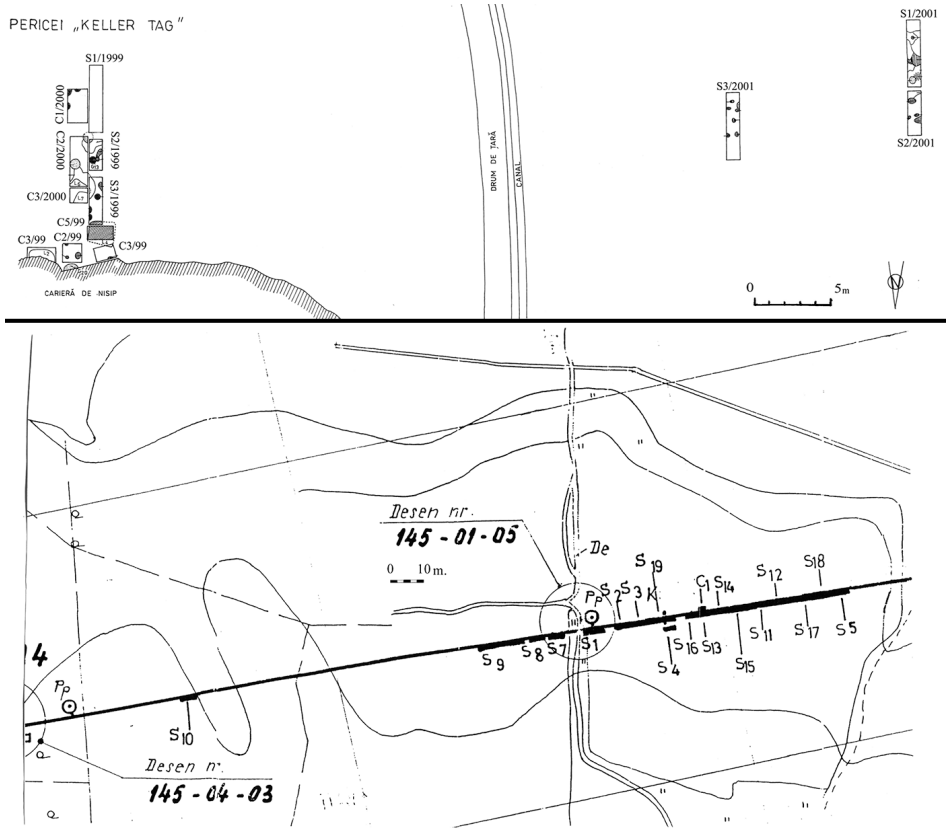


Fig. 2. Plans of the surfaces investigated at Pericei.

2008.28–29). The ground stone material was found in the following 15 trenches excavated between 1999 and 2004: C1/1999, C2/2000 (8 x 2.5m), C3/2000 (2 x 2.50m) (Fig. 2.1; *Băcueţ Crişan 2008.27–28*), C1/2004 (5 x 3m), S1/2004 (24 x 2m), S4/2004 (25 x 2m), S5/2004 (28 x 2m), S11/2004 (33 x 2m), S13/2004 (10 x 2m), S14/2004 (27,5 x 2m), S15/2004 (32.7 x 2m), S16/2004 (17 x 2m), S17/2004 (55 x 2m), S19/2004 (46 x 2m) (Fig. 2.2; *Matei* et al. *2000. 259–262*).

Raw material

There are no petrographic analyses for Pericei, but considering the proximity of the Suplac/Porţ site, we can assume the same lithic sources, the Plopiş Mountains, with alluvial exploitation (from the Barcău Valley for Suplac/Porţ; *Ignat 1998.10; Lazăr* et al. *2007. 34*). In the Pericei case, rocks could have been collected from the valley of the River Crasna. At Suplac/Porţ, rocks with a high degree of hardness were used: *e.g.*, amphibolite, quartzite, rhyolite, dacite, porphyry, as well as other rocks such as paragneis, chlorite shale, amphibolite-chlorite shale, and feldspar sandstone, and only rarely softer rocks such as limestone marl, mudstone, and clay sandstone (*Ignat 1998.33*). We could not say for sure that all these rocks were used at Pericei, but most of them probably were, considering the resemblance between the lithic material of both sites. Unworked stone was found at Pericei in the form of five pebble agglomerations (Fig. 3): C18/S11 (representing two close agglomerations), C30/S13, C33/S11, and C69/S14. Compared to the Suplac II phase from Porţ, where 11 such agglomerations were discovered (*Dunca 2016b.90, Pl. 1*), Pericei also has the same frequency of these structures, if not higher. Traces of burning were found next to the C30/S13 agglomeration. We give the same explanation as in the case of Porţ for these features, as places for working raw material, either by thermal shock or by percussion (*Dunca 2016b.84*). Ethno-archaeological observations in New Guinea have shown that fire can be used to break stone and obtain fragments to be processed afterwards (*Pétrequin* et al. *2006. 421–422; Pétrequin, Pétrequin 2000.21; Jeudi* et al. *1995.253*).

Classification of the ground stone sample

The total of 73 ground stone sample is comprised of: cores (4%), preforms (8%), waste (3%), chisels (41%), axes (5%), axe-chisels (1%), adzes (11%), hammers (percutors) (1%), sandstone slabs (1%), millstones

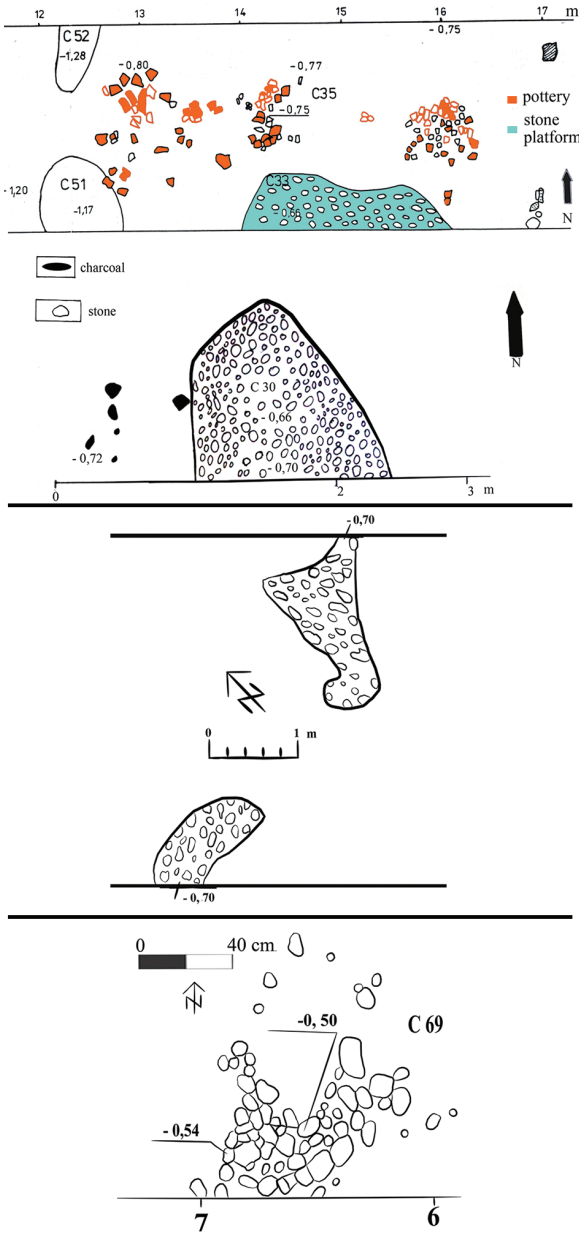


Fig. 3. Pebble agglomerations from Pericei.

(7%), grinders (9%), and stone fragments (10%). For typology, we used the typological classification made for Porţ (*Dunca 2016a*) and related these results to the phases of working observed on the lithic material at the same site (*Dunca 2015*). For a better understanding of the present analysis, we resumed the main ideas of those two studies. The most difficult problem was separating the main categories of edge tools – chisels, axes and adzes – but as we had a larger sample at Porţ, this was possible by comparing and selecting some general traits. Chisels are usually shorter (approx. 7cm), thinner and flat (at least one face). Axes are the largest items, being more than 10cm long and 3 to 4cm wide, and have a more prominent cutting edge than chisels. Adzes

are asymmetrical as a result of the cutting edge being sharpened mostly from one side. Their proportions are similar to chisels in most cases. Each category was divided into types and variants based on shape – respectively, the longer profile (considered from the base of the cutting edge) or reversing the two characteristics if the profile was more important in relation to the use of the tool. These were the criteria used by Ignat for the tools from Suplacu de Barcău (*Ignat 1998.35–36*), but in a different and more complicated combination.

Several working stages can be established. The contouring of the cutting edge was considered the limit between the worked raw material and pieces in the working process. Raw material was divided into cores by methods that we present in the sample analysis. This was followed by the reduction or splitting of the cores into fragments similar to the tools that were being fashioned (chisels, axes, adzes). We classified these fragments as preforms. They became tools after polishing, often combined with pecking. The two working stages, initial and advanced, were separated based mainly on the symmetry of the shape compared with the finished product. There are differences between pieces included in the same working stage, both at Porţ and Pericei; the latter will be detailed in the following parts of the paper.

Cores

We have two simple cores (Fig. 4.1–2; Fig. 12.1–2) the first being a pebble fragment, and the second a whole stone with a fissure that could be connected to the use of thermal shock, according to experimental archaeology (*Pétrequin* et al. *2012.263, Fig. 6*). The third (Fig. 4.3; Fig. 12.3) is from the category of cores with working traces (which relate to actions after the breaking of the raw material), presenting saw marks on a small surface.

	total	sawing and pecking	pecking
Preform	2	2	
Chisel preform	3		3
Ax-chisel preform	1		1

Tab. 1. Characteristics of the preforms.

Preforms

Of the six samples, we were able to determine pieces with dimensions close to the chisels (Fig. 4.4–6; Fig. 12.4–6) and a fragment similar to the axe-chisels (Fig. 4.7; Fig. 12.9); the remainder (Fig. 4.8–9; Fig. 12.7–8) do not fit clearly into a category of stone tools. The combining of processing techniques is illustrated in Table 1.

Two of the preforms display sawing marks either on a face or contour, as well as pecking marks on the contour. Sawing was required to split the cores, while pecking followed to achieve the desired shape, combined with brief polishing. The preforms that match a tool category only illustrate the pecking applied to the contour, probably after detachment from the core, in which case the saw marks were obliterated by subsequent operations.

Two fragments of waste (Fig. 4.10–11; Fig. 12.10–11) were found, both with pecking marks.

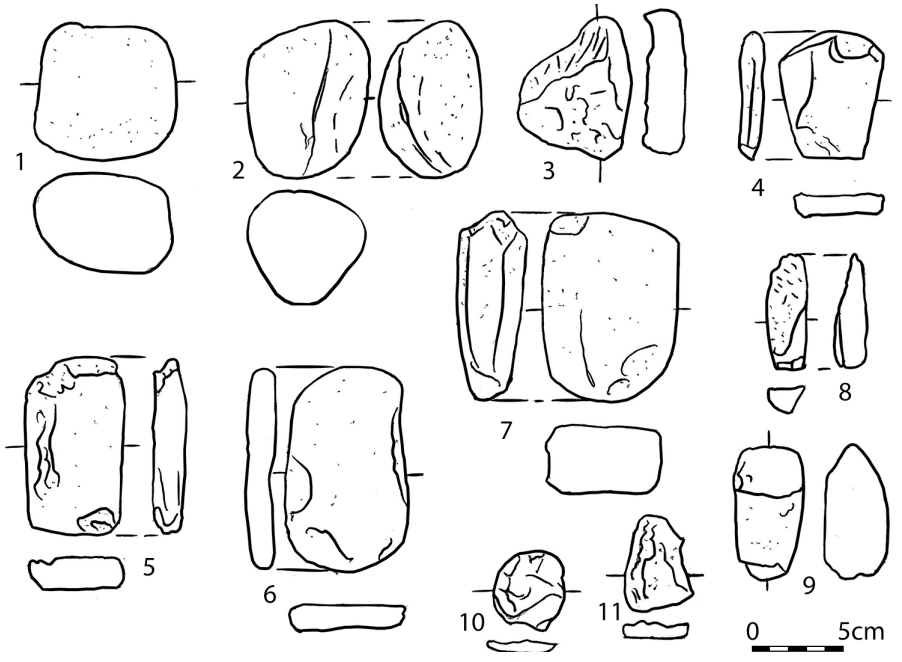


Fig. 4. Raw material: 1 simple core (dwelling C1/S1); 2 core with fissure (layer); 3 core with sawing marks (layer); 4-5 chisel preforms (layer); 6 chisel preforms (dwelling C68/S14); 7 axe-chisel (layer); 8-9 undefined preforms (layer); 10 waste with pecking marks (layer); 11 waste with pecking marks (dwelling C68/S14).

Chisels

Typologically, chisels are divided (Fig. 5) into D1 rectangular, D2 elongated, D3 trapezoidal, and D4 oval. The only finished pieces are trapezoidal – variants D3a (with a rectangular profile; Fig. 8.1; Fig. 13.1) and D3d (with an oblique profile; Fig. 8.2; Fig. 13.2) – and oval, variant D4c (with a rounded profile; Fig. 8.3; Fig. 13.3), which means just 11% of the total, a smaller proportion of finished chisels than is present at Porţ, where the proportion varies between 8% and 30%, according to type. Taking into account the slightly higher proportion of chisels at Pericei than at Porţ, we can assume they were worked more frequently for exchange than for internal needs. Samples framed within the typology can be divided almost equally between the initial and advanced stages of working, which indicates a higher proportion of the initial stage than at Porţ. Regarding the quantities, the situation is analogous to the Suplac III phase at Porţ (*Dunca 2016a.Tab. 1*): chisels of D3 type predominate, followed by the D1 type, with the fewest being the D2 type.

The chisels assigned to the advanced stage of working (Fig. 8.4–9; Fig. 13.4–9) were grouped according to the sharpening of the edge and the degree of polishing on the surface, adding secondary characteristics (Fig. 6).

An advance in working over the rest is illustrated by artefacts of category A with a sharp edge. Those from category B have only a contoured edge, which, along with the advanced polishing, represents the general characteristic of this working stage. Pecking marks appear on the contour, so they must be connected to the achievement of form. The symmetrical contour of some chisels indicates a focus on obtaining the desired shape first, while concentrating on smoothing the faces and sharpening the edge afterwards.

Initial stage of working (Figs. 7; 8.10–13; 9. 1–8; 14; 15.1–2)

Pieces included in categories A and B present a feature, a slightly contoured edge, often encountered in chisels in initial processing, meaning a thicker one compared to a contoured edge that is thin and needs only a little grinding to become functional. Pecking marks appear often, not only on the margins but also on the faces of the chisels. The unlevelled faces could be the result of polishing after pecking. Saw marks are sometimes visible. They could be the remains of the preform stage, but more probably, since the pieces had undergone enough changes, it could be a new sawing phase, having the same role as pecking, *i.e.* the removal of excess stone in a faster way than by polishing alone. The difference between superficial and advanced polishing (B category) can be explained by the application of less pecking, or perhaps none at all, and more polishing for surface adjustment.

Axes

Only one complete example of this category was found, assigned to the T2a type (elongated, with a

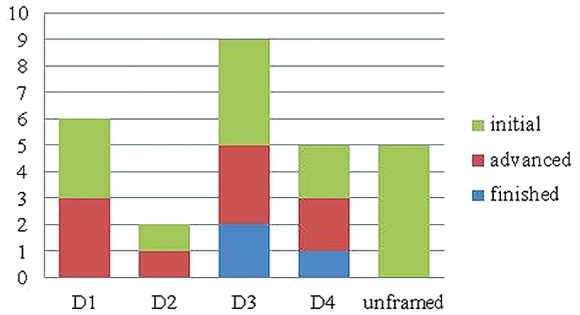


Fig. 5. Division of the chisels by type and working stage.

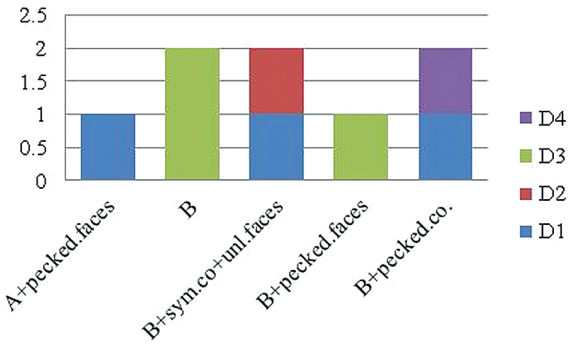


Fig. 6. Combined characteristics of the chisels in advanced working stage. A sharp edge and advanced polishing (Pl. 5.4); B contoured edge and advanced polishing (Pl. 5.5–9) (sym. symmetrical; co. contour; unl. unlevelled).

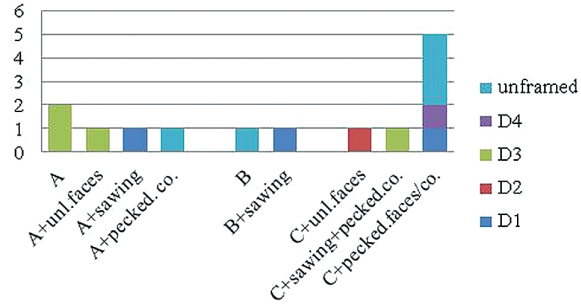


Fig. 7. Combined characteristics of the chisels in initial working stage. A slightly contoured edge and superficial polishing (Pl. 5.10–13); B slightly contoured edge and advanced polishing (Pl. 6.1–2); C contoured edge and superficial polishing (Pl. 6.3–8) (co. contour; unl. unlevelled).

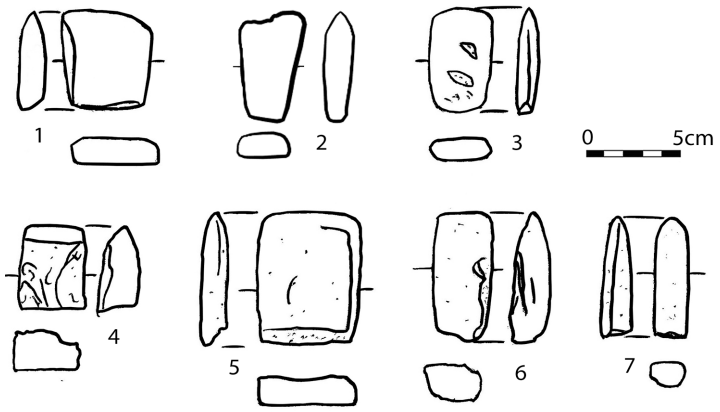
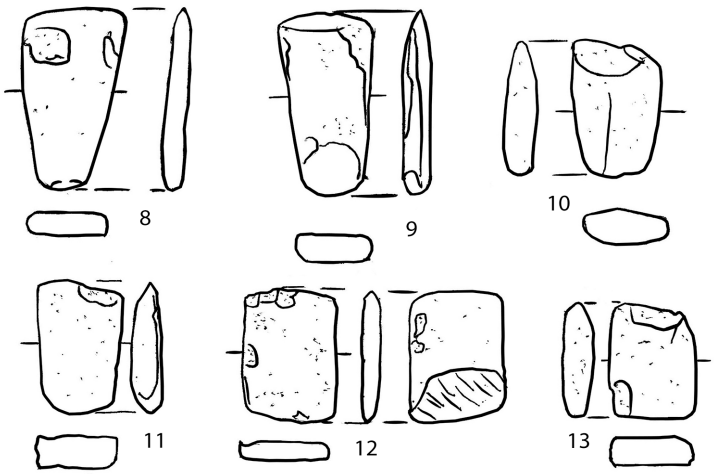


Fig. 8. Finished chisels (1-3), chisels in advanced working stages (4-9) and chisels in initial working stages (10-13). 1 type D3a (dwelling); 2 type D3d (layer); 3 type D4c (layer); 4 category A, type D1 (layer); 5-6 category B, type D1 (layer); 7 category B, type D2 (layer); 8 category B, type D3 (dwelling C35/S11); 9 category B, type D3 (dwelling C35/S11); 10-11 category A, type D3 (layer); 12 category A, type D1 (layer); 13 undefined (ditch C106/S7).



rectangular profile; Fig. 9.9; Fig. 15.3). Another three fragments, one of which one has perforations, can be added, but they cannot be assigned to a type. We mention here an axe-chisel of TD2 type (trapezoidal form; Fig. 9.10, Fig. 15.4). The term 'axe-chisel' does not necessarily denote a mixed tool, but mixed features. They have the appearance and relative proportions of the chisels, but the massiveness of the axes (*Dunca 2016a. 90*).

Adzes

The same types defined at Porţ were also identified at Pericei (Fig. 10), with some differences in variants. The Te1 type (trapezoidal type) includes a piece with a rectangular profile (type Te1d; Fig. 9. 12; Fig. 15.5). The second type, Te2 (with an elongated form) is divided into sub-types Te2a with a rectangular profile (Fig. 9.11; Fig. 15.6), and sub-type Te2b with an oblique profile (Fig. 11.1; Fig. 15.7). The oval shaped Te3 type has one variant Te3b with a rectangular profile (Fig. 11.5–6; Fig. 15.8–9) not found at Porţ. For the rectangular Te4 type, we have one variant Te4a with a rectangular profile (Fig. 11.2; Fig. 15.10). Adzes were much more numerous at Pericei than at Porţ. They comprise 11%

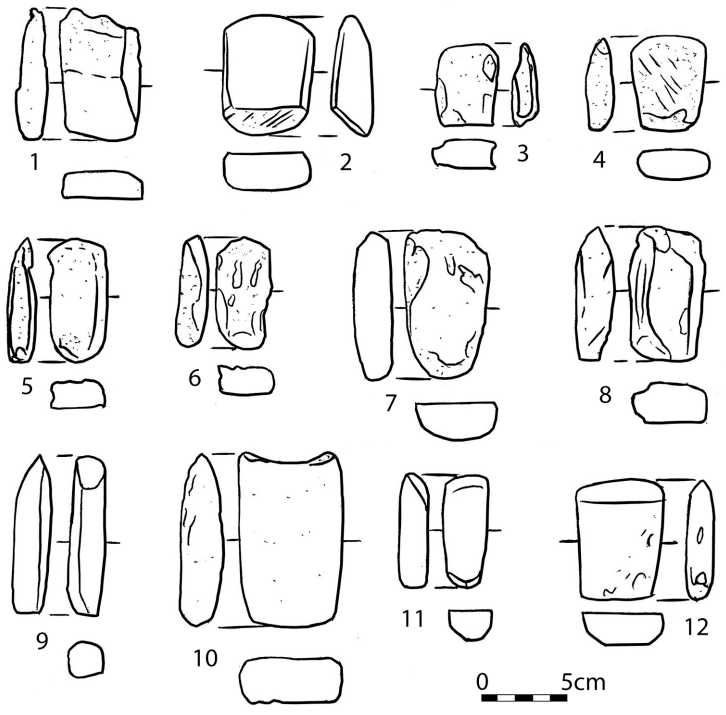


Fig. 9. Chisels in initial working stages (1-8), axes (9-10) and adzes (11-12). 1 category B, undefined (layer); 2 category B, type D1 (pit C74/S17); 3 category C, type D1 (layer); 4 category C, type D3 (layer); 5 category C, type D4 (layer); 6 category C, undefined (layer); 7 category C, undefined (pebble agglomeration C30/S13); 8 category C, undefined (dwelling C48/S13); 9 axe, type T2a (layer); 10 axe-chisel, type TD2 (layer); 11 adze, type Te2a (pebble agglomeration C33/S17); 12 adze, type Te1d (grave C21/S11).

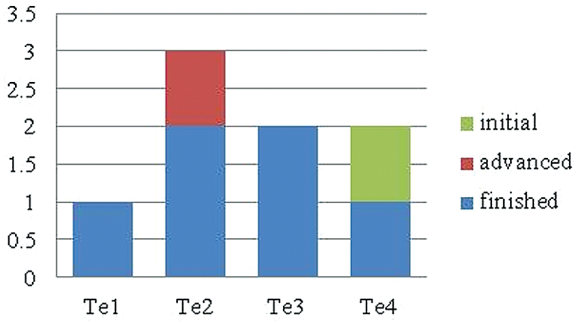


Fig. 10. Division of the adzes by type and working stages.

of the total lithic sample in the first case, and only 2% in the second. In terms of finished pieces, adzes constitute the main category of wood-working tool at Pericei, while at Porţ these finds are only in third place, with axes being in second place (*Dunca 2016b. Tab. 1–3*). Most of them are visibly worn, especially the edges.

Only two adzes were left in the working process. Based on the asymmetry, the unlevelled faces and superficial polishing, the Te4 adze (Fig. 11.3; Fig. 15.2) can be assigned to the initial stage. The advanced stage of working includes a Te2 adze (Fig. 11.4; Fig. 16.1) with advanced polishing. Both of them have a contoured edge and pecking marks, so we can assume similar working methods as in the case of the chisels, although we can make no observations about the shaping of the adzes.

Tools for stone working

Just two pieces of this category were found, a percutor (Fig. 11.7; Fig. 16.3) and a sandstone slab (Fig. 11.8; Fig. 16.4). The percutor would match the long P3 type from Porţ, but it lacks the perforation. The narrow end makes it suitable for pecking. The sandstone slab is rather small; it could have been held in the hand during polishing.

Tools for grinding

Apart from seven grinder fragments (*Băcueţ Crişan 2008.38*), the other tools in this category are millstones of the elongated Z2 type (Fig. 11.9–11; Fig. 16.5–7). More were found than at Porţ, and considering the low representation of percutors, we may conclude that the millstones were also used for pecking, or at least some of them.

Context analysis

The majority of ground stone finds (59%) come from the upper habitation layer. The other 29% were found in dwellings, while 12% were discovered in other contexts, such as pits, graves, ditches, and the pebble agglomerations mentioned at the beginning of this article. We will first discuss the samples that came from contexts related to stone working.

Following Table 2, we can observe that no category or even frequent type is missing from the layer. The same can be said for all the working stages, starting with cores and ending with finished tools; hence we conclude that the whole operational chain related to

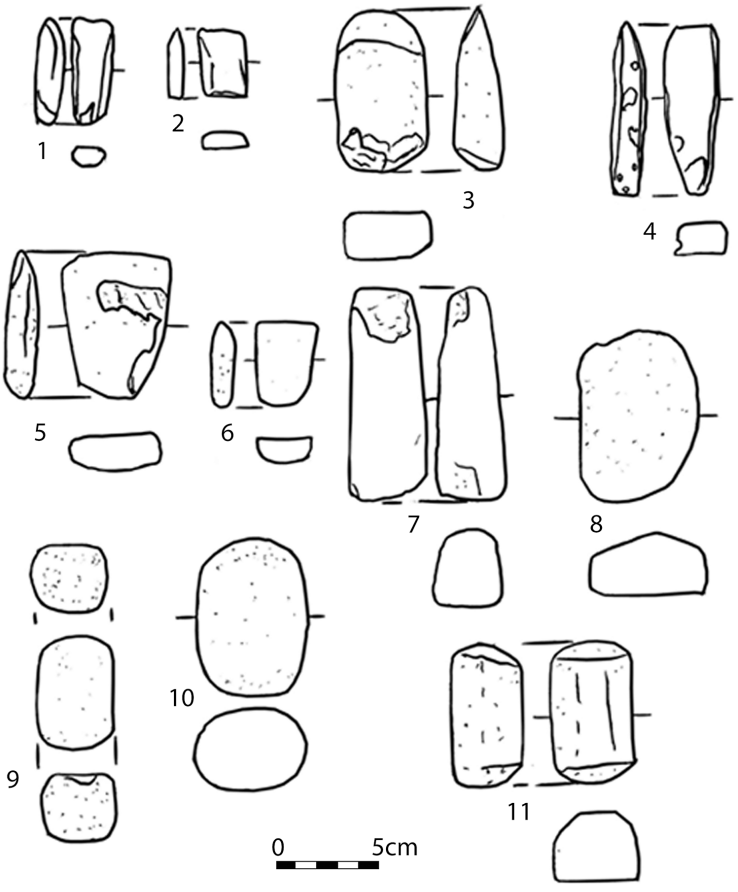


Fig. 11. Adzes (1-6), percutor (7), sandstone slab (8) and millstones (9-11). 1 adze type Te2b (layer); 2 adze type Te4a (layer); 3 adze in initial working stage, type Te4 (pit C29/S13); 4 adze in advanced working stage, type Te2 (dwelling C49a/S15); 5 adze type Te3b (layer); 6 adze type Te3b (dwelling L3); 7 percutor type P3b (layer); 8 sandstone slab (layer); 9-11 millstones type Z2 (layer).

production could have taken place outside the houses, in open areas. The initial working stage is predominant, and in terms of typology, the D3 type of chisel predominates. The frequency is lower than at Porţ, where no more than 1m² of ground free of archaeological features lacked pieces of stone or worked raw material (*Dunca 2016b.84*).

Nine of the 16 dwellings contained ground stone items. Chisels are the most common, but in the advanced working stage. Except for trench C1/S1 where a core was found, and trench C68/S14 from which a preform and a discard came, nothing indicates the possibility of ground stone tools being made entirely inside houses. More probably, finishing was done inside the dwellings after the first part of the process took place outside. A similar division was concluded for the pieces from Hauterive Champréveyres in Switzerland (*Joye 2012.42*) due to a smaller amount of waste produced in later working stages.

Ground stone industry discoveries are rarely presented by context or even mention one. We have selected a few Eneolithic sites where such information exists in order to determine the role of the items from the Pericei dwellings. At Carcaliu (Tulcea county), a settlement of the Gumelniţa culture, half of the dwellings revealed a ground stone inventory, from one to 16 pieces, but grinders and millstones predominated in all of them; edge tools amounted to no more than three per dwelling (*Micu* et al. *2005–2006.26, Tab. 2*). The predominance of grinders and millstones is also characteristic of the Luncaviţa site (*Micu* et al. *2005.235–236*), which is contemporaneous with Carcaliu. These two types of tools are related to domestic activities, while the edge tools from Pericei are related to stone working, as most of the tools were left unfinished. At Hăbăşeşti (Iaşi county), a Cucuteni culture settlement, all the dwellings yielded two or three pieces, but they were usually fragmented (*Dumitrescu 1954.250*), which can be related to the long use of the tools, rather than primarily to their production, unlike at Pericei. The special situation of a house at Pietrele, a Gumelniţa culture site, deserves attention. Its inventory seems to have been complete (*Klimscha 2011.Fig. 12*), containing nine large flint axes, twelve small axes and five fragments. Again, the number of pieces found

			Dwellings									Pebble agglomerations	
Category	Type	Layer	L3	L6	L7	C1/S1	C35/S11	C48/S13	C68/S14	C49a/S15	C75/S19	C30/S13	C33/S11
cores	simple	1				1							
	worked	1											
preforms	chisel	2							1				
	ax-chisel	1											
	unframed	2											
chisels	D1.in.	2											
	D1.ad.	1					1						
	D2.in.	1											
	D3.in.	2					1						
	D3.ad.	2											
	D3.fin.				1								
	D4.in.	1					1						
	D4.ad.				1								
	D4.fin.	1											
	unframed.in	2						1				1	
	fragments	1		1		1							
axes	T2.fin.	1											
	fragments	1							1		1		
ax-chisel	TD2	1											
adzes	Te2.fin.	1											1
	Te2.ad.									1			
	Te3.fin.		1										
	Te4.fin.	1											
	Te4.in.	1											
percutors		1											
millstones		3			1								
waste		1							1				
fragments		4			1								

Tab. 2. Context related to stone working (in. initial; ad. advanced; fin. finished).

Fig. 12. Cores and preforms. 1 simple core; 2 core with fissure; 3 core with sawing marks; 4-6 chisel preforms; 7-8 undefined preforms; 9 axe-chisels preform; 10-11 waste.

there is much higher than in any dwelling at Pericei or even Porţ, where the entire surface of some of the dwellings was investigated. The typology is also very different; neither the large nor the small flint axes have analogies at Pericei, and differences in function and operational chain are assumed (*Klimscha 2011.368–369*), but we presume that most tools were finished, unlike at Pericei.

Pebble agglomerations usually do not contain stones other than the raw one that defines them. The chisel in the initial stage of working from trench C30/S13 might indicate the use of these structures for something other than just splitting pebbles. The division of ground stone working between outside and inside the house may be indicated by the placement of a pebble agglomeration next to a dwelling (Fig. 3.1).

In other contexts, three pits contained one item each, an adze or a chisel, all in the initial working stage. They show no signs of reject, failure of manufacture. An inhumation grave contained an adze of the Te1d type, and a ditch was the location of a chisel in the initial working stage.

The characteristics of the ground stone industry at Pericei

The total number of pieces connected to this economic activity is not very large, but we must keep in mind the rather small area excavated at Pericei. The pebble agglomerations indicate a local exploitation of stone resources, and most of the tools are unfinished. All the aforementioned facts provide sufficient grounds for proposing that

Fig. 13. Finished (1-3) and advanced working stage chisels (4-9). 1 type D3a; 2 type D3d; 3 type D4c; 4-6 type D1; 7 type D2; 8 type D3; 9 type D4.

the settlement at Pericei was a centre for producing polished stone tools for trading, but we can add the relative standardisation of the lithic tools evident from the succession of techniques and similar approaches to working on most pieces.

The proximity of another settlement with the same economic orientation, namely at Porţ, raises questions regarding the relationship between them. We have seen that, culturally, they form part of the same group, the so-called Suplac group, and that they are partly contemporary, meaning that, in terms of the ground stone industry, the Porţ settlement begins production earlier and ends later. The principle products of the ground stone industry at Porţ were chisels and axes (at least in the Suplac II phase), while at Pericei the focus was on production of chisels. In this second phase, the demand for chisels increased and the industry at Pericei developed for that reason. That chisel production was mainly for trading purposes is indicated by the low proportion of finished pieces, with adzes being the most common in this category. The pre-

Fig. 14. Chisels in initial working stage. 1-2 type D1; 3-5 type D3; 6 type D4; 7-9 undefined.

Fig. 15. Chisels (1-2), axe (3), axe-chisel (4) and adzes (5-10). 1-2 in initial working stage (undefined); 3 axe type T2; 4 axe-chisel type TD2; 5 adze type Te1; 6-7 adze type Te2; 8-9 adze type Te3; 10 adze type Te4.

ponderance of adzes is related to the scarcity of axes, and an increase in one category is correlated with a decrease in the other (*Cotoi, Grasu 2000.54–55*). Adzes were versatile tools, able to function as an axe for some activities, such as the clearing of young trees (*Barkai 2011.43*). Only for this category we can make some observations regarding utilisation. Most of them are worn-out and have irregularities connected to retouching the edge or the faces.

Fig. 16. Adzes (1-2), percutor, sandstone slab and millstones. 1 in advanced working stage, type Te2; 2 in initial working stage, type Te4; 3 percutor; 4 sandstone slab; 5-7 millstones.

At present, we cannot identify a settlement where chisels from Pericei arrived; future analysis of the lithic industry at Pericei and other sites will have to clarify this matter. Even for Suplac/Porţ, only one site (*i.e.* Tăşad in Bihor county; *Ignat 1987*) has been identified as a recipient of its tools. We cannot say what the Neolithic inhabitants from Pericei received from other settlements. None of the chopped obsidian tools use local resources, as only finished items have been discovered (*Băcueţ Crişan 2008.37*). Recent analysis indicates the region of Košice in Slovakia as a possible source of the obsidian tools found at Pericei and Porţ (*Glascock* et al. *2016. 85*). It is probable that exchange networks existed involving different objects over wide areas, as shown for stone axes produced in the alpine area (*Pétrequin* et al. *1997.139–140*). Similar to that phenomenon, chisels from Pericei could have been traded unfinished, and the high proportion of initial and advanced stages of working may reflect not an accidental interruption of that process, but the expected shape(s) to be exchanged.

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Pivoting East: Çadır Höyük, Transcaucasia, and complex connectivity in the Late Chalcolithic

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ABSTRACT – *The investigation of 'complex connectivities' as defined by Tomlinson (*1999*) is a critical element in the understanding of how the modern globalisation model has been repurposed by archaeologists to explain mechanisms at work in the archaeological past. This study applies Tomlinson's network of complex connectivities to interpret evidence to the contemporary Kura-Araxes culture in Transcaucasia, and the north-central Anatolian plateau in the second half of the fourth millennium BCE, known as the Late Chalcolithic period, all taking place in the context of the vast Uruk system in Mesopotamia in the globalised background. We focus on the site of Çadır Höyük, on the north-central Anatolian plateau. The occupants of this rural settlement experienced some dramatic changes in the later fourth millennium, including substantial reorganisation of their village plan, expansions and contractions in socio-economic activity and long-distance trade, more elaborate burials, and possibly the evolution of new socio-political and religious ideologies. Here we explore the increasing evidence that socio-economic 'complex connectivity' with Transcaucasia, as well as with Mesopotamia, played some role in the substantial modifications and internal dynamics at Late Chalcolithic Çadır Höyük.*

KEY WORDS – *Late Chalcolithic Anatolia; complex connectivity; Transcaucasia; Kura-Araxes Culture; Uruk system*

Zasuk proti vzhodu: Çadır Höyük, Transkavkazija in kompleksna povezljivost v pozni bakreni dobi

IZVLEČEK – *Preučevanje 'kompleksne povezljivosti', kot jo je definiral Tomlinson (*1999*), je ključno za razumevanje načina, kako so arheologi spremenili model moderne globalizacije za to, da bi lahko razlagali mehanizme, ki so delovali v arheološki preteklosti. V članku uporabljamo Tomlinsonovo mrežo kompleksnih povezljivosti pri razlagi dokazov o sočasnosti kulture Kura-Araxes v Transkavkaziji ter v severnem centralnem delu Anatolije v drugi polovici četrtega tisočletja pr.n.št. oz. v času pozne bakrene dobe, in sicer v okviru širšega globalnega konteksta sistema mesta Uruk v Mezopotamiji. Osredotočamo se na najdišče Çadır Höyük v severni centralni Anatoliji. Prebivalci te ruralne naselbine so bili konec četrtega tisočletja priča dramatičnim spremembam, ki so vključevale veliko reorganizacijo načrta vasi, širitve in krčenja družbeno-ekonomskih aktivnosti in menjave na dolge razdalje, bolj izpopolnjene načine pokopa in morda evolucijo novih družbeno-političnih in verskih ideologij. Raziskujemo tudi dokaze o tem, da je imela družbeno-ekonomska 'kompleksna povezljivost' s Transkavkazijo in Mezopotamijo pomembno vlogo pri bistvenih spremembah in notranji dinamiki na pozno bakrenodobnem najdišču Çadır Höyük.*

KLJUČNE BESEDE – *Anatolija; pozna bakrena doba; kompleksna povezljivost; Transkavkazija; kultura Kura-Araxes; sistem Uruk*

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Introduction

The archaeological exploration of past globalisations is couched in terms of the socioeconomic, sociopolitical, and ideological interconnections, termed 'complex connectivities' (*Tomlinson 1999*), that link disparate regions into an experiential 'globalized world.' Globalisation has recently been a major theme in the archaeology of complex societies, and John Tomlinson's idea of complex connectivities offers a productive way to conceptualise interconnections identified in the archaeological record. This study applies Tomlinson's model to interpret evidence that such connectivities linked Transcaucasia and the north-central Anatolian plateau, networked within the long reach of the Mesopotamian Uruk system. Our research suggests that well-established exchange systems spurred the creation of new networks that reached far into rural areas not generally recognised in previous work on prehistoric globalisation events.

Our case study focuses on the site of Çadır Höyük, on the north-central Anatolian plateau (Fig. 1), which boasts an occupational history spanning 6000 years (*c.* 5200 BC to the 13th century AD). The occupants of this rural settlement introduced, and weathered, many changes to their lives and livelihoods over these millennia. Some of the most dramatic of these occurred in the fourth millennium BC, known as the 'Late Chalcolithic' period on the plateau. Modifications included substantial reorganisation of village plans, expansions and contractions in socio-economic activity and long-distance trade, more elaborate burials, and possibly the evolution of new socio-political and religious ideologies. Our research has focused on identifying the underlying reasons for these considerable modifications at Late Chalcolithic Çadır which emerged out of internal dynamics within the community.

The fourth millennium BC is a consequential time in the cultural history of Southwest Asia; the Mesopotamian Uruk period includes the world's first urban literate societies and the establishment of complicated networks of trade and resource acquisition spanning much of the region, including south-eastern Anatolia and the site of Arslantepe. The expansion of the Uruk system corresponds with the rapid and dramatic changes that occurred at Çadır Höyük, which lies far from the Uruk centre in southern Mesopotamia. Contemporary with the rise and expansion of the Uruk system is the development of the Kura-Araxes culture in Transcaucasia. Material and conceptual elements of this culture begin to appear at eastern and south-eastern Anatolian sites in the second half of the fourth millennium. Examples of Kura-Araxes culture also appear at Çadır Höyük at this time, providing an excellent case study to assess the unexpected geographic extent of the complex connectivities of goods, ideologies and, probably, people associated with both the Uruk and Kura-Araxes cultural entities.

Complex connectivity and past globalisations

For decades, scholars have sought to identify the mechanisms that created today's globalisation. One of the most important of these mechanisms is complex connectivity, a term coined by Tomlinson (*1999*), that describes the deeply-embedded systems of interaction that criss-cross a globalised world. In recent years, a number of archaeologists have noted that the complex connectivity of today's world can also be found in the archaeological past, signalling the presence of past globaliations (*LaBianca, Scham 2006; Jennings 2011; Hodos 2017a*). Complex connectivity is very similar to the well-known models that arise from interregional interaction systems (*Schortman 1989; Boyd, Richerson 1985; Schortman, Urban 1992; Lightfoot 1995; Cusick 1998;*

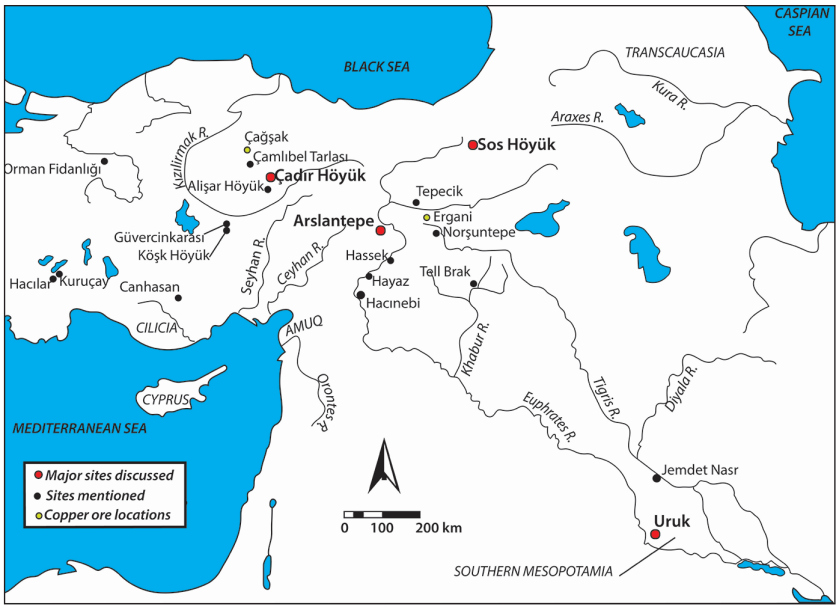

Fig. 1. Map of sites and regions discussed in the text.

Parker 2006; Steadman 1995; 1996). Tomlinson seats connectivity in the modern globalised world within the cultural realm: it is an 'ever-densening network of interconnections and interdependencies that characterize material, social, economic and cultural life' (*Tomlinson 2012.352*). While these connectivities may affect every aspect of life, Tomlinson asserts that it is the economic sphere that is most affected (*2012.353*); although Tomlinson's research focuses on the modern globalised world, the level of impact that economic interaction, or connectivity, has on interactive cultures cannot be understated in the past or present world. Critiques of Tomlinson's model note that complex connectivity in the modern world can, and often do, lead to cultural imperialism (*Xue 2008*). It is not cultural imperialism that is argued here, but rather the efficacy of economic interactions, through complex connectivity, that were at work in the Late Chalcolithic Çadır Höyük community. Such interactions may have initially emanated from centres such as Uruk and Arslantepe in south-eastern Anatolia, but they soon blossomed into new far-reaching tendrils of connectivity, linking regions previously untapped, into Tomlinson's 'ever-densening network of interconnections' that defines complex connectivity. It is these that reached onto the north-central Anatolian plateau and into Transcaucasia.

Archaeologists who apply the globalisation model to past systems describe the mechanisms within such systems as occurring within the known, and reachable, world, depending on transport technologies (see discussions in *Hodos 2017b; Jennings 2011*). Within such parameters, the fourth millennium BC Uruk system can, and has been, defined as an ancient globalisation (*Jennings 2011.57–76; Hodos 2017c; Kardulias 2014*). The Uruk system relied on a network of complex connectivity to acquire and distribute a wide variety of resources and goods (*Algaze 1993a; Frangipane* et al. *1993*). By the mid-fourth millennium BC, Uruk trade networks had been established with the Levant and the Amuq region along the Syro-Lebanon coast, south-eastern and eastern Turkey, and with western and north-western Iran (*Gopnik* et al. *2016; Minc, Emberling 2016; Stein 2002; Gerritsen* et al. *2008; Sağlamtimur, Ozan 2012*). These trade networks spurred residents in these outlying regions to develop new spheres of interaction even farther afield from their own regions to meet supply and demand needs within, and connected to, the Uruk system. These new exchange networks benefitted not only southern Mesopotamian centres such as Uruk, but also settlements in these outer regions. Çadır's specific interaction with this Uruk globalisation has been explored in more detail elsewhere (*Steadman* et al. *2019*).

Largely simultaneously with the Uruk system was another interaction network that encompassed the Kura-Araxes culture in Transcaucasia, and eastern and south-eastern Anatolian sites such as Sos Höyük and Arslantepe by the second half of the fourth millennium. It is likely that this exchange network was a product of both organic circumstances, especially the migration of peoples across, and out of, the Kura-Araxes region into Anatolia, as well as the heightened connectivity occurring as a result of the Uruk globalised system. The exchanges of goods, technologies, and possibly people, between Transcaucasia and eastern/south-eastern Anatolia also appear to have reached farther west, to sites such as Çadır Höyük on the north-central Anatolian plateau. It is this aspect of complex connectivity, tangentially related to the Uruk system, that is the focus of the remainder of this study. The interactions between Arslantepe and the Kura-Araxes region are first detailed, followed by the evidence for Çadır Höyük's involvement in this fourth millennium network of connections.

Arslantepe, Transcaucasia, and fourth millennium connectivity

The expansion of the Kura-Araxes culture of Transcaucasia into south-eastern Anatolia, as well as western Iran, occurred in the fourth millennium BC, contemporaneous with the northward movement of Uruk influence into these regions. The multi-regional complex connectivities generated by these interactions are well represented at the Anatolian site of Arslantepe, located high in the Euphrates Valley in the Malatya region.

Arslantepe, Transcaucasia and the Uruk system

Arslantepe, the seat of an indigenous south-eastern Anatolian polity, consistently interacted with the growing Uruk system to its south in the mid-later fourth millennium, while concurrently establishing links with the Kura-Araxes culture in Transcaucasia. As is discussed below, the Kura-Araxes culture was also involved, at least on a socio-economic level, with residents at Sos Höyük, in eastern Anatolia (*Işıklı 2015a*). Arslantepe stands as a vital link in the connectivity between the Uruk system and inter-regional interaction with Transcaucasia.

By the earlier fourth millennium, the site of Arslantepe (period VII, *c.* 3900–3400 BC) had established

long-distance exchange networks and built a sophisticated socio-economic structure. Large ceremonial buildings indicate a high level of indigenous social organisation (*Frangipane 2003, 2009; Frangipane* et al. *2017*). Several hundred sealings demonstrate long-distance contacts with centres such as Tell Brak and other areas of Mesopotamia (*Frangipane* et al. *2017*). The presence of numerous mass-produced bowls suggests a food distribution programme, perhaps in the context of feasting or for ceremonies (*Frangipane 2003; 2012*). Products acquired from the outlying lands appear to have been collected at Arslantepe, perhaps for redistribution (*Frangipane 2010; 2012*). Residents there acquired their obsidian from a wide variety of places, including central and south-eastern Anatolia, and possibly from as far away as Transcaucasia (*Fornaseri* et al. *1975; Frahm* et al. *2016*).

By the mid-fourth millennium BC, the Uruk system began to expand across Mesopotamia and into other regions such as Iran and south-eastern Anatolia (*Algaze 1993a; 1993b; 2001; 2008; Frangipane 2001; Rothman 2001; 2004*). The Arslantepe period VIA (*c*. 3350–3000 BC) largely coincides with the Late Uruk phase (*c*. 3300–3000 BC), during which time Arslantepe interacted economically with the Uruk system. Evidence of trade with Uruk or Uruk-influenced centres is present at Arslantepe in the form of Late Uruk or Uruk-style vessels and the growth in numbers and styles of metal objects, the latter likely made possible through trade contacts that brought additional raw resources to Arslantepe and new metallurgical techniques and styles (*Frangipane 2002; 2011*). The increase in the volume of trade goods moving across the region triggered the further expansion of exchange networks.

Textile production at Arslantepe also reflects a connection with the Uruk system. The presence of caprines substantially increases at Uruk sites such as Hacınebi, Hassek Höyük, and Hayaz Höyük at this time (*Stein 2001b; Pollock 1999; Boessneck 1992; Zeder 1998; Vila, Helmer 2014*), suggesting caprine management strategies focused on secondary products, including wool. The same transition from an economy focused on cattle and pigs to caprines occurs at Arslantepe (*Bartosiewicz 1998*), suggesting an increase in textile production throughout the regions connected to the Uruk system.

It is during the last third of the fourth millennium that ties between Arslantepe and Transcaucasia begin to appear (*Frangipane 2011; 2015; Işıklı 2015a; Palumbi 2008a; 2008b; 2011; Sagona 2011; Sagona, Sagona 2000; Wilkinson 2014*). Trade networks, perhaps fuelled in part by nomadic pastoralists from the northeast (*Rothman 2003; Sagona 2013*), connected the Caucasus cultures with both Arslantepe and eastern Anatolian sites such as Sos Höyük (*Işıklı 2015b; Palumbi 2008a*), moving material goods such as ceramics (in the form of vessels and portable hearths), and technologies such as metalcraft, between the regions. By the end of the fourth millennium, when the Uruk system's influence was declining, there is some evidence to suggest that Transcaucasian cultures not only settled at Arslantepe, but also became prominent members of the elite class (*Frangipane 2015*).

Transcaucasia and the Kura-Araxes culture

The Kura-Araxes culture, also known as the Early Transcaucasian Culture, had originated in the Transcaucasia region at least by the mid-fourth millennium, if not several centuries earlier (*Palumbi, Chataigner 2014; Marro* et al. *2014; Rova 2014; Sagona 2014; Wilkinson* et al. *2012*). Kura-Araxes culture is characterised by an assemblage of material culture that includes ceramic and metal types, domestic architectural norms, and ritual behaviour (*Sagona 1984*). Only the material culture relevant to the present discussion will be presented in this section.

The Kura-Araxes ceramic assemblage (known as Khirbet Kerak in the Levant) consists of highly burnished vessels, typically black on the exterior and ranging from buff to orange on the interior; in south-eastern Anatolia, it is referred to as Red-Black Burnished Ware (RBBW) (*Palumbi 2003; 2008a*). Decorations include raised patterns on the exterior, usually in the form of rectilinear motifs, as well as post-firing incised patterns. The presence of Kura-Araxes style vessels at sites such as Arslantepe, and Sos Höyük in eastern Anatolia, at least by the mid- to late fourth millennium, demonstrates contacts between these regions (*Abay 2005; Sagona 2003; Palumbi, Chataigner 2014*). Whether the ceramics themselves (perhaps with contents) were transported, Kura-Araxes potters made them at these settlements, or the ceramic styles were simply emulated by local potters, is a topic of continuing research (*Batiuk 2005; Batiuk, Rothman 2007; Iserlis* et al. *2010; Kibaroğlu* et al. *2011; Schwartz* et al. *2009*). The interaction, however, is clearly attested on the basis of the ceramic evidence.

Kura-Araxes culture is also known for its advanced copper metallurgical expertise, which developed at

least in the fifth millennium BC and probably earlier (*Courcier 2014; Kohl 2007; Roberts* et al. *2009; Wilkinson 2014*). Products included a variety of spear points and daggers, axes, and personal ornaments such as earrings, hair-spirals, and double-spiral pins (*Huot 1969, 2009; Sagona 1984; Wilkinson 2014.169–170*). Kura-Araxes-style metal items are found in a variety of locations outside Transcaucasia, most notably in a 'royal' tomb at Early Bronze I Arslantepe, but also in the Amuq and Levant (*Batiuk 2005; 2013; Greenberg 2007; Iserlis 2009*). As is the case with Kura-Araxes style ceramics, explanations for the mode of transmission of these metal objects vary. One view is that Kura-Araxes nomadic pastoralist populations moved westward and south- westward (as well as into northern Iran), carrying with them their metallurgical knowledge, techniques, and styles (*Batiuk 2005; 2013; Rothman 2004;* but see *Philip 1999*). Recent work on transportation technologies (*Sagona 2013*) broadens the description of such groups to include agro-pastoralists or even migrant communities of farmers.

Research on the location of copper ore sources for Kura-Araxes style metal items has been uneven due to the difficulty of identifying evidence of ancient mining (*Wilkinson 2014.158*). Rich copper ore sources have been located across northern Iran and Transcaucasia, as well as in south-eastern Anatolia (at Ergani), and on the north-central Anatolian plateau and Black Sea littoral (*de Jesus 1978; 1980; Wagner, Öztunalı 2000*). While Transcaucasian sources would seem the logical choice for exploitation by Kura-Araxes cultures in this region, migrant communities must have maintained exchange networks that provided access to the more distant sources across western Asia.

A final element recognisable as Kura-Araxes is their ritual behaviour and associated material culture. As is true in most cultures, ritual behaviours were associated with burial in the Kura-Araxes culture. A recent study (*Poulmarc'h* et al. *2014*) identified six different burial methods, including pit tombs marked by a covering of stones. The pit tombs usually contained primary deposits, and a number of these burials contained grave goods such as ceramics or metal objects, most often jewellery.

In addition to burials, household ritual was important in Kura-Araxes culture. Often present inside Kura-Araxes homes were fire installations, sometimes associated with raised platforms; ash and burned ceramics were also associated with these installations. The centre of the household ritual was the interior hearth (*Sagona 1998; Sagona, Sagona 2009; Simonyan, Rothman 2015; Wilkinson 2014*). Hearths built into the floor of Kura-Araxes homes were circular or three-lobed, and constructed of clay. The focus of Kura-Araxes ritual must have included the element of fire; possibly the sacrifice of plants and animals was also performed (*Simonyan, Rothman 2015*), although evidence for this activity is not as robust. Material culture associated with these hearths, often buried around them, include small figurines of animals such as sheep or bull, and very occasionally, humans. Vessels located near hearths in some Kura-Araxes contexts contained burned remains of wheat and barley, indicating 'worshippers were burning, not so much cooking, these plant remains' (*Simonyan, Rothman 2015.32*). The built-in hearths are most often found in the Kura-Araxes Transcaucasian region, but they have also been discovered in eastern Anatolia at Sos Höyük and elsewhere (*Sagona 2000; Sagona, Sagona 2009; Hopkins 2003.81; Takaoğlu 2000*) and in the south-eastern Anatolian site of Norşuntepe (*Hauptmann 1982*).

In addition to built-in hearths, the Kura-Araxes culture also employed portable hearths known as 'andirons.' These portable hearths were usually rectangular or u-shaped, and were often decorated with imagery representing bulls (*Smororzewska 2004*). In addition to their presence at many Kura-Araxes settlements, these portable hearths were found at sites in eastern Anatolia, including Sos Höyük (*Sagona 1998*) and in the southeast at Arslantepe, as well as at a number of other sites (*Koşay 1976; Kelly-Buccellati 2004; van Loon 1978*), especially in the very late fourth, and very early third, millennia. Fragments of andirons exhibiting this type of decoration were also found during survey expeditions in the Konya Plain on the southern Anatolian plateau (*Mellaart 1963*). Elements of Kura-Araxes household ritual certainly included fire, but may also have encompassed cooking and cuisine, as well as the broader context of agro-pastoralism.

Çadır Höyük pivots East

The Çadır Höyük mound and surrounding terrace cover roughly 20 hectares. The site rests on major east/west and north/south trade routes that operated throughout the site's occupation. With the exception of the Alişar Höyük excavations by Hans Henning von der Osten (*1937*) in the 1930s and recent work at Late Chalcolithic Çamlıbel Tarlası by Ulf-Dietrich Schoop (*2007; 2008; 2015*), there are no other

extensively excavated contemporary sites on the north-central plateau. Our most intensive work on the prehistoric periods has taken place on the lower southern slope of the mound in trenches LSS 3–5, LSS 8–10, and SES 1–2 (see Fig. 2). Previous reports have offered detailed description of findings from these areas (*Steadman, McMahon 2015; 2017; Steadman* et al. *2007; 2008; 2013; 2015; 2017*); only findings relevant to the present discussion will be offered here.

Two main occupational phases are relevant to this discussion. The earliest horizontal exposure at Çadır is known as the 'Agglutinated' phase, which begins at some time in the earlier fourth millennium (excavations of its earliest extent are not yet completed) and extends to roughly 3600 BC. This occupation corresponds with the Early Uruk period, prior to the major expansion of this system and the full extent of its complex connectivity; the Agglutinated phase also pre-dates the firm establishment of the Kura-Araxes culture. The second Çadır occupational phase is termed the 'Burnt House and Omphalos Building,' *c.* 3600–3200/3100 BC. This phase corresponds with the Middle and earlier part of the Lake Uruk periods, when this system was at its height; it is contemporary with the rise and spread of Kura-Araxes culture into eastern and south-eastern Anatolia.

The Pre-Kura-Araxes period at Çadır Höyük

When we began Chalcolithic excavations in the 1990s, we expected to discover small rooms built in attached layouts, with internal courtyards, like the architecture known from contemporary settlements to the south. However, this architectural footprint did not come to light at Çadır until our 2015 and 2016 excavations, in what is now the Agglutinated phase, *c.* 3700–3600 BC (based on Deep Sounding Beta #134069, see Table 1). The settlement plan at Çadır conforms to what is generally found at other Middle and Late Chalcolithic settlements such as Hacılar II (*Mellaart 1970*), Canhasan 1 (*French 1998*), and Güvercinkayası (*Gülçür 1997*).

The Agglutinated phase offered an architectural plan with seven separate rooms or spaces (Fig. 3), mostly single-celled, with some built-in storage bins (constructed of mudbrick or packed mud). While the discussion here focuses on the eastern half of the settlement, which has been more extensively excavated, our 2017 excavations indicated that a similar domestic compound, underlying the 'Omphalos Building' (see below), will be found in this area. The exterior walls were substantial enough to support a roof sufficient for rooftop activities, or even a second storey. Internal and external courtyards provided work areas outside the homes, and a forecourt separated the complex from a street that ran through the cen-

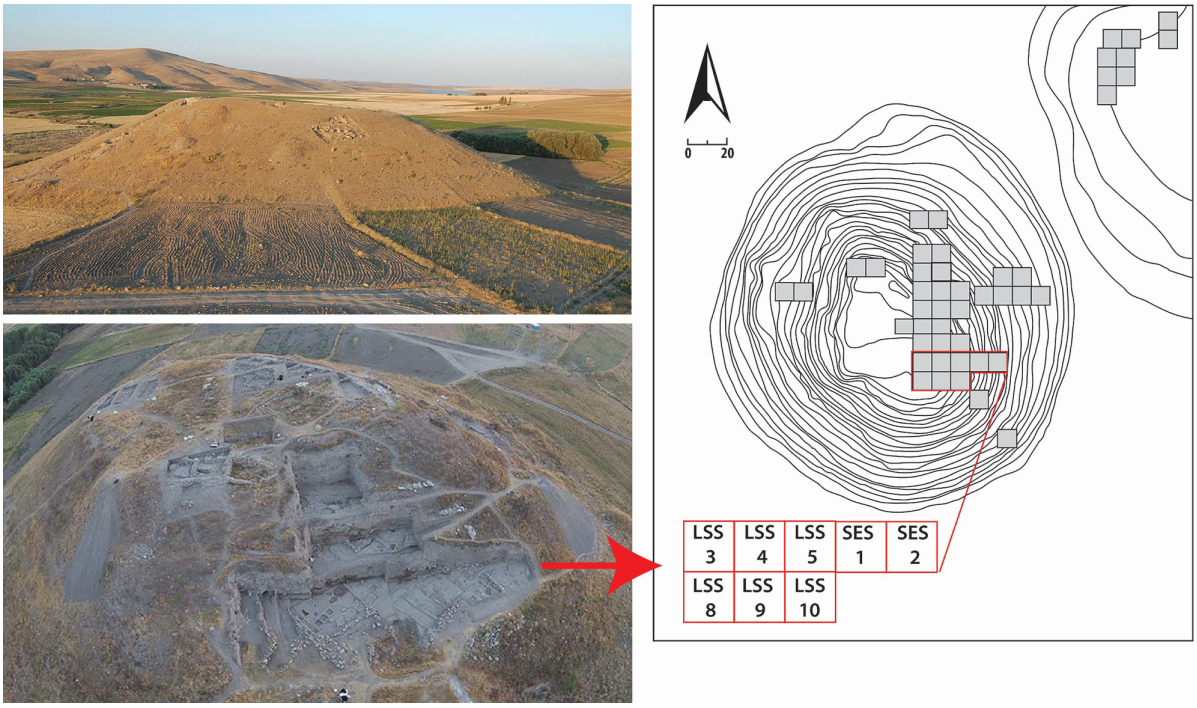

Fig. 2. Top left: view of the Çadır Höyük mound looking southwest; right: topographical map of Çadır Höyük and location of excavated trenches discussed in text; bottom left: aerial view of Çadır showing southern slope excavated areas discussed in text.

tre of the settlement. At the time of construction, residents buried infants, in whole or partial storage jars, within walls, emplaced at corner junctions (Fig. 4). No burial gifts were found in these interments.

Subsistence data for this phase suggest that residents cultivated crops such as hulled wheats and lentils, also the norm at other Late Chalcolithic settlements on the plateau. The faunal data suggest a strong reliance on caprines, as sheep and goat made up roughly 80% of the assemblage; other species present include cattle and domestic pig. Evidence suggests residents were engaged in small-scale agro-pastoralism sufficient to support the households at Çadır.

The material culture for this period indicates most items were locally produced for household use. Metal is rare, with the only recognisable piece thus far being a (broken) loop-headed pin; a few small individual metal fragments make up the rest of the metal assemblage. Lithic production appears sufficient for household use. Analyses for this phase are ongoing, but data from 2017 suggest that the total number of lithics (including partially or wholly completed tools and flakes) would number fewer than 190, with the percentage of obsidian reaching approx. 55%. Agglutinated residents exploited two clay sources to make their pottery. Surface treatment included slip and burnish, and firing resulted in colours ranging from black to buff and orange. Decoration was rare, the most common being three diagonal white lines on the shoulder or body. Forms included bowls, sometimes with carination below the rim, narrow-necked jars, hole-mouth jars, and large coarse cooking vessels. Also common were large storage vessels.

Çadır Höyük in the first half of the fourth millennium appears to be an agro-pastoral settlement with architectural planning and socio-economic pursuits similar to those practiced at contemporary settlements on the southern plateau. Trade, while almost certainly present, may have been local or perhaps regional, but evidence for long-distance trade, with the exception of the acquisition of obsidian from Cappadocia, has not been found. Metal items were rare and metallurgy not attested. Other household goods were produced on a household-level scale; ritual activity is represented by infant burials within the architecture, but evidence for community-wide ritual practice is lacking.

Çadır Höyük in the second half of the fourth millennium BC

Starting in the mid-fourth millennium, the Çadır settlement began to experience some dramatic changes in its settlement plan, socio-economy, and perhaps in the practice of religion and ritual. These changes may have resulted from increased connectivity both with Transcaucasia and also with exchange networks integrated with settlements such as Arslantepe, which was intertwined with the expanding Uruk system. This 'Burnt House and Omphalos Building' phase spans much of the second half of the fourth millennium (*c.* 3600–3200 BC based on radiometric dates).

The Burnt House and Courtyard complex (Fig. 5) is named for a hearth fire that destroyed the area. The Burnt House is free-standing, unlike architecture in the previous Agglutinated phase; the same is true of other structures in this phase, discussed below. Some Burnt House walls made use of previous Agglutinated walls; in other cases, rooms were filled in with mudbrick to create a 'Southern Courtyard', which featured several hearths, a bread oven, a kiln, and evidence of ceramic production based on the presence of unbaked clay ovoids (clay ready for working), burnishing stones, and ochre, used for paint, located in a storage bin (*Steadman* et al. *2013*). The Southern Courtyard may have served as a community production area connected to, perhaps controlled by, residents of the Burnt House. The Burnt House private courtyard was west of the house; it contained baskets of sto-

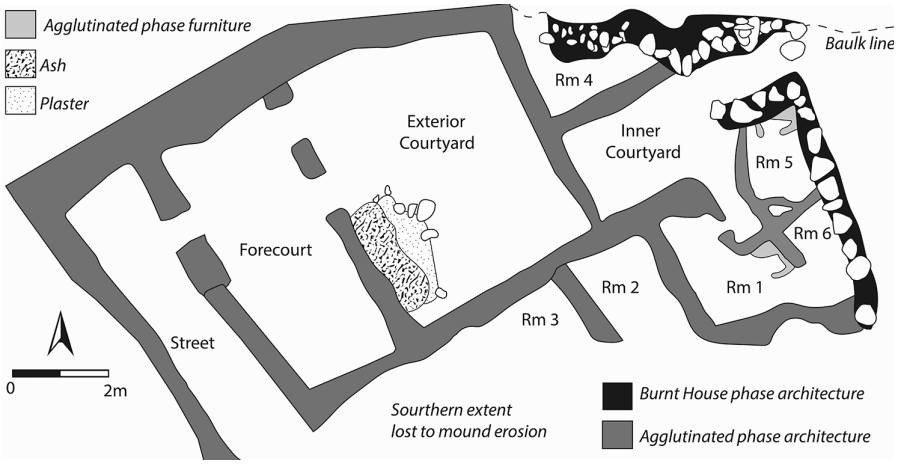

Fig. 3. Plan of Agglutinated occupational phase in trenches SES 1 and LSS 5.

Relevant ^{14}C dates from Çadır Höyük contexts

Sample #	Trench	Context	2σ max cal age (cal age intercept) min cal age
PRE-AGGLUTINATED PHASE (Deep Sounding)			
Beta #146707	LSS 5	F43 (DS) fill from stone wall *c.* 1m beneath Agglutinated Courtyard	5220–4940 BC (7170–6890 cal BP)
Beta #146710	LSS 5	L65 (DS) burned area just below F43-F44 stone walls	4520–4480 BC (6670–6430 cal BP)
AA84957	LSS5	L62 (DS) fill above L65	^{14}C age uncal BP 5829 ± 56
AGGLUTINATED PHASE			
Beta #134069	LSS 5	L46 (DS) from Agglutinated Outer Courtyard	3705–3620 BC (5655–5570 cal BP)
BURNT HOUSE / OMPHALOS BUILDING PHASE			
Beta #134066	LSS 5	L53 – roofing material of Burnt House/Courtyard	3780–3505 BC (5730–5455 cal BP) 3435–3380 BC (5385–5330 cal BP)
Beta #146714	LSS 5	F56/L71 wooden beam from Burnt House/Courtyard	3670–3360 BC (5620–5310 cal BP)
Beta #391301	SES 1	L139 inside Non-Domestic Building	3625–3590 cal BC (5575–5540 cal BP) 3525–3485 cal BC (5475–5435 cal BP)
Beta #159391	LSS 4	L69 fill between floors of Omphalos Building	3650–3340 BC (5600–5290 cal BP)
Beta #159391	LSS 4	L42 courtyard between second Omphalos Building structure and Burnt House	3485–3475 BC (5435–5423 cal BP)
Beta # 391309	LSS 3	L94 Enclosure Wall	3335–3210 cal BC (5285 cal BP)
TRANSITIONAL / EARLY BRONZE I PHASE			
Beta #363831	SES 1	F107 transitional period courtyard	3100–2920 cal BC (5050–4870 cal BP)
Beta #363830	SES 1	L112 transitional period courtyard	3350–3080 cal BC (5300–5030 cal BP) 3060–3030 cal BC (5010–4980 cal BP)
Beta #363865	USS 10	L 50 feature in EB industrial area	3090–2910 cal BC (5040–4860 cal BP)
Beta #363833	USS 10	L49 from inside large oven	3090–3060 cal BC (5040–5010 cal BP) 3030–2910 cal BC (4980–4860 cal BP)

Tab. 1. Selected radiocarbon dates relevant to the discussion.

red grain, evidence of lithic production, a number of complete vessels for storage, cooking, and consumption, and evidence of textile production (discovered in collapsed roofing materials, suggesting the roof or a second storey served as a work area) (*Steadman* et al. *2007; 2008*). The Burnt House occupants did not appear to lack material goods, having access to both trade items and high-quality household goods. A child burial was cut into one of the Southern Courtyard walls, thus belonging to this phase. It was not inside a jar, but it did include our first example of a burial good (excavated in 2016); a bronze earring was buried with the child (probably under 5 years of age).

Just behind, and connected to, the Burnt House was another structure named the 'Non-Domestic Building' (Fig. 5). This was a substantial structure, at least 5 x 5m in area, built of stone and mudbrick walls, completely devoid of any domestic materials (*e.g.,* hearth, cooking/storage vessels, *etc*.). Inside the building was a semi-circular mudbrick feature with a posthole in the centre; just to its west were two small holes with large rocks next to them (Fig. 6a). One of these

Fig. 4. Photo of infant burial within storage jar (F164) built into Agglutinated phase architecture.

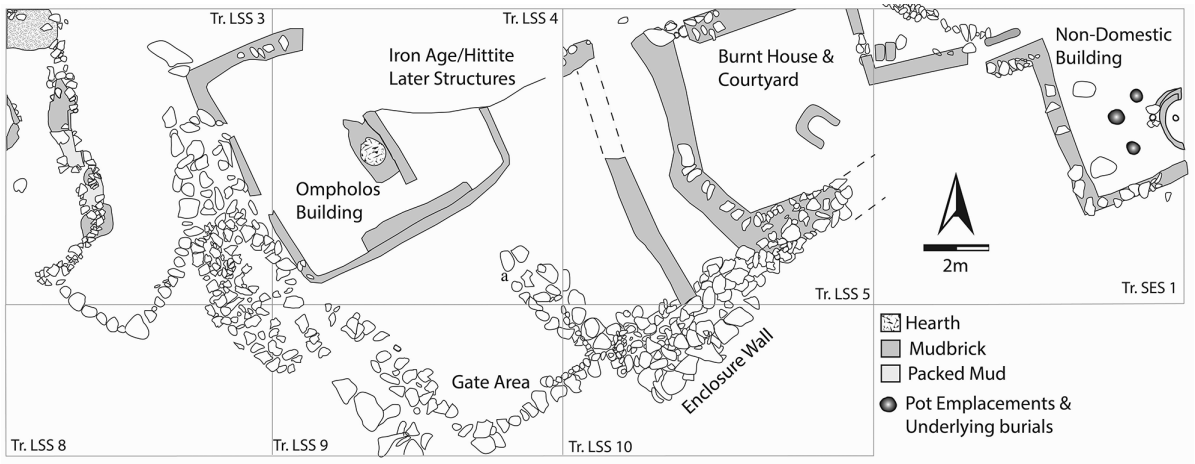

Fig. 5. Plan of the Burnt House and Courtyard and Omphalos Building Phase at Çadır Höyük.

contained seeds; the other was damaged by rodent activity, but may also have contained seeds. Beyond these were three circular depressions, pot emplacements, two of which were above infant/child burials (Fig. 6b–c). One burial was covered by a broken 'fruit stand' bowl (Fig. 6b), a vessel used in rituals, the other by a black burnished storage vessel. A third child burial was also buried within a storage vessel in the south-west quadrant of the room. The room was largely devoid of objects; those that were present were distinctly non-domestic; for instance, found within the room was a copper axe head (Fig. 7), the finest example of metallurgy recovered from the site. Near the doorway, a crystal amulet was discovered, and finally, a small unbaked clay figurine, apparently female, also came from inside the building.

The Burnt House area contained far more numerous examples of metal objects than in the previous Agglutinated phase. Nearly 20 individual metal items, consisting of pins, needles, and jewellery, were recovered from the house and courtyard; these are in addition to the fine axe head found in the Non-Domestic Building. Analyses have not yet provided sourcing for the metal; preliminary analysis suggests differing levels of arsenic, nickel, and zinc in the ores, perhaps indicating that the finished products came from a variety of ore sources.

Across the Late Chalcolithic settlement, the number of lithics increased dramatically as compared to the Agglutinated phase. There was a four-fold increase in the number of lithics, with nearly 800 whole and partial tools and flakes recovered. The percentage of obsidian rises slightly (58%), but the overall volume of lithics present, primarily in the Burnt House/Courtyard area (*i.e.* the percentage in the assemblage is largely consistent, with 55 and 58%, respectively, but the amount of obsidian acquired increases dramatically), indicate a substantial increase in the acquisition and production of materials. P-xrf analysis of obsidian from this phase indicates that at least four different sources were exploited, although the actual location of these sources has yet to be determined. Intensification in the acquisition of obsidian might have involved the exploitation of new sources to the east and southeast in Transcaucasia and Arslantepe or more frequent use of Cappadocian sources, either increasing the possibility of encountering exchange networks connected to Arslantepe, and other regions of the Uruk system. There is also a change in the ceramic assemblage in this phase; a greater variety of forms and decoration make their appearance in the Burnt House/Omphalos Building phase. The 'Omphalos Bowl' becomes a prominent feature, as do the 'fruit stands', which may have been primarily dedicated to ritual rather than daily use. Incised decoration, sometimes with white in-fill, becomes much more frequent; also common is the application of red paint (ochre-based) applied after firing. This is found on a variety of vessel types, usually at the rim, but occasionally in lines and geometric figures on the bodies of larger vessels.

Herd management strategies also change in this phase. Sheep and goat remain prominent, representing 72% of the livestock; sheep now outnumber goat by close to a 2:1 ratio. Biometric data show that large-sized, presumably male, sheep were common, a pattern interpreted to represent wool production at other sites (*Arbuckle 2015*; and see *Schoop 2014*). This is supported by slaughter patterns; sheep were culled as adults rather than as juveniles, again suggesting wool was an important goal of pastoral production (*Arbuckle* et al. *2009*). Livestock were also used for secondary products at Uruk system sites in

Fig. 6. a photo of the Non-Domestic Building with semi-circular mudbrick feature, postholes, and excavated pot emplacements; b photo of broken fruit stand bowl placed over infant burial under pot emplacement; c photo of child burial under broken ceramics beneath pot emplacement.

the southeast (*Boessneck, von den Driesch 1976; Pollock 1999; Stein 2001*) and in Transcaucasia (*Obermaier 2006*). Besides the production of hulled wheats and lentils which continue into the Burnt House/Omphalos phase, a significant quantity of flax (*Linum usitatissimum*) was recovered from the Burnt House and Southern Courtyard area; it may have been used for cooking or oil production, but given the textile producing tools found in the Burnt House, it may have also been used in weaving activities (along with the wool).

West of the Burnt House complex is the Omphalos Building; just to the south of this structure is the gate complex associated with the Enclosure Wall. The Omphalos Building was constructed by the mid-fourth millennium (*c.* 3500–3400 BC), with two structural reorganisations over the next several centuries. The earliest layout featured a large singular room; an organic partition may have separated the space into two halves (*Steadman* et al. *2017*). Sitting on the mud-plaster floor of this structure was a collection of ceramics, mainly storage vessels and smaller bowls. Perhaps a century later, a mudbrick wall was built to divide the room into two (see Fig. 5). Phytoliths recovered from the floor of the westernmost room revealed a shelf pattern; scattered among the phytoliths were dozens of broken vessels. Some showed signs of use, including burning, others appeared freshly made. Furniture features in this building consisted of a bench and a mudbrick platform within which a small fire installation had been placed. It was perhaps meant to heat the room, or food, or may have served another purpose. This building was almost certainly involved in ceramic distribution to the community, and perhaps beyond. A substantial kiln, located in the courtyard east of the Omphalos Building, and a collection of areas in the courtyard dedicated to the storage of ceramic production items (quartz used in temper, ochre, and clay ovoids; see *Steadman, McMahon 2017*) support this interpretation.

The entire Late Chalcolithic settlement was enclosed by a wall and gate system that stretched from just south of the Burnt Courtyard to around the western wall of the Omphalos Building (see Fig. 5). The gate leading into the settlement was centred in the Enclosure Wall and was flanked by two small rooms (*Gorny* et al. *2002; Steadman* et al. *2008*). It was perhaps built in conjunction with the Burnt House, and may have made use of an earlier (Agglutinated phase) mudbrick wall surrounding the settlement. For at least two centuries, it provided a grand entrance to the Late Chalcolithic settlement at Çadır.

It is the material culture found in and near the Omphalos Building that, in concert with increased exploitation of obsidian and textile production, offers

some of the strongest evidence of Çadır's connectivity with regions and cultures to the east. The first item of note was a small clay quadruped (likely bull) figurine (Fig. 8), somewhat burnt, found inside the two-roomed Omphalos Building. This, and the tiny female figurine found in the Non-Domestic Building constitute the earliest figurines yet discovered at the site. The second item to mention was also recovered from the Omphalos Building, from a 'box' dug into the floor. From this box, we recovered most of the pieces of a squared ceramic vessel open at both top and bottom. It was heavily decorated with incision and white in-fill; protruding from one of the corners was a bull's head with a decorative triangular motif embedded in the forehead (Fig. 9). Based on correlation with similar discoveries in Transcaucasia, at Sos Höyük, and elsewhere in the southeast, we are fairly certain this item was an 'andiron' or portable hearth. A lack of burning on this vessel indicates it was never used for cooking. Its placement in a 'box' cut into the floor of the Omphalos Building suggests it may have been a specialised object (it is unclear if the box was easily accessible, *e.g.*, covered by a wooden plank or flat stone; it was not plastered over). Though found in Anatolia, andirons are thought to have originated among the Kura-Araxes culture and been transported westward. Just outside the Omphalos Building, near the gate, a very fine double-spiral headed pin was discovered (Fig. 10). The metal contains a significant amount of arsenic, but little zinc and no nickel, suggesting it may have come from a different ore source than many of the other metals recovered from this phase. The pin is largely unique on the north-central plateau, but has very close parallels to examples at Arslantepe, Norşuntepe, and sites to the east in Van and Transcaucasia (*Huot 2009; 2014; Frangipane 2014; Marro 2011; Rova 2014; Sagona 1981*). Recent work has suggested such pins made their way as far east as the Indus Valley (*Miller 2013*) and as far west as Orman Fidanlığı (*Efe, Fidan 2006; Fidan* et al. *2014*).

The final set of material culture that points toward Transcaucasia comes from the 2017 excavations. A total of three infant/child burials were recovered from the courtyard area in front of the Omphalos Building, just to the west of the gate entryway. Two additional burials were discovered in 2000 when the gate was excavated, although it is as yet unclear if they are related to the three excavated in 2017. All of the burials were contained in, or covered by, typical Late Chalcolithic storage jars (Fig. 11). Several factors make these burials stand out as different from those found in the Burnt House area and Agglutinated phase. First, they are not built into, or apparently associated with, a building. Secondly, a layer of stones, mostly flat, was laid over the burials, particularly the three discovered in 2017 (one burial was missing a covering stone, but this may have been removed in previous excavations as part of nearby gate tumble). The stones created a type of 'flagstone patio' over the burials. An additional element is a slight mounding of the burials, especially near the apex of the triangle, which received additional fill underlying the burial in order to elevate it. The final unusual factor is also the most remarkable. Each of the three burials discovered in 2017 contained a minimum of five items of metal jewellery (Fig. 12) given as burial goods. In addition to the jewellery, one of the 2017 burials had a bowl placed with the child; initial examination suggests the bowl may have held a food item (Fig. 12). The copper jewellery (not yet analysed, as these burials were found in the very last days of the 2017 season) is in the form of wrist and ankle bracelets and hair spirals (Fig. 13a–c). It should be noted that the double-spiral pin was also found near one of the other burials discovered in 2000, but it is unclear whether the two were associated. The 2017 burials were by far the most remarkable, and unique, thus far recovered in the Çadır Höyük excavations.

Fig. 7. Photo of the copper axe found in the Non-Domestic Building.

Fig. 8. Photo of the zoomorphic (bull?) figurine found in the Omphalos Building.

Discussion: complex connectivity

The residents at mid- and late fourth millennium BC Çadır Höyük saw some substantial changes in their settlement and lifestyle. A new town plan, with public, or at least non-domestic, buildings, and a wall and gate were coupled with a much more robust socio-economy and possibly the organisation of labour. These changes, it is argued here, were in part generated by the increased complex connectivity emanating both from the Uruk system to the south (*Steadman* et al. *2019*), and the rise of the Kura-Araxes culture to the east. The material culture at Çadır illustrating these connections was described above within their archaeological contexts. Here we elucidate the material culture specifically with regard to evidence for complex connectivity with both the Kura-Araxes region and Arslantepe in south-eastern Anatolia.

Specific, traceable, points of connectivity stemming from the increased exchange of goods between the Çadır settlement and these regions include metals and obsidian. In the earlier Agglutinated phase, obsidian constituted 55% of the lithic assemblage (over 100 tools and flakes of the nearly 190 collected). In the Burnt House phase, the percentage of obsidian remains nearly the same (58%) but the quantity is significantly higher, over 400 tools and flakes of the nearly 800 collected. This indicates a significant increase in obsidian acquisition, which in turn suggests a more robust exchange system allowing residents to access higher quantities of this desirable material. Analysis shows four different flows represented at Çadır during the Burnt House phase; some of these sources may have been located farther afield than Cappadocian sources, raising the opportunity for connectivity with residents from elsewhere, including Arslantepe, and possibly Transcaucasia. The obsidian evidence, at its most basic, indicates a much denser movement of goods such as this resource in the later centuries of the fourth millennium.

The dramatic increase in the presence of metals at Çadır is even more convincing proof of increased exchange and thus connectivity. Metal ore sources for Çadır's assemblage have yet to be traced. At present, we do not have good evidence for metalworking in this phase, and thus it is likely that objects were obtained in completed form through exchange. There is a small copper ore source on the north-central plateau, although evidence for mining there is not indicated. Larger, exploited sources are found in Transcaucasia and south-eastern Anatolia at Ergani. The presence of significant numbers of metal objects in this phase of occupation at Çadır are a strong indicator of connectivity with distant regions such as the Uruk frontier, but especially Transcaucasia, given the nature of some of the metal items, discussed in more detail below.

Fig. 9. Photo of the bull-headed ceramic object found in a box within the Omphalos Building floor. This object demonstrates stylistic similarities to portable hearths (andirons) found to the east in Kura-Araxes contexts.

A final indicator of a more vigorous socio-economy and engagement with actors beyond the settlement is evidenced by an increase in both textile and ceramic production. The large kiln associated with the Omphalos Building, and a smaller one in the Southern Courtyard, and the presence of clay ovoids and materials associated with ceramic production in both locations suggests a production scale beyond what is needed for household use. The dozens of varied vessels in the Omphalos Building may have served as products in a ceramic distribution centre for the settlement and the region, and perhaps some of these ceramics and their contents made their way to destinations farther away. That some of these vessels had been burned and returned to the building is interesting. Kura-Araxes ritual calls for the burning of plants in bowls at or near hearths.

Fig. 10. Photo and drawing of double-loop pin from Çadır Höyük from the late Omphalos Building phase.

The increase in textile production at Uruk-period sites was discussed above; Ulf-Dietrich Schoop (*2014*) has also carefully identified an increase in wool-based textile production in the Late Chalcolithic on the Anatolian plateau and at points south and southeast. At Çadır Höyük, a similar increase in wool- and probably flax-based textile production, based on archaeobotanical, archaeozoological, and material evidence in the Southern Courtyard, dates to the same period. It is difficult to gauge the scale of production, except to note that it is far greater than in the preceding Agglutinated phase. The textiles produced may have been sufficient only to serve the Çadır population and surrounding regions, but again, like ceramics, some of these may have been destined for a larger exchange network. The production of textiles may have been based solely within individual households, allowing for surplus goods (not needed by household residents) to enter the exchange system and increase each household's access to trade goods (see *Schoop 2014* for discussion of this type of system). The Southern Courtyard at Çadır, however, may have also served as a small 'production area' for food, including bread, and possibly textiles; this courtyard, adjacent to the Burnt House, may have been controlled by those residents, and the products of labour by those working in there may have benefitted both workers and Burnt House residents alike.

In addition to the increase in exchange systems in the later centuries of the fourth millennium BC, evidence at Çadır suggests that complex connectivity probably played some role in the architectural and socio-economic (and possibly socio-political) changes taking place at Çadır at this time. Most of these changes probably stemmed from organic developments at the settlement in response to the larger global occurrences of increasing trade and exchange emanating from the Uruk system to the south and regions within, and connected to, the Uruk system. However, it is also the case that Çadır clearly appears to have been 'pivoting east' to Transcaucasia, driven in part through the elements of connectivity described just above; the evidence to support this is surprisingly strong.

The most circumstantial evidence comes from the Non-Domestic Building and the seeds deposited in the hole next to the semi-circular mudbrick feature. We believe this structure was indeed dedicated to ritual use, and the presence of the seeds suggests the practice of ritual associated with the agrarian cycle. As noted in the Kura-Araxes section above, instances of burned grains have been found in association with Kura-Araxes ritual activities, especially in association with hearths (*Simonyan, Rothman 2015.32*). However, the presence of grain products in a ritual area in the Late Chalcolithic is not surprising in any context and cannot be used as concrete evidence for

Fig. 11. Top: photo of the Omphalos Building area (the red arrow indicates the location of the three infant/child burials); bottom: close-up photo of the three infant/child burials with their storage vessel covers and stone layer above.

connectivity. A second item worth mentioning is the small animal figurine found in the Omphalos Building. Animal figurines, including bulls, have been found in Kura-Araxes contexts. It is the earliest evidence of a zoomorphic figurine at Çadır (we have several dating to the Early Bronze I period, and a number from Hittite contexts). Given that bull imagery was common in the Neolithic on the plateau, this figurine may indicate nothing more than local ideologies, but its singularity in the Omphalos Building is notable.

Stronger evidence comes from the fireplace in the Omphalos Building. This fire installation inside the middle architectural phase of this structure is the only interior hearth/fireplace discovered in the prehistoric contexts at Çadır, whether in the Agglutinated or Burnt House phases. Hearths and ovens were typically *outside* in internal or external courtyards, making the internal fireplace in the Omphalos Building a unique occurrence. As described above, it does not appear to have been used for full-scale cooking. It was in a 'bench' or platform, raised above the floor; next to it were phytoliths, suggesting a mat once rested there, perhaps for placing food or bowls. It may have been used simply to heat the room, but the importance of the hearth as a central place for ritual in Kura-Araxes settlements, and the uniqueness of the Omphalos Building installation, evokes inference of the ideological. The presence of burned vessels is also notable (see above).

The strongest evidence for connectivity between Çadır and Transcaucasia comes from the infant/child burials and the examples of metal from the Burnt House/Omphalos Building phase. The least of these is the axe found in the Non-Domestic Building. While Kura-Araxes settlements had similar objects, there is nothing particularly distinctive about them or the Çadır example that would certify interaction. Far more suggestive is the double-spiral pin found near the gate (and near one of the infant burials) in this phase. The intricacy of workmanship, and its parallels with examples from Arslantepe (which have been identified as Kura-Araxes in origin) and from Kura-Araxes sites, all but proves that this pin did not originate at Çadır, but came from elsewhere, perhaps as far away as Transcaucasia. Finally, the metal objects from the infant/child burials in the Omphalos Building courtyard are indicative of interaction. Parallels with Kura-Araxes examples of both ankle and wrist bracelets are clear (*Rova 2014; Sagona 1994*). Most importantly, however, are the hair-spirals, which are nearly exact copies of those found in Kura-Araxes contexts. Not just the form and style of the objects themselves, but the quantity of metal objects in these caches within the burials are absolutely unique at Çadır. It would appear that metal objects became an important element in this phase of the Çadır occupation, perhaps due to their availability through connectivity with metal-bearing and metal-producing cultures to the east.

From the material culture assemblage, by far the most telling item is the bull-headed andiron found inside the Omphalos Building. Portable hearths were very much part of the important household and rit-

ual equipment associated with the Kura-Araxes culture, and their presence at sites such as Arslantepe, Sos Höyük, Norşuntepe and elsewhere have indicated to archaeologists that Kura-Araxes people, or at least their objects, were present at these sites (*Smogorzewska 2004*). The form, style, and decorative elements set this object apart from any others at Çadır, and its location in a floor 'box' would suggest it was not used in daily activities, but was meant for specialised purposes. Andirons were also found at the nearby site of Alişar Höyük (*von der Osten 1937. 270*), and the bull head is similar to one discovered at the nearby site of Camlıbel Tarlası (*Schoop 2015*). The presence of andirons, or their associated pieces, at several sites on the north- central plateau would suggest that there was some relatively structured exchange between this region of the plateau and cultures to the east, at least as far as Sos Höyük, and perhaps reaching all the way to Transcaucasia.

Fig. 12. Photo of one of the three burials, with red arrows indicating the location of copper jewellery (two additional pieces were found beneath the remains. Note the small bowl with evidence of a food offering).

Finally, the three infant/child burials in the Omphalos Building courtyard must be included as possible evidence of connectivity. As described above, several elements set them apart from earlier infant burials, which were associated either with architectural elements or with the Non-Domestic structure. These stand alone, located within the corner of the courtyard and near the entrance of the gate. A very unusual element is the placement of the stones above the graves, something entirely unique at Çadır. As noted above, mounding and stones placed above graves are common elements in Kura-Araxes graves. It was with these burials that the caches of metal burial goods were found; one appears to have also been given a bowl/food offering. These features set them apart as unusual; however, each burial was covered by a local Late Chalcolithic storage jar, commensurate with earlier and other contemporary burials. The extraordinary mortuary activity associated with these children features a mix of cultural elements, both from Çadır itself and from burial styles and goods seen in Kura-Araxes contexts. Why they received such unusual attention is a question we must seek to answer as our research continues. At present, we can only acknowledge that these burials, and associated material culture from them and elsewhere in this phase, demonstrate that Çadır Höyük was linked to the complex connectivity between the Uruk system, Transcaucasia, and the Anatolian plateau in the later fourth millennium BC.

Fig. 13. Photos of the copper jewellery discovered in the three infant/child burials. a photo of the entire cache; b photo of a double bracelet; c photo of a hair spiral.

Conclusion

Recent efforts to identify past complex systems as 'globalisations' have led to new avenues for understanding how these ancient systems worked and how vast their interconnections may have been. The focus here was to demonstrate that some type of interaction between Çadır Höyük and Transcaucasia was taking place in the later fourth millennium BC, allowing residents at this settlement to 'pivot east,' for new connections. The Çadır Höyük data were examined within the context of the larger 'globalised Uruk system' and specifically the elements of complex connectivity as the mechanism that links far-flung areas within a globalised world, as well as drawing in regions existing beyond that world, such as Transcaucasia. In addition to dramatic architectural and socio-economic changes at the Çadır settlement in the later fourth millennium, the material culture directed us to identify what types of connectivities might have brought new luxury items and ostensibly new behaviours to the Late Chalcolithic inhabitants of Çadır Höyük. That process of analysis demonstrated links with eastern and south-eastern Anatolia, which in turn had engaged in interactions and exchange with both the Transcaucasian Kura-Araxes culture and the Mesopotamian Uruk system. All of these coalesced to create a set of interlinked complex connectivities between quite disparate regions, including the north-central Anatolian plateau.

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The process of cultural change in the Chalcolithic period in the highlands of Western Iran at Tepe Gheshlagh

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ABSTRACT – *Tepe Gheshlagh is located in the centre of Talvar Valley in Bijar County, in the Kurdistan province of Iran, on the east bank of River Talvar. It lies on a natural terrace, less than 30m above the present-day riverbed. The oval mound is about one hectare in area, and rises more than 14m above the surrounding fields. Three seasons of salvage excavation carried out at the site have revealed significant information on the Early, Middle and Late Chalcolithic periods (5500–3850 BC) in this region. Unfortunately, no accurate archaeological research has been undertaken to gain a better understanding of the Chalcolithic period, especially the Early Chalcolitic, and the current excavation highlights this issue. In fact, exploration of cultural traces and, in particular, the important settlement of Tepe Gheshlagh, as well as recognition of the subsistence economy of its residents can increase our knowledge of cultural traditions in this region.*

KEY WORDS – *Chalcolithic period; Dalma tradition; Tepe Gheshlagh; Iranian prehistory*

Proces kulturne spremembe v času bakrene dobe na območju zahodnega Iranskega višavja na najdišču Tepe Gheshlagh

IZVLEČEK – *Tepe Gheshlagh se nahaja na osrednjem delu doline reke Talvar (okraj Bijar, Kurdistan) v Iranu, in sicer je najdišče locirano na vzhodnem bregu reke. Pozicija najdišča je na naravni terasi, ki se dviga manj kot 30 metrov nad današnjim koritom reke. Ovalna gomila zajema območje enega hektarja in se dviga 14 metrov nad okoliška polja. V treh sezonah zaščitnih izkopavanj smo pridobili pomembne informacije o zgodnji, srednji in pozni bakreni dobi (5000–3850 pr.n.št.) na tem območju. Z novejšimi izkopavanji smo osvetlili tudi čas zgodnje bakrene dobe, ki do sedaj na tem območju ni bila primerno arheološko raziskana. S pomočjo analize kulturnih ostalin in naselbine Tepe Gheshlagh ter analize subsistence takratnih prebivalcev smo povečali naše vedenje o kulturni tradiciji v regiji.*

KLJUČNE BESEDE – *bakrena doba; tradicija Dalma lončenine; Tepe Gheshlagh; prazgodovina v Iranu*

Introduction

The Chalcolithic period in the central Zagros, starting at *c.* 5500 BC and lasting until 3000 BC, marks one of the most important prehistoric periods in Iran, with quite different characteristics compared to the Neolithic period. The chronological sequence is based on thermoluminiscence dating. The local rural communities and their settlements established in the Neolithic period were developed significantly. Tepe Gheshlagh is one of such settlement.

The Chalcolithic period in different parts of the Iranian plateau is difficult to study because of the lack

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of absolute ^{14}C dates, so it cannot be easily distinguished from the Neolithic. In most of the research carried out so far, the only difference between these periods is in the pottery types, which certainly cannot be the only reliable source for distinguishing between one period and another, although it seems to be a significant feature. We may mention here the work of Elizabeth Henrickson, Cuyler Young, and Louis Levin on the west of Iran (*Henrickson 1983; 1985; Young, Levine 1974*). The second reason is the absence of integrated and comprehensive research in this area after the Islamic Revolution in Iran. Certainly, no systematic research was done in western Iran during these years, which could have examined a considerably important settlement of the Chalcolithic period, and present a cohesive and related introduction to its cultural material, rather than some unrelated examples. Hence, comprehensive research of the Early, Middle and Late Chalcolithic periods in Gheshlagh Region is needed. Unfortunately, inconsistent approaches in earlier excavations have led to presentations of fragmentary results, so that it is still impossible to answer many questions concerning the mutual interactions between different areas in the Chalcolithic period. The third reason is that in this period, a larger area of the western highlands of Central Zagros was inhabited, while there had been no reports of any earlier settlements in these regions (*Levine, McDonald 1977*). On the other hand, according to the preliminary results of some field studies, there was a relative increase in the population of these areas, mainly due to movements from surrounding areas due to factors such as population increase (*Motarjem 2011*). The same premise applies to the material found in a number of excavations, and shows the similarity of

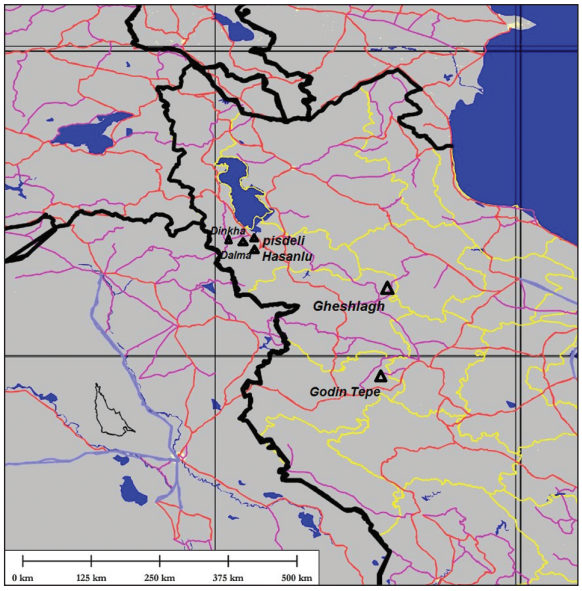

Fig. 1. The location of Tepe Gheshlagh in western Iran.

pottery styles over a wide geographical area. Furthermore, environmental and climatic differences in different parts of Zagros, ranging from the north to the west of Iran, had a great influence on the uneven development of these cultures. In other words, there are marked environmental-regional differences in almost all the cultures related to the Chalcolithic period.

One of the most important Chalcolithic cultures in northwest and north Iran is known as the 'Dalma pottery tradition'. Our information on this tradition is limited. It is known at Tepe Dalma (*Hamlin 1975*), as the second-earliest culture around Lake Uremia after the Hajji Firuz Phase (*Voigt 1983*). Diversity and differences in some special cultural elements relate to social and economic changes, as well as to cultural adaptation to stable environments in the region. They include variations in the material culture, found in three southern sites (at Lake Uremia, Talvar Valley, and Central Zagros) as subcategories of the Dalma tradition. The cultural scope of Dalma has been recognised through archaeological excavations not only in the southern basin of Lake Uremia, but also in vast areas stretching from northwest Mesopotamia to northern Anatolia, as well as from north and

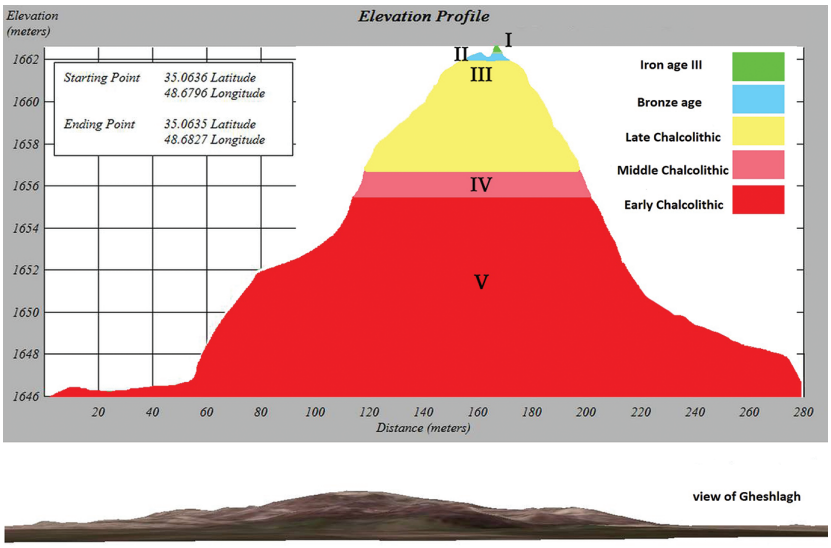

Fig. 2. Tepe Gheshlagh – section profile.

northwest Iran to the natural boundaries of Jebel Hamrin and on the periphery of Khuzestan plain. This shows the cultural evolution and adaptation to environment, since each region demonstrates some specific regional differences along with the general characteristics.

Assessing the relative and absolute chronology of the region in order to identify the precise dates of settlements as well as cultural layers is the main focus of this paper. We also focus on cultural communication between settlements along the eastern ranges of central Zagros and the nearby areas in northwest Iran and Mesopotamia, as well as on the origins and formations of early cultures and their transformation into more complex subsistence and social systems. How much did the environment, climate changes, and neighbouring cultures influence the cultural components of the Chalcolithic period? Were cultural changes in the Talvar Valley due to local transformations or the influence of surrounding areas? What were the cultural interactions between the local residents and the neighboring areas; were they more influenced by the northwest culture (Dalma), or the cultural phases of central Zagros?

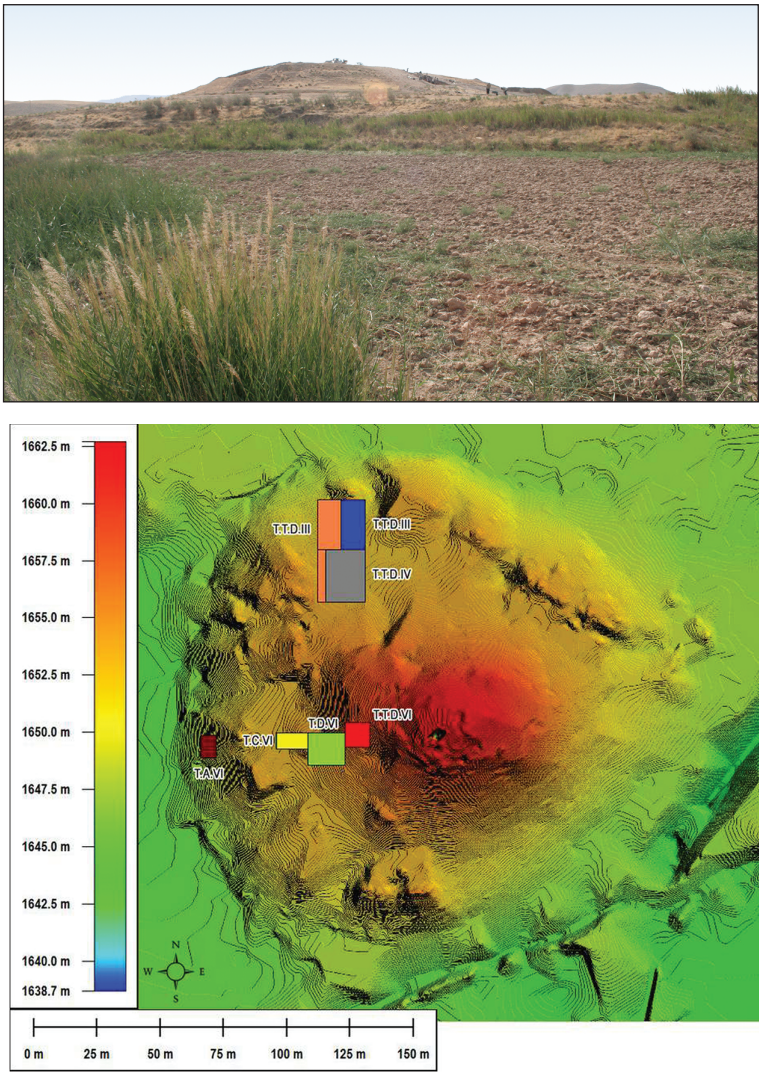

Fig. 3. General view of Tepe Gheshlagh (above) and topographic map showing the location of trenches (down).

Archaeological background

No systematic archaeological studies were carried out in Bijar Province before 1971, when Stuart Swiny carried out archaeological research on the main plains of the southern basin from the northwest to the borders of central Zagros in Hamadan. He identified Dalma sites in the highlands of Kurdistan across the southern basin of Uremia Lake and Bijar Province (*Swiny 1975*). We can also mention the archaeological excavations in Tepe Rezaabad (*Mohamadifar 2010*) as well as Tepe Gheshlagh in 1991, 1992, and 1993, which continued until they reached the archaeologically sterile layer (*Motarjem 2011; Motarjem, Sharifi 2014; 2015*). The excavation of Tepe Kolnan (*Saed 2010*) is among the research projects conducted in Bijar. In 2009, a continuous sequence from the Middle Palaeolithic up to the Bronze Age was documented and published (*Mohammadifar, Motarjem 2009*). The Chalcolithic oc-

	Phase	Depth	Cultural Phases	Date (BC)	Regional Tradition
1	III	–5.38cm	Late Chalcolithic	3600±220 3800	GODIN VII
2	III	–6.84cm	Late Chalcolithic	3915±270	GODIN VII
3	III	–7.60 cm	Late Chalcolithic	3850±280 4100	GODIN VII
4				3960±290 4100	
5	V	–12.50cm	Early Chalcolithic	5000 ±305	Dalma tradition
6	V	–14cm	Early Chalcolithic	5500±250	Dalma tradition

Fig. 4. Chronological table of Tepe Gheshlagh, based on thermoluminescence dating.

Fig. 5. Phase I – the Late Chalcolithic period in layer 3 at Tepe Gheshlagh.

cupations in the east of central Zagros were documented by excavations in Tepe Seh Gabi and Godin (*Young 1969; 1975; McDonald 1979.348; Levin, Young 1986.17; Henrickson 1983.478; 1985.66*). Research in Chogha Maran and Siahbid in the west of central Zagros in Mahidasht revealed Late Chalcolithic pottery, which is known as 'J Ware' (*Levine, Mc Donald 1977.44*). 'J Ware' originated from Mesopotamia (the Late Halaf period), and hence was made using similar technology; and in terms of fabrics and forms, it resembles the pottery of the Late Halaf period (*Levin, Young 1986.19–21; Henrickson 1983.80; 1985.69; Levine, McDonald 1977; Rothman, Badler 2011.75*).

Some Dalma ceramics were found during surveys in Mahidasht, and at two excavated sites, Chogha maran and Siahbid (*Henrickson, Vitali 1987.38*). At the Godin site, phase VIII is known as the Taherabad phase, which is attributed to the end of the mid-Chalcolithic period (*Henrickson 1985*). The late Chalcolithic period is recognised through pottery from Godin phases VI–VII, which is concurrent with the Hosseinabad phase and Cheshme Nosh in Segabi (*Henrickson 1985.74*). At Godin Tepe, traces of phase VII-VI were found in trenches A, E, and F (*Young, Levine 1974. 12*). Cuyler T. Young and Elizabeth F. Henrickson (*1991.281*) believe there are significant traces of cultural continuity of Godin VII that most probably began in the mid-Chalcolithic phase III. The analysis of plant remains revealed traces of wheat and barley in the Godin excavations (*Miller 2011.59*). The archaeological excavations of the Chalcolithic period in Ghazvin plain in the central plateau of Iran were carried out by Hassan Fazeli and Mark Pollard (see *Pollard* et al. *2012; Fazeli* et al. *2013*).

Tepe Gheshlagh

The mound measures about 80m long and 70m wide, covering a total area of approx. 5600m^2. At the highest point, it rises about 7m above the surrounding land. It is the largest prehistoric site in the Talvar Valley (Fig. 2). During three seasons of excavations (*Motarjem Sharifi 2015.27*), five cultural layers were identified at Gheshlagh, showing the cultural continuity from the Early Chalcolithic to the Iron Age III period, along with two culture gaps that will be presented below (Fig. 3).

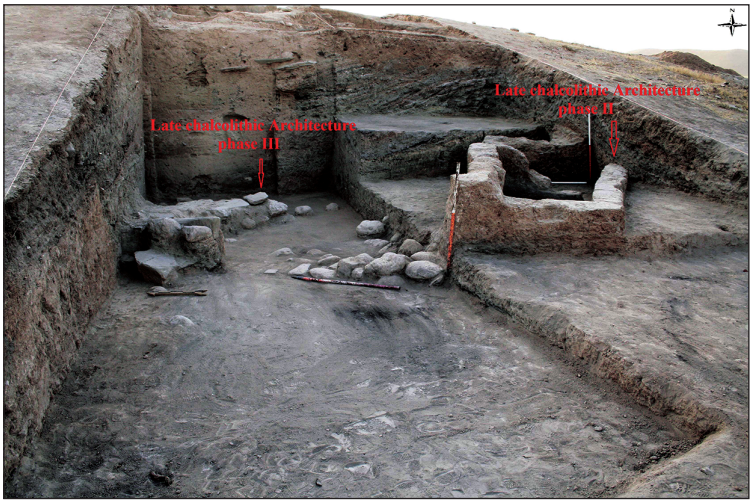

Fig. 6. Phase II – the Late Chalcolithic period in layer 2 at the site.

● Layer 1: the Iron Age III layer with architectural remains in the right corner that include mudbrick walls with stone foundations. The cultural remains include pottery and a child burial in a trench.

● Layer 2: the cultural layer of this level is 60cm thick and, according to archaeological studies, dates to the Late Bronze Age.

● Culture hiatus II: this gap falls between the Early and Middle Bronze ages and the Late Chalcolithic period. In terms of chronology, it is synchronous with Godin VI phase, and then with the cultural development of Kura-Araxes or Yanik in the northwest and eastern parts of central Zagros, which dates to 1600–2800 BC. Most of the ^{14}C dates and relative chronology indicate that the Kura-Arex culture emerged in central Zagors around 3000 BC. In view of the special developments and migration in this period, the region appears to have been empty of population, while the same culture in the Talvar Valley has been identified in a field survey. The cultural hiatus is an indication of the relocation of settlements and the consequence of differences in subsistence. The Talvar plain was not inhabited, but the patterns of establishment changed.

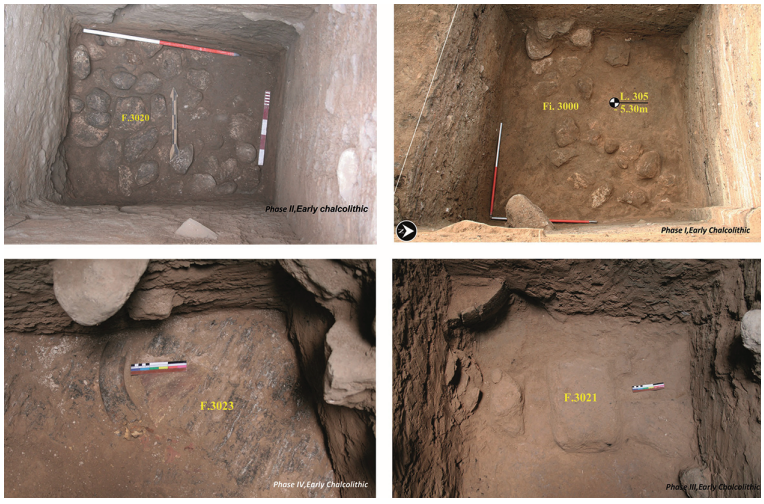

Fig. 7. Phases I to IV – the Early Chalcolithic period at the site.

● Layer 3: the Late Chalcolithic layer includes three architectural phases (about 5m thick). In Phase I, we found a complete building plan in the top layer that included a room, a hall, and a separate rectangular kitchen space made of mud brick, as well as an outer wall (Fig. 5). Thermoluminescence dating determined the relative and absolute dating of this layer to the Late Chalcolithic period, with three separate phases (3915 ± 270, 3850 ± 280, 3600 ± 220 BC). The archaeological finds follow traditions in central Zagros (*Motarjem, Sharifi 2014.49*). An oven and a mud brick structure were discovered in the Late Chalcolithic phase II, and phase III included stone structures (Fig. 6).

● Layer 4: the Middle Chalcolithic layer is 0.55m thick and lackisany type of architecture; it was identified by its cultural remains. The pottery includes Pizdeli, Seh gabi, Black-on-Buff and Red-on-Buff pottery, which indicate some cultural connections between this area and the Lake Uremia basin, as well as with the east of central Zagros (*Henrickson 1983. 246; Levin, Young 1986.Fig 17:36, No. 9*). Since the pottery resembles Pizdeli and Seh Gabi types, and also based on comparisons with the Lake Urmia basin material, this phase is recognised as the Hasanlu VIII and Godin IX phases. The deposits from this area date to the Middle Chalcolithic period (*Motarjem, Sharifi 2014.52*).

● Layer 5: the cultural characteristics of this 5-metre-thick layer date to the Early Chalcolithic period or

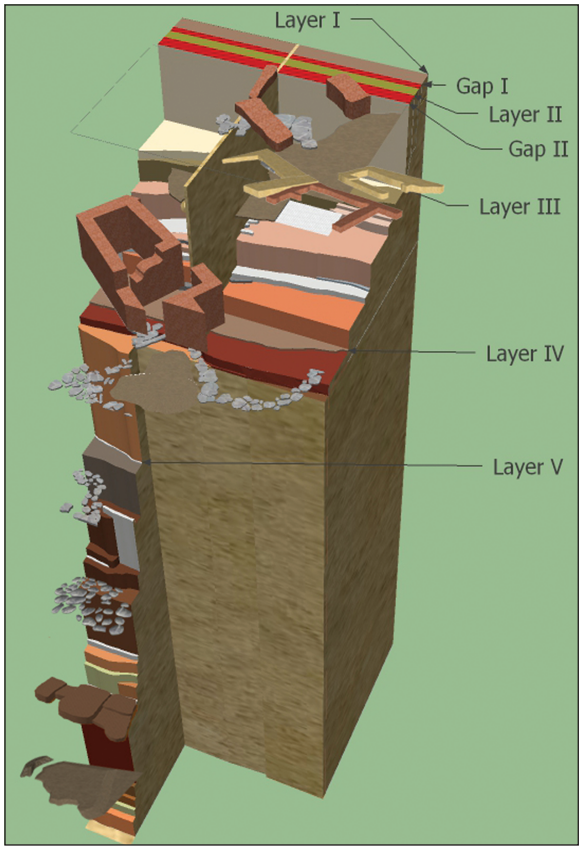

Fig. 8. A reconstruction of the spatial sequence of architecture at the site.

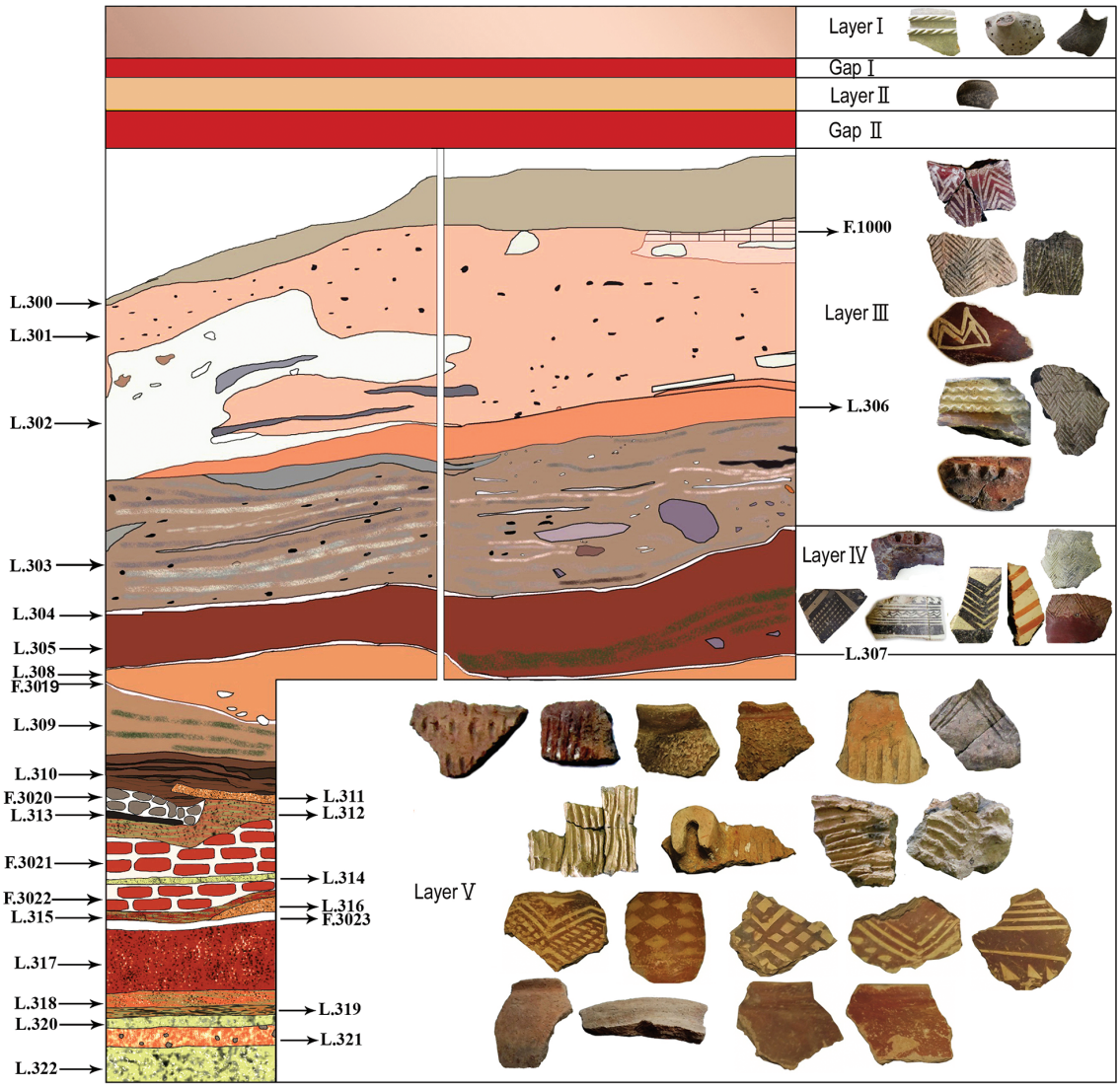

Fig. 9. Stratigraphic section of trenches II and III at the site.

Dalma phase. Four occupational phases were identified in this level, and the comparisons, especially for the Dalma ware, show connections with the Early Chalcolithic period in the south of Lake Urmia. The first phase includes crushed dry stone, as well as husking trays. The second phase contained the remains of stone constructions made of gypsum. The remains of moulded mud brick structures were found in the third phase. Phase IV contains the last trace of the Early Chalcolithic period, with a residue of reed and sedge on a beaten floor (Fig. 7).

Material culture at Tepe Gheshlagh

The Tepe Gheshlagh layer III pottery can be divided into several groups: open bowls with incurving rim and a handle, incurving rim bowls without handles, bowls with inverted rim, cups, decorated storage jars, and small bowls. Different types of streaky decorated storage jars were found in this area. These wares are dated to the Middle and Late Chalcolithic periods, and belong to the characteristic pottery type of the east of central Zagros, the Dalma phase or Godin X, also known as Dalma streaky pottery (*Henrickson 1983*). They reveal close technical connections with the incised pottery of lower Hassuna (*Lloyd, Fuad Safar 1945.Fig. 10; Braidwood* et al. *1983*). A few pieces of Tepe Gheshlagh pottery had decorations on the vessel bases.

Based on decoration, the pottery in layer III is divided into two categories: plain and painted ware. Plain pottery was made with two types of slip – also reported in Seh Gabi and Godin VII (*Young, Levine 1974*) – as well as without a slip.

The pottery with a slip at Tepe Gheshlagh is up to 80% covered with a thick slip, and the firing is large-

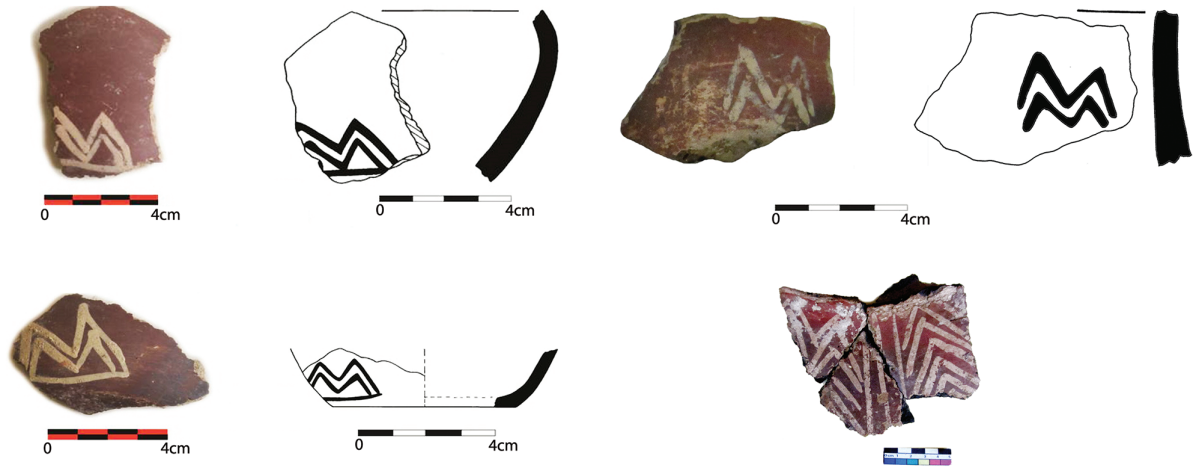

Fig. 10. The Late Chalcolithic pottery from Tepe Gheshlagh.

ly insufficient. There are two main reasons for the poor firing of the pottery: the energy required to reach the optimum temperature for perfect firing was not available, or the temperature was high enough, but the firing was too brief. These reasons could be due to a lack of facilities and stable environmental conditions, as well as pottery technology. Climatic conditions and limited access to energy resources could be the main reason for the firing conditions, since no significant climate changes have been reported for the area after the Chalcolithic period. We propose that this situation was similar to the pre-history situation, with only slight differences (*Heidari 2016*).

The plain, un-slipped pottery includes two sherds of lentil-shaped wares, and a short rimmed vessel, and according to topographic tests, they did not originate in this area, and were probably imported from Mesopotamia.

Painted pottery is divided into several classes, including geometric patterns, animal motifs, natural elements, and Halaf slipped pottery decorations, applied decorations, and incised designs.

The geometric patterns in layer III that were abundantly obtained from the Late Chalcolithic period comprise repeated zigzag motifs in white on a brown background; similar pieces were found in Haji-firuz and Sarab (*Levine, McDonald 1977.40*). Similarities between the pottery from Tepe Gheshlagh and the geometric designs of the Neolithic period in Sarab, Hassuna in Iraq, and Haji-firuz in Azerbaijan indicate

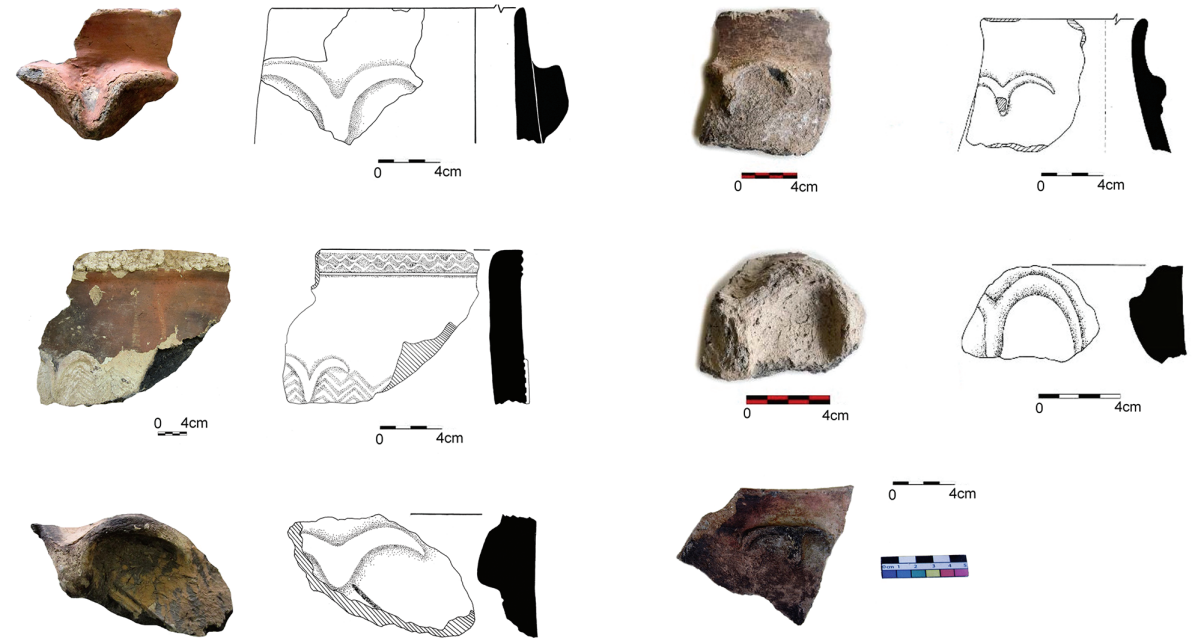

Fig. 11. Pottery samples with applied decorations from Tepe Gheshlagh.

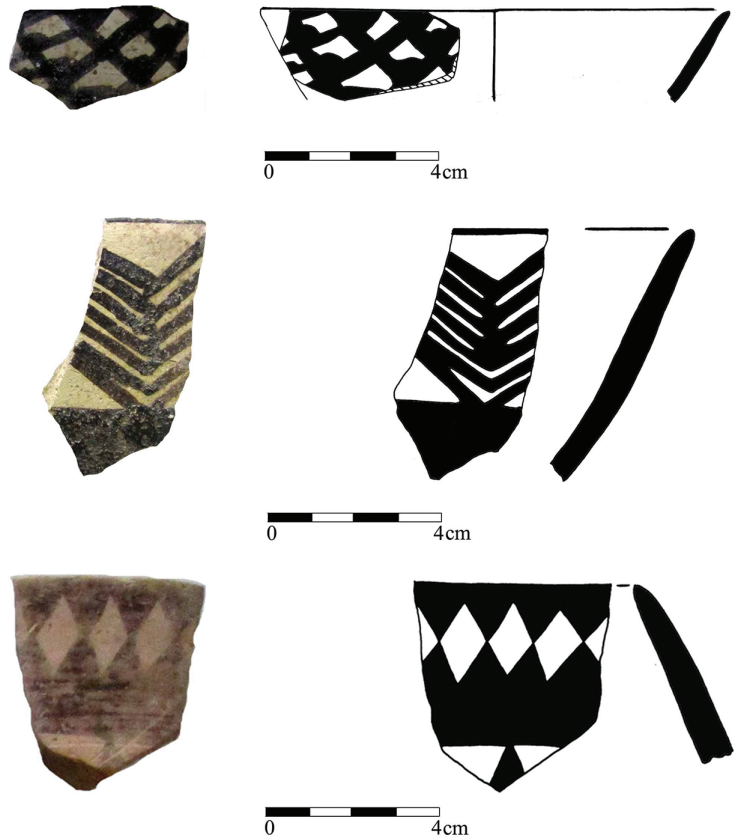

Fig. 12. Middle Chalcolithic pottery from layer IV at the site.

the continuity of cultural traditions which continued also in the next periods (Fig. 10).

Applied decorations include some animal horns; the most dominant motifs are rams' and goats' heads, wholly abstracted and summarised. This technique of pottery decoration is also found on pottery types from the lower Hassuna period in Umm Dabaghiyah (Fig. 11).

Rope ornamentation was abundant in layer III, as well as in the Late Chalcolithic III period. This design was found in a single-row form on the Central Plateau, at Tepe Ghabristan, while a three-row design was recoded at Tepe Gheshlagh. This decoration technique was an innovation by the Tepe Gheshlagh potters, as the design is unique to this site (Fig. 15).

Appliqué handles, known as Godin VII pottery, were found in abundance in layer III, as well as in all the other phases.

Incised decoration on pottery most commonly comprises incised chevrons under the rim, which is obliquely decorated. Incised designs in layer V (the Early Chalcolithic period) include four types: streaky pottery (Fig. 14), husking trays (Fig. 16), impressed designs (Fig. 17), and special handles with striated decorations. Impress and streaky pottery generally date to the Early Chalcolithic period found in phase I, in layer V at the site. This type of pottery has been found in abundance outside the borders of Iran. Semi-husking trays were discovered in phase II which are reminiscent of Hassuna types. The distribution of this type of pottery in other areas suggests its widespread popularity.

Similar ornamental traditions were reported in the north of Iraq and in Turkey (*Yildrim, Gates 2007.283*), at Gil Stein's excavations (*Stein 1998*) in Hajinabi, South Anatlia and Hakemi Use (*Tekin 2007*), and in Tepe Haji-firuz (*Voigt 1983.101–102*). This phase must be transitional from the Hassuna to Dalma culture. This type of pottery seems to be kitchenware. Incised streaky decorations were local features in Tepe Gheshlagh during the Early, Middle, and Late Chalcolithic periods.

The Dalma style painted pottery includes geometric designs characteristic of the Early Chalcolithic pottery (Fig. 18). The designs include geometric patterns, diagonal, vertical, and horizontal lines, intersecting, zigzags, separate and diamond shaped, as well as small triangles and rectangles, which were used extensively in Dalma, Godin, and Seh Gabi pottery. The Late Chalcolithic Tepe Gheshlagh pottery was greatly influenced by the Azerbayian style, especially Dalma and Haji-firuz. It is technically similar to the Neolithic pottery in Haji-firuz, as well as the tadpole pottery of the Middle and Late Neolithic in Zagros, which has been reported from many sites (*Merpert, Munchaev 1973.Plate XLI.2*).

Discussion and conclusion

In general, the pottery tradition found in layers III, IV, and V at Tepe Gheshlagh includes storage jars with streaky decorations and a thick red slip, which is a local tradition at this site from the oldest layer V to layer III. There are also obvious similarities between the pottery tradition in layer III at Tepe Gheshlagh and Godin VII phase, which indicates their connections. Moreover, at least two other pottery

types occur, *i.e.* Ubaid or Susiana, which, based on colour, form and fabric (also suggested in petrographic studies), differ from the other pottery in Tepe Gheshlagh, indicating relations with other areas. Thermoluminescence dating carried out on two pottery fragments, deposited in layer III suggest dates of 3850 ± 280 and 3600 ± 220 BC. Based on the material and all the analyses, as well as the relative and absolute chronology, this layer can be dated to the Late Chalcolithic period. Additionally in layer III at Tepe Gheshlagh, we can observe a connection or interaction between Pisdeli pottery traditions from the south of Lake Uremia and the painted pottery tradition of Seh Gabi, which proves that both areas were influenced by these two traditions. The absolute chronology of these two phases of layer III is 3915 ± 270 BC and 3960 ± 290 BC.

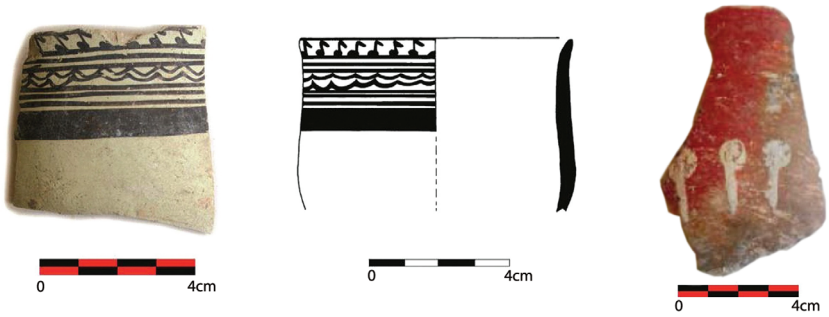

Fig. 13. Early Chalcolithic pottery at Tepe Gheshlagh.

The continuity of the pottery tradition during the long period of layer V (Early Chalcolithic) is explained as follows:

- Layer I – prevalence of Impressed Dalma pottery;
- Layer II – prevalence of Hassuna sherds, including geometric semi-husking trays and Haji firuz pottery;
- Layer III – pottery with horned handles, and their continuity into other periods or the same layers of III and IV, under the influence of the Umm Dabaghiyah culture;
- Layer IV – this layer, which is approx. 9.5m thick, definitely belongs to the Dalma period; the absolute chronology in the lowest layers indicates date of 5500 ± 250 BC.

Given the presence of the Dalma tradition, including painted, impressed semi-husking trays, and streaky pottery in a layer 9m thick, and due to their date at 5500 BC, these finds must be local to this area, and not influenced by any other areas. We can observe the important influence of Dalma pottery from the southern basin of Lake Urmia, and see how this tradition penetrated through central Zagros in the lowest depositions of Tepe Seh Gabi; and during the Godin VII phase, this tradition most probably encompassed the entire area of Zagros.

In general, the small and narrow valley of the Talvar is like a natural corridor, which makes possible communication between residents of eastern areas of Central Zagros with the south of Lake Urmia. This

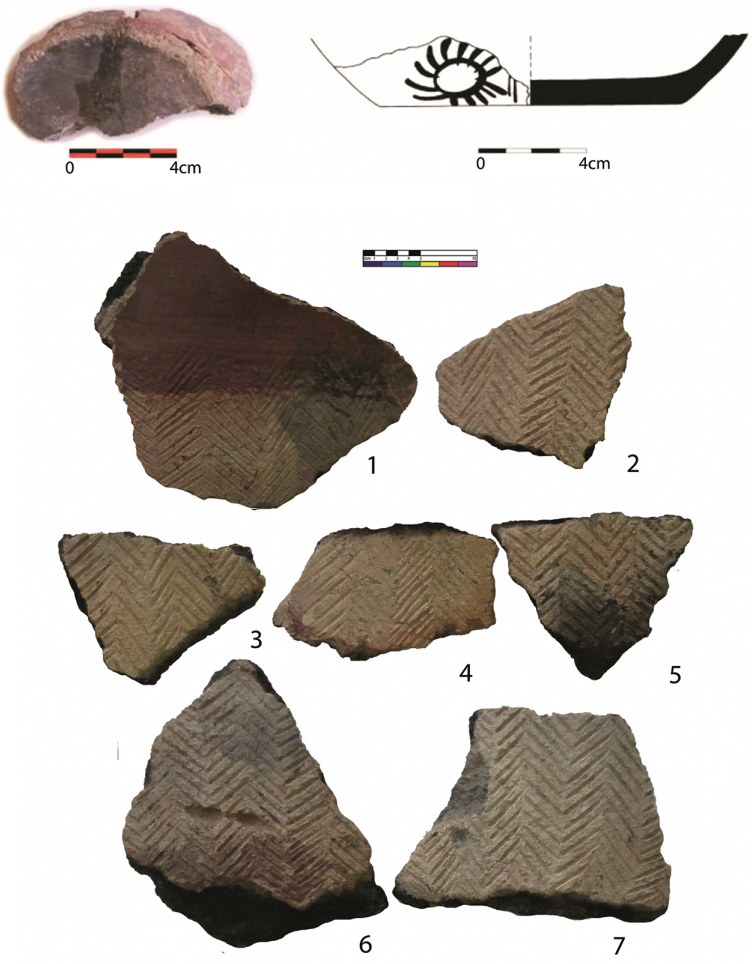

Fig. 14. Incised chevron decorations seen on streaky pottery at Tepe Gheshlagh.

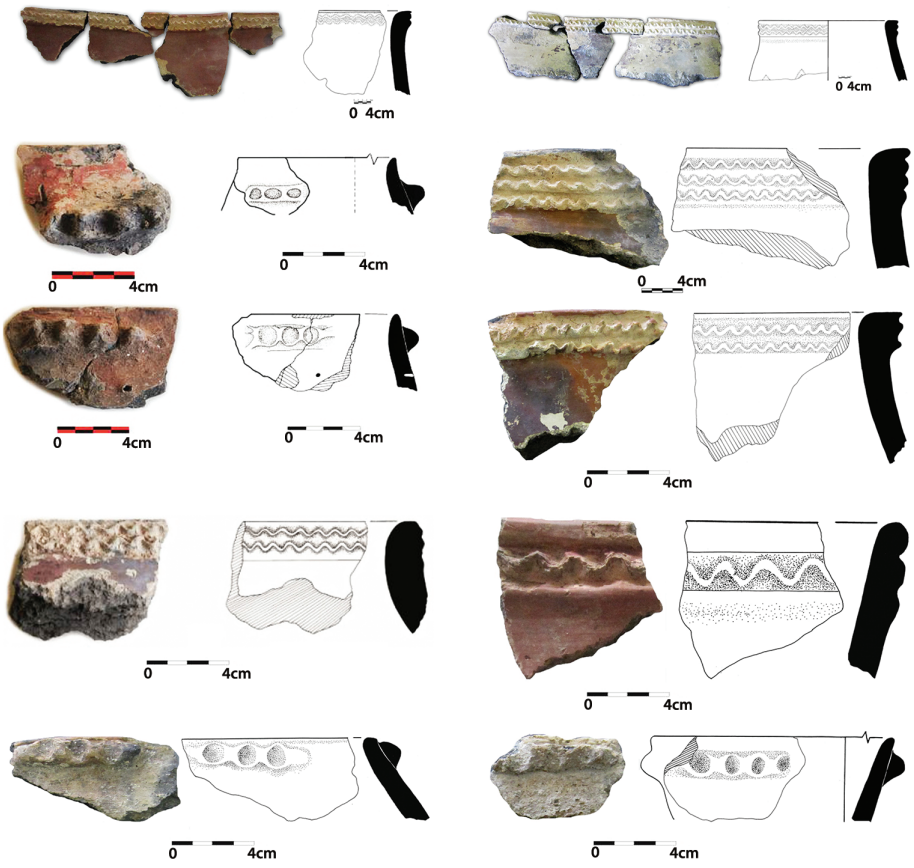

Fig. 15. Rope ornament and Godin VII pottery at Tepe Gheshlagh.

route includes a series of connected valleys. Regarding its elevation, over 1600m a.s.l., its semi-steppe vegetation makes it unsuitable for cultivation. However, these conditions provide good pastures, and a natural habitat for animals such as goats, sheep, rabbits and pigs. These features, along with the permanent water supply of the River Talvar, made for suitable settlement conditions throughout the Chalcolitic period. The mode of production combined hunting and animal husbandry, while fishing also had a significant role.

The presence of Ubaid pottery and obsidian artefacts, prove the existence of trans-regional connections. Also, the great prevalence of tokens and their diversity indicates the existence of an open economic system in conntact with neighbouring areas. The widespread use of stamp seals in particular in this area is regarded as evidence of the existence of such a system. Moreover, one thousand years of uninterrupted occupation in this region was a result of the relatively stable climate and environment, which changed only at the end of the Late Chalcolithic, and then in the Godin VII phase, as Yanik-related peoples entered into the region and changed the spatial site arrangement. Most Chalcolithic sites were abandoned in this period, and new settlements were founded at the foot of a mountain.

Most archaeological finds come from the thick deposition of the Early Chalcolithic layer V at Tepe Gheshlagh, which is dated to the Dalma pottery tradition. Only a few changes occurred in this layer, but

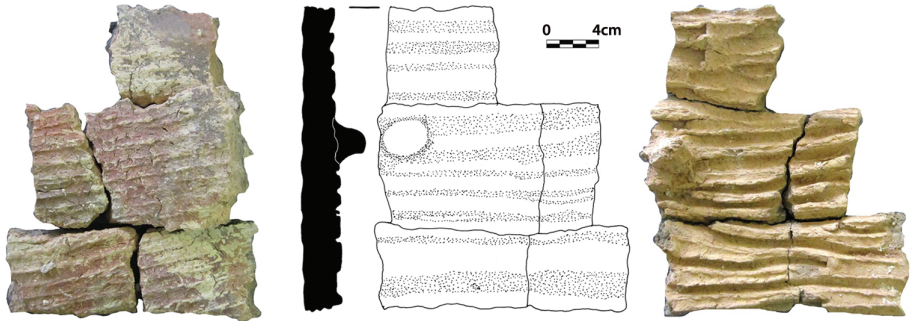

Fig. 16. Early Chalcolithic husking trays at Tepe Gheshlagh.

there was signicifact change in the younger layers, *i.e.* layers III and IV. After initial settlement in the Middle Chalcolithic period, the deposits then show the remains of the Godin VII phase, which is an indication of the Late Chalcolithic period in east-central Zagros. In this regard, and due to the lack of evidence of any Pisdeli and Seh Gabi pottery styles in this phase, there seems to have been a cultural stasis, which fits with the cultural evidence of Pisdeli in the southwest and Seh Gabi and Hossain Abad in western Iran. The Tepe Gheshlagh archaeological finds show a continuity of Dalma culture in a relatively enclosed area between the valleys of east-central Zagros that lasted a longer period than in the peripheral area which can be due to the more suitable environment. It seems that the area around Tepe Gheshlagh did not face the same dificulties as were documented at Dalma Tepe and Tepe Seh Gabi that resulted in their respective cultural changes.

Fig. 17. Early Chalcolithic impressed pottery at Tepe Gheshlagh.

Considering the density and number of ceramic finds from the Chalcolithic period, it seems that the Dalma pottery tradition was long-lived in Western Iran area. The presence of pottery traditions throughout Zagros, such as Seh Gabi and Dalma pottery in the northwest, as well as Haji Firuz traditions and the influence of the Hassuna culture from north Mesopotamia, clearly shows a connection between Tepe Gheshlagh and the neighbouring areas in the timespan from the 3rd to 5th millenium BC. Therefore, considering all these results, one can suggest the existence of transregional relations at this site.

It should be mentioned that the hypothesis of sudden growth in the Chalcolithic period in Zagros has already been proposed by several archaeologists (*Henrickson 1983; 1985; Young, Levine 1974*). Two important issues in this regard are the environmental and human factors.

Fig. 18. Early Chalcolithic Dalma pottery from Tepe Gheshlagh.

Regarding the environmental factor, the area was occupied continuously over one thousand years, indicating the relatively stable environment and climate, and around 3500 BC this situation gradually reached a point which looked very much like the current one. During this period, there was a gradual rise in temperature, the development of dense oak forests and a gradual increase in rainfall (*Van Zeist* et al. *1983*). All these conditions increased the chances of population growth and made it possible for people to further exploitat the environment.

Regarding population factors, there is no doubt that from the beginning of the Chalcolithic period, the population of the Talvar River valley and Bijar suddenly increased; however, there have been no reports of Palaeolithic to

Neolithic settlements in this area. The relative elevation above 1600m and a colder climate be the main factor in the absence of settlements from these periods. Accordingly, it seems that at the end of the 6th millennium BC, a large mass of people suddenly dispersed throughout the entire region. Traces of such rapid population growth and expansion can be seen in surveys of the Bijar plain and the Talvar River Basin. In fact, the increasing population required more space and access to resources, resulting in the distribution of the population. These sites were formed in a linear fashion on small plains between mountains. All of this confirms the hypothesis of a rapid occupation of the Zagros high valley in the late Neolithic in the 6th millennium BC. Due to the close resemblance of the pottery asseblages and architecture at the sites in the south Lake Uremia area, it appears that in the Neolithic the occupation extended from the Lake Uremia to the south as well as to the north Zagros area which coincides with the gradual warming of the climate. These populations took advantage of the more suitable natural conditions and settled in these areas for the first time, while they still maintained some cultural traditions, such as the making of bone tools and husking trays. More surprisingly, the way of life was still based on hunting and farming in less populated areas.

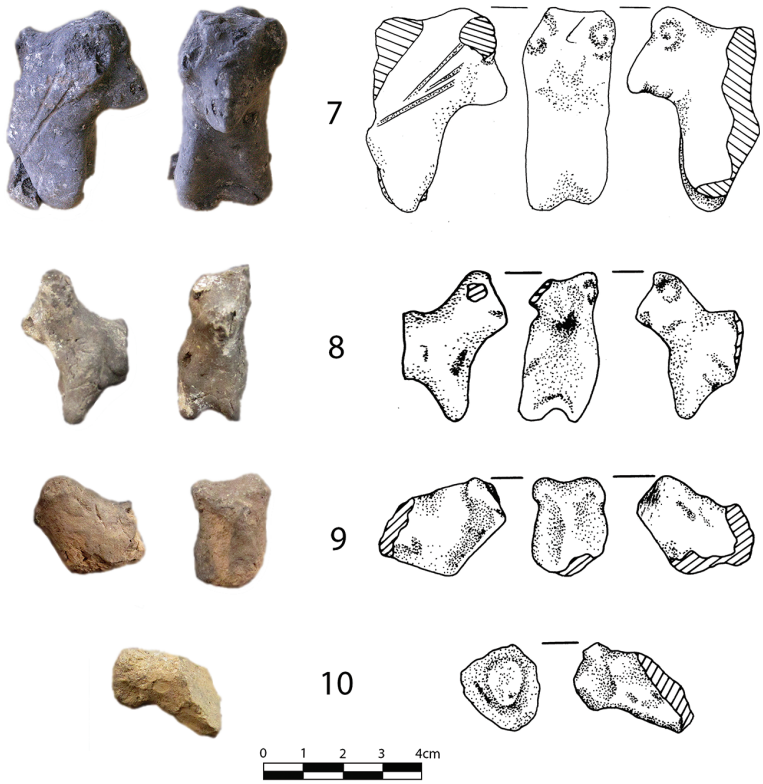

Fig. 19. Animal figurines of the Late Chalcolithic from Tepe Gheshlagh.

Archaeological excavations in Tepe Gheshlagh have offered significant information about Dalma culture in east Kurdistan which enables us to make a comprehensive analysis of cultural advances in this period compared to other sites. One reason for the importance of Tepe Gheshlagh in the Early Chalcolithic period is the 9-metre-thick layer containing Dalma pottery. It evidences permanent habitation, and no changes in materiality. This has not been seen in other parts of Iran or outside its borders. Due to this longevity, this area is one of the key sites for the study of Dalma culture.

A stable environment was reflected in the use of too much stucco to plaster warehouses and house floors, which in turn, remained the special characteristic of this culture. Also, the use of stucco as a material for consolidation within the context of architecture is considered a local phenomenon. Hence it is worth noting the following fundamental factors studied at Tepe Gheshlagh:

❶ The adaptation of architecture to the environment. Houses are made of thick mudbrick walls facing south, while winter winds blow from the west.

❷ Use of local material such as gypsum in building material, barn floors, wall coatings, and storage jar consolidation on the floor. The architectural patterns of the Chalcolithic period were influenced by the enironment, with gypsum being the main raw material. The use of pumice stone was another cultural feature of Tepe Gheshlagh buildings.

❸ Environmental adaptation such as the economic practises of hunting and fishing, animal husbandry, and also limited cultivation, as only a few sickle blades have been found in theses areas.

❹ The widespread use of local resources is evident at Tepe Gheshlagh. Not only large, but also small animals, such as rabbits, foxes, pigs, turtles, and fish were hunted, as demonstarted by the abundant remains of fish and turtle bones. The remnants of wild animal bones obtained from waste pits also indicate the hunting of these animals.

As Tepe Gheshlagh is located in the centre of a natural corridor which connects the North West, the Central Plateau, and the western areas of Iran, we can expect regional and trans-regional connections. The special continental and environmental conditions of this region are undoubtedly similar to the neighbouring regions, such as the basin of Lake Urmia in the North West, the highlands of Zagros, and the north of Mesopotamia. Therefore, during the investigation of cultural data, the mutual effects of known and concurrent cultures, such as the Dalma and Middle-Dalma Chalcolithic cultures, and Seh Gabi, and also the Hassuna culture in the North of Mesopotamia, could be observed.

Relations with southern Mesopotamia can be seen through the study of cultural material, examples of which would be two pieces of pottery from the Ubaid and Umm Dabaghiyah tradition. A large amount of the Dalma pottery cultural material in a 9m thick layer at Tepe Gheshlagh could point to the formation of the dominant culture among all those neighbouring areas. Considering the prevalence of Dalma culture in this layer, we can assume that Tepe Gheshlagh was one of the main centres of settlement and transition in this culture, from which other cultures in the vicinity were derived. It appears that during the Chalcolithic period, the population found this place suitable for animal husbandry, as well as slme limited cultivation. It also seems that the inhabitants

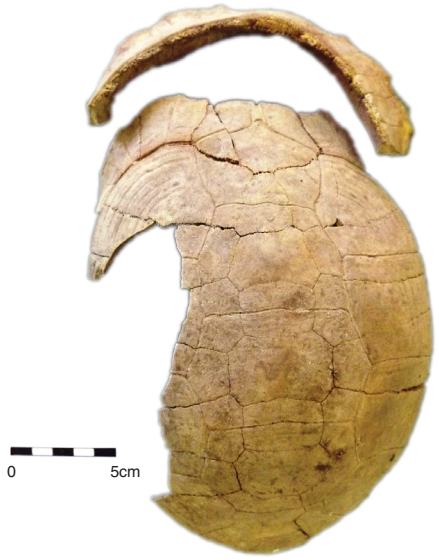

Fig. 20. Turtle shell found at the site.

of Dalma were already familiar with the Hassuna culture, and their main reason for immigration was to access more space, as well as population growth, forcing them to move towards the foothills and plains between the mountains. The steppe nature of the area made animal husbandry possible, since water was always accessible, although it is difficult to control and direct the rivers in these highlands. Directing water to farmland was especially hard, so animal husbandry was preferred, and water was not used for larger scale irrigation.

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Evidence of an early accounting system found at Tal-e Mash Karim, a Chalcolithic site in Iran

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ABSTRACT – *Investigating accounting systems and their progressive development during the prehistoric period is a critical issue in the recognition of human societies, their communication, and the formation of inter- and intra-regional trade systems, which led to the invention of writing systems. The present study deals with the typology and classification of the Chalcolithic (Bakun) period. Numerical/counting tokens have been discovered in Tal-e Mash Karim in Semirom district in Esfahan province in Iran. The cultural materials include thirty-two numerical tokens and a clay slab with tally marks. The numerical tokens may be divided into three main categories and seven subcategories: round and oval tokens for measuring agricultural products, and flat and disc-shaped tokens representing animals and food products. The discovery of a tallying slab beside the artefacts proves the existence of an early accounting system.*

KEY WORDS – *accounting system; Chalcolithic period; numerical tokens; clay slab with tally marks; Tal-e Mash Karim*

Dokazi o zgodnjih sistemih štetja in beleženja na halkolitskem najdišču Tal-e Mash Karim v Iranu

IZVLEČEK – *Raziskovanje sistemov štetja in beleženja ter njihovega postopnega razvoja v prazgodovini je pomembna tema pri prepoznavanju človeških skupnosti, njihove medsebojne komunikacije in oblikovanja znotraj regionalnih in med-regionalnih sistemov menjav, kar je privedlo do odkritja sistemov pisave. V članku se ukvarjamo s tipologijo in klasifikacijo halkolitika oz. obdobja Bakun. Žetoni so bili odkriti na najdišču Tal-e Mash Karim v okraju Semirom v provinci Esfahan v Iranu. Kulturne ostaline vključujejo 32 žetonov in označeno glineno ploščo. Žetone lahko razdelimo na tri kategorije in sedem podkategorij: okrogle in ovalne žetone za merjenje kmetijskih pridelkov ter ploščate žetone v obliki diska, ki predstavljajo živali in hrano. Odkritje glinene plošče z vrezi oz. označitvami dokazuje obstoj zgodnjega sistema štetja in beleženja.*

KLJUČNE BESEDE – *sistem štetja in beleženja; halkolitik; numerični žetoni; označene glinene plošče; Tal-e Mash Karim*

Introduction

Small objects in various shapes and sizes at prehistoric Near Eastern sites have always been the most significant finds of archeological projects. Archeologists and art historians have attributed many applications to these items, from games to religious symbols and, ultimately, numerical/counting objects. However, their actual function was not clear until the American-French researcher Denise Schmandt-Bes-

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serat suggested they were used in accounting and numerical systems, or as numerical tokens (*Schmandt-Besserat 1974*), and interpreted them as prototypes of the emergence of writing.

Before Schmandt-Besserat's studies, some hollow clay balls (numerical globular envelopes), including tokens, were found in excavations of late prehistoric sites in Mesopotamia (Uruk, Nuzi) and Iran (Susa and Chogha Mish), and Adolf L. Oppenheim (*1959. 122*) was the first to interpret them. He investigated the economic texts on the clay tablets and envelopes from the Nuzi site, and suggested that categorising these materials based on their shape would reveal quite interesting and reliable information about the administrative mechanism of bureaucracy in ancient societies (*Oppenheim 1959.122*). Therefore, despite lacking knowledge about the real function of these balls without tokens, after reading eight lines on one of the balls, he found that the 48 tokens inside the ball indicated a number of objects or animals.

Schmandt-Besserat's studies of the tokens show that ancient societies' familiarity with accounting activities and numerical systems dates back to the late Paleolithic and Epi-Paleolithic periods (*Schmandt-Besserat 1992.180*). The samples of bone objects with carved lines, like slabs with tally marks which refer to goods, found in the caves of these periods, are considered as the first steps in documenting and transferring information. Unlike these slabs, the tokens which become prevalent from the Neolithic period were artefacts with specific shapes, and made of clay for communication and documentation purposes. In fact, tokens were the modern media for processing information, and the technology had been devised long before. These objects continued to be used until the Chalcolithic period and the Bronze ages and, alongside the bulla and clay ball objects, had a major role in the administration of early complex societies and the emergence of early states and the beginning of writing (*Schmandt-Besserat 1996*). Due to the development of administrative techniques in the form of tablets and reliefs during the historical period, their usage declined, continuing merely as simple numerical tokens.

The present study is intended to describe and analyse tokens and a clay tallying slab from Tal-e Mash Karim, a fifth millennium Chalcolithic site, and attempts to clarify their role in developing ancient accounting systems by making comparisons with other contemporary or similar settlements.

Evidence of accounting from prehistory

Based on their shapes, Schmandt-Besserat categorised numerical tokens into sixteen types (*e.g.*, conical, globular, flat, cylindrical, triangular, and other; *Schmandt-Besserat 1978.44–45*). Their markings include carved lines, cuts, holes or impressions made with a finger. Since they are handmade we can recognise many variants of these types at different sites. The usual token size is between 1 to 3cm. However, some larger conical or flat examples are 3 to 5cm.

Unlike the slab with tally marks, each token shape has a specific meaning. Therefore, unlike the slab lines, which can have an infinite number of possible interpretations, each clay token was a specific sign with a certain importance. If the slabs had been found outside their context, they would make no sense, while for those familiar with this system, tokens are comprehensible based on their shape and importance. For example, the conical shape was used for a specific amount of grain. Thus the tokens indicate a type of pictography, with each token representing a specific meaning, just like the motifs of the late Sumerian period, where tokens were 'conceptual symbols' (*Schmandt-Besserat 1992.161*).

However, the major innovation of this medium was the emergence of a 'system'. There was not only one type of token with an absolute meaning, but a complete set of related types of tokens on which information regarding different categories of goods could be modified. Therefore, this system was the result of more complex processing of information and storing a huge amount of information that avoided the risks inherent in human memory. This system was open, so it was possible to add new information any time. The smoothness of clay was also a key feature for developing codes, so the token system can be considered the first code, or the most ancient system of signs for transferring information. The systematic feature of tokens had a great influence on their geographical distribution. These bullae were transferring as a certain code from one society to another, and eventually extended throughout the Near East.

Unlike slabs with tally marks, which store only quantitative information, tokens can also register qualitative information about merchandise. According to the assemblages from Neolithic sites such as Ganj Dareh and Asiab in Iran and also Tal-e Osud, Muri Beit, and Sheikh Hassan in Syria (*Nilhemn 2002*), the emergence of tokens dates back to periods after

sedentarisation. Neolithic tokens are the second stage between the stages of information processing, coming after the Paleolithic and Mesolithic eras' slabs with tally marks as the complementary phase. With the emergence of pictographic writing in early states and urbanised societies, tokens lost their initial simplicity and became more complicated, and can be categorised into two groups:

❶ Simple tokens: their utilisation began from the emergence of tokens in 8000 BC and continued until 4400 BC; this category consists of geometric shapes only.

❷ Complex tokens: these emerged around 4400 BC, and included geometric shapes and naturalistic forms. The developmental peak of these tokens was in the middle of the fourth millennium BC, which was the foundation of pictographic writing and, eventually, around 2900 BC, writing emerged to record historical events and religious matters (*Schmandt-Besserat 1992.164*).

The history of the use of tokens and numerical tokens in Iran dates back to Neolithic societies such as Asiab and Ganj Dareh, and sites such as Sheikhi Abad, Chiya Sabz, and Chogha Golan, which have recently been studied more. Tepe Zaqheh in Qazvin is one of the prominent sites of this period, containing the transitional period from the Neolithic to Chalcolithic, and its numerical tokens and accounting system have been precisely investigated (*Salehi 1997; Fazeli, Moghimi 2013*). During the primary excavation season at Tepe Zaqheh, 19 tokens were discovered (*Moghimi, Fazeli 2015*), 238 fragments were also discovered during the recent season (*Moghimi 2015*). These finds indicate the existence of a society with a quite developed accounting system at the beginning of the Chalcolithic era on the central Iranian plateau. Furthermore, some evidence of numerical tokens has been discovered in Tepe Qabrestan, another Chalcolithic-related society on the Qazvin Plain (*Madjidzadeh 2008.45*).

In this regard, 253 numerical tokens were discovered in Tepe Khalese in Zanjan, another Neolithic site, which fall into eight categories of different shapes (*Valipour* et al. *2013*). Moreover, Tepe Qeshlaq Chehel Amiran in the eastern region of central Zagros and the southern area of Lake Urmia is also one of the main sites related to the Chalcolithic Dalma culture, with many numerical tokens (*Motarjem, Sharifi 2014*).

Chogha Mish in the southwest of Iran on the Susiana Plain, was a developed society in terms of accounting and administrative affairs (*Delougaz, Kantor 1996*). The long settlement sequences from 8000 BC to 4000 BC, the extensions of sites over some 17ha and the extensive archaeological excavations on the one hand, and the emergence of urbanism and writing on the other provided for the discovery of 813 numerical fragments in a variety of shapes. Of this number, 241 tokens were found in rooms and floors, 81 in pits, 5 in the remnants of carpet tiles, 63 in structures such as channels, kilns and walls, while 375 were found in sedimentary deposits, and 48 examples were found in areas with no specific context (*Delougaz, Kantor 1996.121–122, Tab. 11*). The main tokens, conical and disc shapes, date back to the middle Susiana (early Chalcolithic) period.

Other prehistoric sites on the Susiana Plain, such as Susa, Jafarabad and Jowi, also contained some representative samples of these tokens (*Amiet 1972.69*). Five other tokens from the late Susiana era 2, dating back to the late fifth millennium BC, have been found in Tale Geser, on the Ramhormoz Plain (*Alizadeh* et al. *2014*).

Regarding the attribution of Tal-e Mash Karim excavations in Semirom County to Fars cultural traditions, referring to the main prehistoric sites of this area can reveal more real evidence about cultural and commercial interactions and the accounting system of the region. In this regard, the archeological excavations at Tale Bashi (*Pollock* et al. *2010*), Tal-e Bakun (*Alizadeh 2006*), Tepe Mehr Ali (*Sardari Zarchi* et al. *2011*) and Rahmatabad Tepe (*Bernbeck* et al. *2005*) in Jari, and Bakun (fifth and sixth millennium BC) have revealed some accounting and numerical evidence.

Several numerical tokens were discovered in Tale Bashi on the Beyza Plain in Fars that are related to the Jari period in the early sixth millennium BC; these tokens include five small ball-shaped fragments made of clay that have been identified by researchers (*Pollock* et al. *2010.192*). Moreover, the researcher of Tal-e Bashi discovered eight numerical tokens during another excavation in Rahmatabad Tepe, a site adjacent to Dareh Bolaqi, northwest of Fars, and identified them as tokens. However, these items may be confused with sling shots that the local people made of clay for hunting birds (*Bernbeck* et al. *2005.95*).

Tepe Mehr Ali in the Sarhad region in the north of Fars province is the closest site to Tal-e Mash Karim containing evidence of numerical tokens from the

Bakun and Lapui periods. A total of 9 tokens including 2 conical, 5 globular and 2 hemispherical have been discovered at this site (*Sardari Zarchi* et al. *2011.322*). The hemispherical tokens are perforated with traces of strings, indicating their function as complex tokens related to fusiform stamped pieces (*Schmandt-Besserat 1992.146*).

Tal-e Bakun on the Marvdasht Plain, in the centre of Fars, is the most significant site contemporary with Tal-e Mash Karim. Extensive excavations at this site have led to the discovery of numerous tokens, including 46 different examples, which can be divided into 46 different shapes, such as tetrahedral, prismatic, conical, globular, planar, cylindrical, triangular, nail shape, wedged, heart shape, and also painted examples (*Alizadeh 2006.55–154*). The time-span of these objects continues from the establishment of Tal-e Bakun A until its end, and are distributed in every layer; however, they are mainly concentrated in layer III, along with clay seal fragments, indicating the importance of these objects in early administrative procedures.

Several numerical tokens have been found at Tepe Haji Firuz in the Solduz valley, a late Neolithic site in the northwest of Iran; the excavators described these clay fragments as conical (*Voigt, Dyson 1992. 279*).

Tal-e Mash Karim and archeological excavation

Tal-e Mash Karim is a small, low-lying mound in the south of the Semirom district, identified during surveys in 2007 (*Javeri 2008*). This site covers an area of approx. 35 x 40m and is two metres higher than the surrounding land. The presence of the oldest materials and layers ever found in Semirom, in the south of Esfahan province, is the main reason this site is significant (Figs. 1 and 2). These layers have been dated to the Bakun period, *i.e.* 4468–4339 BC, based on the recent excavation, which reveals the closeness of this area to the local cultures of southern Iran and Fars province.

The Bakun period is the fifth millennium BC cultural phase in Fars province, with the emergence of painted buff ware ceramic assemblages, one of the most important stages of the Chalcolithic period in Iran (*Herzfeld 1929*). Most archeologists believe that the Bakun period is a crucial stage in the socio-economic transformation in Iran (*Sumner 1994; Alizadeh 2006*). As the cultural expansion of this period in Iran and during prehistory includes all of Fars and several neighbouring provinces, such as Esfahan (*Sardari Zarchi* et al. *2011*), a precise study of materials and artefacts from Tal-e Mash Karim can yield new insights into cultural, economic and social aspects in the north and the cultural expansion of Bakun in the Sarhad (upper borderlands) region.

Number of types and subtypes	Description of types and subtypes
8	conical
2	with total static
1	without static
2	with rounded tip
3	with triangular base
23	globular and oval type
2	series A
21	series B
1	disc shape type
32	total

Tab. 1. Numerical tokens from Iranian sites.

The excavations at this site consisted of two trenches of 5 x 5m, and a sounding of 1 x 2m, which revealed significant evidence of several occupational phases and the remnants of simple architectural remains. The layers containing remains of ash and stone foundations may suggest that there was seasonal and short-term settlement in the area. However, the remains of a square room with walls painted in three colours and a brick platform would indicate the importance of this site. Some scattered

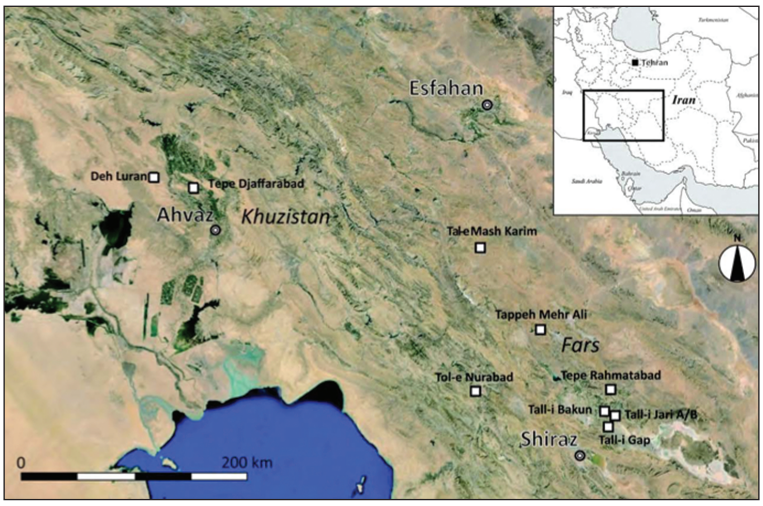

Fig. 1. Location of Tal-e Mash Karim in Esfahan Province in Iran (*Nishiaki *et al.* 2018*).

Fig. 2. A view of Tal-e Mash Karim mound.

evidence of numerical tokens and, in some cases, a number of them were found among the deposits and ash.

Description of numerical objects found at Tal-e Mash Karim

A total of 32 numerical tokens were recovered from the three trenches at Tal-e Mash Karim. They are made of stone or clay and can be divided into three general categories: conical, globular and elliptical, and disc shapes.

Conical type

This category comprises 8 numerical token fragments, used mainly to calculate and maintain grain amounts. Small cones represented units of small grains or a small basket (*Schmandt-Besserat 1981.283; 1996.80–82*) and are divided into four subtypes:

❶ Subtype with complete static (2 items)
❷ Subtype without static (1 item)
❸ Subtype with rounded tip (2 items)
❹ Subtype with triangular and pyramidal base (3 items made of black stone)

The conical types are generally 15 to 20mm high and weigh 2 to 4g. The clay types are made of baked red paste, with a black polished surface, and have complete static; however some of them do not have static, despite their delicacy, and might have had different functions (Fig. 3).

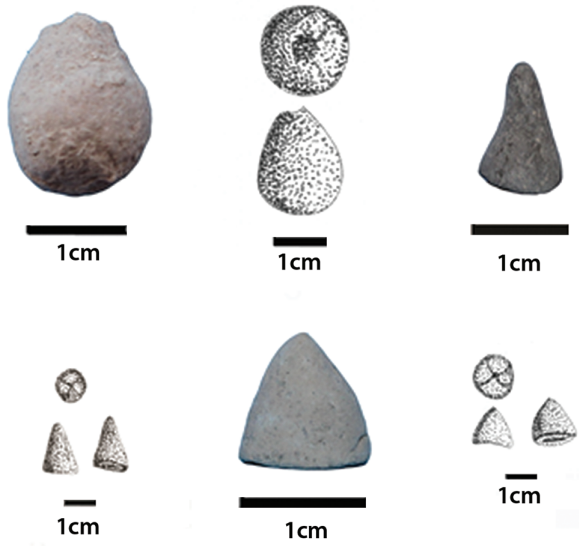

Fig. 3. Conical clay tokens.

The two subtypes with rounded tips are made of brown and black baked clay, and are 10 to15mm high and weigh 2 to 4g (Fig. 3).

All of the subtypes made of black stone have triangular bases and sharp tips; the heights range between 15 to 20mm and weights from 2 to 4g (Fig. 4).

Globular and elliptical types

This type, totalling 23, is the most frequent among the objects discovered. These objects represented large units (large baskets) of grains and cereals (*Schmandt-Besserat 1981.283; 1996.80–82*).

This category includes two different sets based on the location of the discovery:

❶ Series A: 2 tokens made of baked clay found in trench A, location 54. Their form is almost oval; they are 13mm high, 17mm wide, and 16mm in diameter, and weigh 4g (Fig. 5).
❷ Series B: 21 tokens discovered in a corner of trench B, location 37, all made of baked clay and brownish. They are divided into three categories based on dimensions:
  ❶ 20mm high, 17mm wide, 16mm in diameter, and weighing 14g (5 items).
  ❷ 6mm high, 9mm wide, 8mm in diameter, weighing 5g (8 items).
  ❸ 6mm high, 9mm wide, 8mm in diameter and weighing 5g (7 items) (Fig. 4).

Disc type

There was only one item of this type among the objects found. This object represents a group or herd of animals. For example, a disc-shaped numerical token

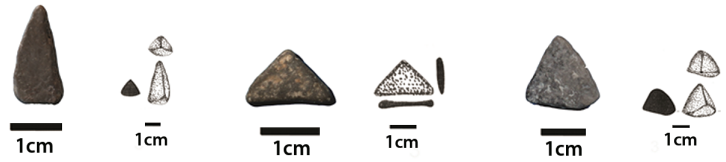

Fig. 4. Triangular and pyramidal tokens.

represents ten sheep (Fig. 7) (*Moghimi 2015*). Tokens of this type were made of baked clay with a completely polished surface, as well as two grooves on their reverse side, although some parts were damaged. Its diameter is 24mm and it weighs 8g.

Clay slab with tally marks: this object was discovered in trench B; it is brownish baked clay, with traces of grooves and engraved curved lines on its surface, which were made by a sharp pointed object. This object is almost oval in form: 23mm high, 44mm wide, 25mm thick, and weighing 35g. The traces of circular and winding marks engraved on one side of the object are not clear and cannot be reconstructed to know their precise function (Fig. 8).

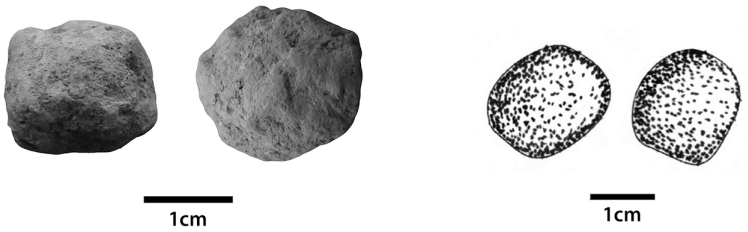

Fig. 5. Examples of globular and elliptical numerical tokens (close-up view).

This slab is similar to the objects discovered in Tepe Sofalin (*Hessari 2013.55, Fig. 22*). The object found in Tepe Sofalin is elliptical, with carved half-crescent grooves on it. Moreover, a few pieces of artefacts discovered in Chogha Mish (*Delougaz, Kantor 1996. 119*) are in the shape of broken pieces. These objects seem to be long clay boards with dots and grooves, and one of them is probably the end of a rough plaster board of irregular thickness, while another is an elliptical object with corrugated edges and four holes.

Discussion and conclusion

Due to the lack of evidence allowing the identification and reconstruction of their precise nature, examining the numerical tokens from prehistoric sites is usually difficult, and requires the use of any possible clues to understand them. Besides the functional nature of the cultural materials found in archeological layers, comparing them with other sites in different regions can pave the way to analysing them, especially since these objects were used in economic exchanges and trading; thus a specific and coordinated pattern can be perceived based on the results of comparative studies. Therefore, the statistical analysis of the examples discovered based on the distribution of sites is very important.

Tal-e Mash Karim has an area of some 1500m^2; only 3.5% of its cultural layers have been excavated within an excavation area of 50m^2. The average thickness of the excavated cultural layers is about 1.5m, and a total volume of 75m^3 have been excavated. Identifying 32 numerical tokens in such a small area is quite significant, and strengthens the possibility that a great deal of economic activity occurred here, along with accounting with these tokens and clay slabs with tally marks. However, it

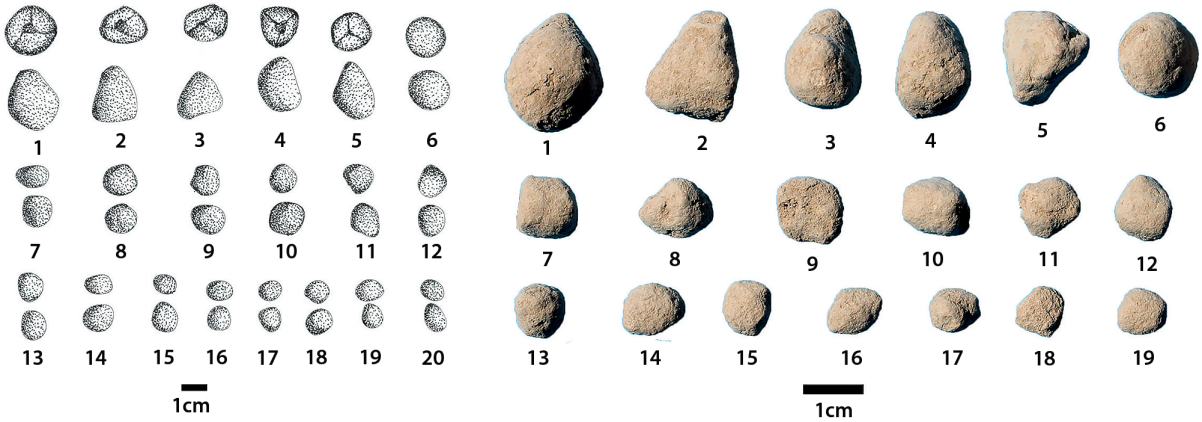

Fig. 6. Examples of globular and elliptical numerical tokens.

is necessary to explain these accounting objects in the general framework of economic and subsistence activities.

The quantity of tokens discovered at Tal-e Bakun and the excavated area is very limited (*Alizadeh 2006.154*). Although the number of conical tokens in Tal-e Bakun is almost the same as the number of examples at Tal-e Mash Karim, the globular and elliptical tokens in Tal-e Mash Karim are much more numerous compared with the number found at Tal-e Bakun.

Fig. 7. Disc-shaped numerical token.

Fig. 8. Sample of slab with tally marks discovered at the site.

Tepe Mehr Ali is also another site contemporary with Tal-e Mash Karim; despite the wide area of excavations of this area (200m²), no particular accounting activities were discovered (*Sardari Zarchi* et al. *2011*); however, the 5 globular tokens among the total of 9 numerical tokens found were similar to the Tal-e Mash Karim materials.

The globular tokens, as found at Tal-e Mash Karim in large numbers are also in the majority, along with conical tokens at other sites such as Tal-e Bashi (*Pollock* et al. *2010.192*), Rahmatabad (*Bernbeck* et al. *2005*), Tal-e Chehel-Amiran (*Motarjem, Sharifi 2014. 33*), and Zagheh (*Moghimi 2016*), which may represent grain quantities. Furthermore, the elliptical types also refer to the number of livestock and sheep (*Schmandt-Besserat 1996.210*). Therefore, the discovery of conical, globular and disc-shaped tokens in large quantities at many sites may be due to their frequent use in counting and recording agricultural and husbandry activities. Globular tokens were also in the great majority in Chogha Mish in three categories based on their sizes (*Delougaz, Kantor 1996.121*). The conical and globular subtypes in Tal-e Mash Karim, which were in standardised shapes, represent more detailed values and quantities of agricultural and husbandry goods.

The spatial distribution of numerical tokens is also an important component in identifying them precisely, so their exact context of discovery, such as waste holes and pits, rooms and their floors, the remnants of debris, ceramics' and structures' waste, needs to be considered. Most of the examples at Tal-e Mash Karim occur in ash and dust heaps between trenches of A and B. Their location at the centre of the Tepe site indicates the layer was a place for waste objects such as discarded numerical tokens.

From a general point of view, we consider the ancient site of Tal-e Mash Karim in Semirom as a main centre of cultural interactions and economic exchanges and trade, and as a society with simple agricultural methods, but developed husbandry. Through studying the materials' distribution from these interactions, we can analyse this site in the more extended context of the Iranian plateau. Tokens and numerical tokens are symbolic materials for such interactions and activities in accounting and recording merchandise and services in Tal-e Mash Karim; they represent the fundamental similarities of such technologies in the economic system of this site and other primary rural and pastoral nomad societies in Iran during the prehistoric period.

Finally, these tokens are representative of a society with an administrative and chiefdom system. Regarding the location of the residential society of Mash Karim on the trade route between Esfahan and northern Fars, an accounting system was required to manage their trading and economic affairs, and the archeological evidence and discoveries confirm this hypothesis.

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An Eneolithic pottery hoard from Turnišče, NE Slovenia

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ABSTRACT – *'Pottery hoard' (ger.* Keramikdepotfunde*), meaning a buried group of vessels, is a well-known term in the Bronze Age archaeology, but in Neolithic and Eneolithic archaeology the term appears only rarely. In this article, we discuss the case-study of Pit PO 118, discovered at the Turnišče site. In the past, Pit PO 118 was interpreted as a potential storage pit or as remnants of past economic activities. In the article, we consider the possibilities of a different interpretation.*

KEY WORDS – *Eneolithic; settlement; north-east Slovenia; pottery hoard*

Eneolitski keramični depo iz najdišča Turnišče, SV Slovenija

IZVLEČEK – *'Keramični depo', kot pokopana skupina posod, je uveljavljen termin v okviru arheologije bronaste dobe, v arheologiji neolitika in eneolitika pa mu je pozornost namenjena le redko. V članku predstavljamo primer jame PO 118, odkrite na najdišču Turnišče. V preteklosti je bila jama interpretirana kot potencialna shrambna jama oziroma kot sledi nekdanjih gospodarskih aktivnosti. V članku presojamo možnosti njene drugačne interpretacije.*

KLJUČNE BESEDE – *eneolitik; naselbina; severovzhodna Slovenija; keramični depo*

Introduction

North-eastern Slovenia has been known for decades as region of numerous individual finds of stone axes and adzes, usually attributed to the Neolithic or Eneolithic periods. In last four decades, systematic archaeological surveys have revealed many new Neolithic and Eneolithic sites in both the Prekmurje and Štajerska regions. Many of them have also been excavated and published, thus enriching our knowledge regarding Neolithic and Eneolithic settlement patterns, settlement organisation and material culture (*Šavel 1994; 1996; 2006*). The majority of newly discovered archaeological evidence is connected to settlements or their parts in the form of dug-out pits or remains of architecture, such as post-holes *etc*. Especially interesting are the numerous pits or dug structures which are discovered at every Neolithic and Eneolithic site in the region. Although of different shapes and sizes, with different contents and repertoires of material culture deposited in them, their interpretation is usually more or less the same. They are interpreted either as waste pits – rarely as abandoned storage pits – or interpreted in a general manner as the remains of past economic activities. In this article, I argue that Pit PO 118 at the Turnišče site in north-eastern Slovenia can be interpreted as a pottery hoard.

The site and its surroundings

The Prekmurje region is a geographically, culturally and ethnically defined region, located in the most northeastern part of Slovenia between the Mura River and the Rába Valley. The region is divided into three geographical sub-regions: Goričko (the hilly

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area to the north of Murska Sobota); Ravensko (the eastern flatlands stretching around the Mura) and Dolinsko (the western lowlands around Lendava). In the Dolinsko region, several sites have been discovered during systematic archaeological surveys in 2005, and excavated in 2006 as a part of an extensive project of protective excavations on Slovenian highways. The majority of newly discovered sites revealed remains of the Eneolithic period, thus enriching our knowledge regarding Eneolithic settlement patterns in the biggest part of north-eastern Slovenia.

Fig.1. Location of the Turnišče sites and other Eneolithic sites in its vicinity (created by M. Zorko).

Turnišče is one of these sites; it is located south of the village of Renkovci and west of the town with the same name as the site. In the vicinity, within a 1-kilometre radius, four other settlement areas have been identified (Zagonce, Gorice, Brezje and Kalinovnjek), covering roughly the same period of occupation as Turnišče (Fig. 1).

An archaeological team from the University of Primorska conducted a protective excavation at Turnišče in 2006, covering an area of around 16 000 m^2. The excavation area was limited to within the boundaries of the construction of the highway, which is why the settlement area has not been fully investigated.

The surrounding of the site is typically Pannonian, almost completely flat or slightly undulating. The site is located at approx. 175m a. s. l. The main natural resource in this area is fertile soil, thus allowing intensive agriculture to be the main activity for centuries, which has also affected the state of preservation of archaeological remains at the site. The surrounding geology of the site consists of quaternary surface deposits from the Mura River and its tributaries, with the Holocene alluvial belt alongside the Mura River thus covering an area 20km wide. During excavations, it was found that the micro-morphological setting of the site is closely related to the surrounding geology and this conditioned the settlement pattern, not only within the site but also in the nearby area. The majority of archaeological remains were discovered in lightly elevated areas consisting of sand dunes, while only a few of them could be found in slightly lower areas, where pebble deposits constitute the primary geological foundation (Fig. 2). The same observation was made at all the neighbouring sites (*Tomaž 2012a*). Altogether, more than 160 archaeological contexts were discovered at Turnišče. There were several contexts connected with the processes of modern activities at the site; some related to the Roman settlement, but majority of archaeological remains were pits of various shapes and sizes dating to the Eneolithic period. Also, the remains of an Eneolithic cultural layer were preserved at the site (Fig. 3).

Fig. 2. Turnišče, view of the site (photo A. Ogorelec).

According to the radiocarbon dates, as well as the analyses of ceramic finds, the site went through two phases of Eneolithic settlement. The remains of the First Settlement Phase can be dated to the last quarter of the 5th millennium BC. Culturally, they can be attributed to the so-called Lasinja culture. The remains of the Second Settlement Phase can be dated to the first quarter of the 4th millennium BC; however, culturally they can be ascribed to the 'horizon with furrow incision pottery' or Retz Gajary horizon (*Tomaž 2012a*). Among all the pits from the First Settlement Phase, pit PO 118 is the most interesting, and requires our particular attention.

Pit PO 118

Pit PO 118 was discovered in a slightly elevated section in the central part of the excavated area on its northern border. The location of the pit was somewhat isolated from the centre of the Eneolithic settlement, *i.e.* no other Eneolithic remains were found in its immediate vicinty (Fig. 3). The pit had an irregular oval ground plan, and was quite large, 3.46 x 2.34m. It was dug only 0.48m deep into the geological base, and filled with two different fillings; in the north-eastern part, the filling consisted mainly of pebble deposit, the north-western part contained a mixture of fine greyish-brown sand and pebbles (*Tomaž 2012a.67*). The filling of Pit PO 118 also included numerous pottery fragments, pieces of charcoal and burned clay, and three fragments of animal bones (unidentifiable) (Fig. 4a-c). the radiocarbon date of the charcoal sample number KIA 41443 places pit PO 118 at 5477±27 BP (calibrated age 1-σ: (59.4%): 4352–4328 cal BC; calibrated age 2-σ (69.6%.): 4364–4316 cal BC (*Tomaž 2012a.67*).

Description of the ceramic assemblage

Altogether, over 680 ceramic fragments were deposited in Pit PO 118. It was one of the largest ceram-

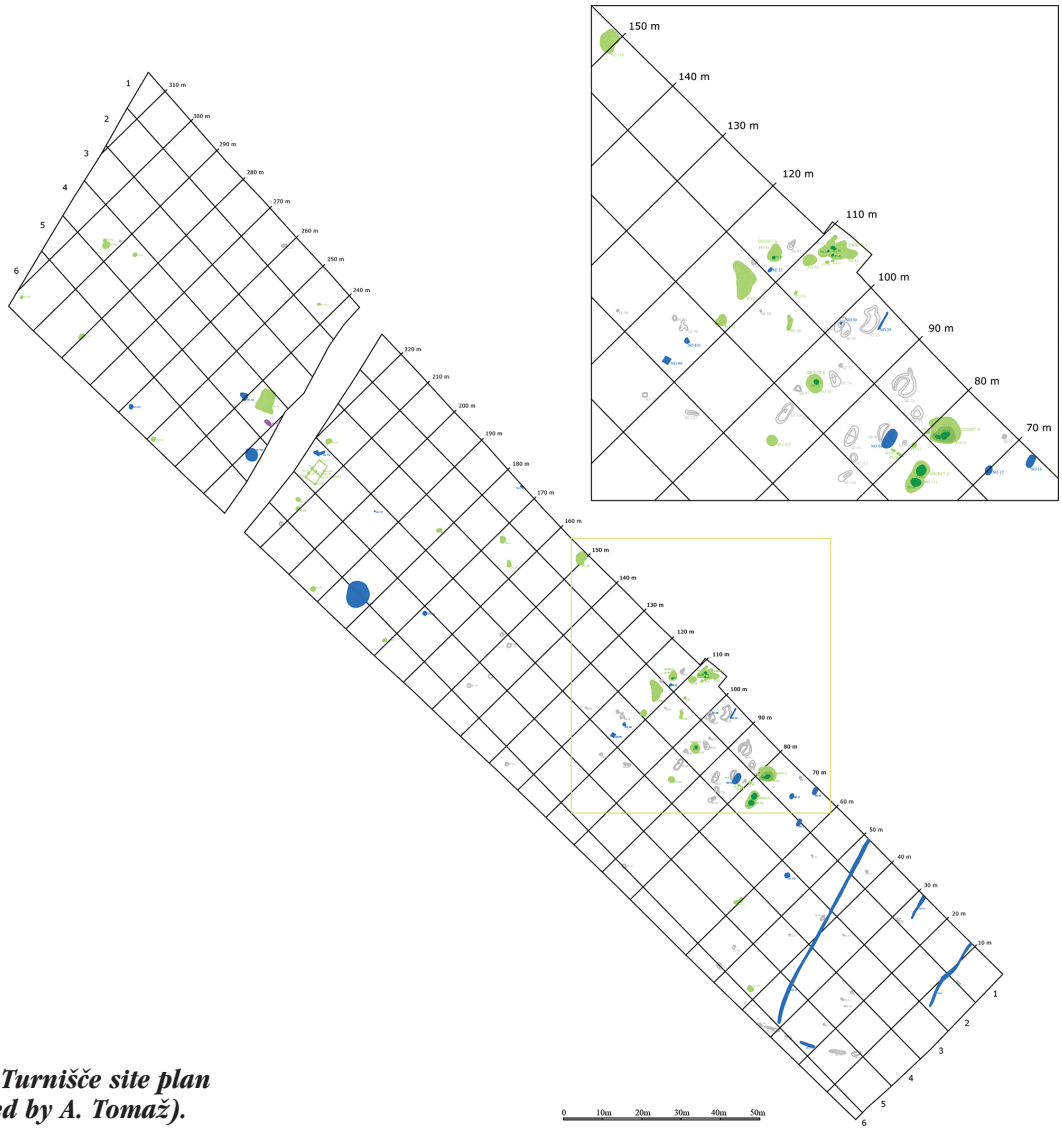

Fig. 3. Turnišče site plan (created by A. Tomaž).

ic assemblages at the site. The assemblage is rather fragmented, but after primary processing of the finds, almost 60% of the fragments could be assembled into whole items (*Tomaž 2012b.28, Fig. 23*). We could confirm that at least 28 ceramic containers were deposited in the pit, as well as a number of fragmented vessels (*Tomaž 2012a.27*). Most of the whole containers are pots; only some are shaped as bowls and ladles (Fig. 5). The pots are generally shaped as barrel-shaped pots, with one or two handles; some are shaped as biconical pots, with two handles or without them (Figs. 11.7–11 and 12.12–16). According to the number of fragmented bases discovered in PO 118, the total number of deposited containers was much larger. We analysed the macroscopic characteristics of a sample of the ceramic assemblage, covering 50% of the total (*Tomaž 2012a.268, Figs. 43–44*), thus enabling a thorough insight into the ceramic technology. The macroscopic characteristics confirm that the ceramic items deposited in Pit PO 118 have similar technological traits. The majority of them were made from medium-coarse, coarse and very coarse-grained clay. Fine-grained and very fine-grained pottery account for less than 25% of the total assemblage (Fig. 6). Most commonly, quartz, mica and iron oxide particles are added to the clay (38%), and in significant proportions also quartz and mica particles (15%) or quartz, mica and organic particles (13%) or quartz, mica, organic and iron oxide particles are added (11%). Other combinations of clay additives are rare (Fig. 7). The surface of the pottery is generally smooth (67%), which means that the potter spent quite some time removing any irregularities on the surface; only 16% of the whole ceramic assemblage has a rough surface. Combinations of different surface treatment are infrequent (Fig. 8). The majority of ceramic vessels from Pit PO 118 were fired in an oxidising atmosphere, but the process of firing was not completed (incomplete oxidising firing – 93%). Only in rare cases was a reducing atmosphere applied toward the end of the firing process (2%) (Fig. 9). In most cases, the pottery is undecorated (82%) (Fig. 10), which is quite surprising and points towards the special selection of the deposited pottery. So-called 'Lasinja' pottery is often decorated in a highly elaborated manner, as seen in other contexts at Turnišče (*Tomaž 2012a.items no. G70-72, G77, G82-84*). Pottery decoration within the assemblage of Pit PO 118 consists mostly of appliqués of different shapes (Fig. 10).

In relation to other contexts of the 'First Settlement Phase' at Turnišče, PIT PO 118 shows some similar

Fig. 4. Turnišče, view of PO 118, during excavations (photo A. Ogorelec).

traits regarding the pottery assemblage, but also some differences. The shapes of the pottery (Figs. 11–14), as well as their technological macroscopic characteristics fit well within other pottery assemblages of the same phase, but similar ceramics as in Pit PO 118 can also be found at other Slovenian, Hungarian, Austrian and Croatian early Eneolithic sites. In Slovenia, carinated bowls with circular knob

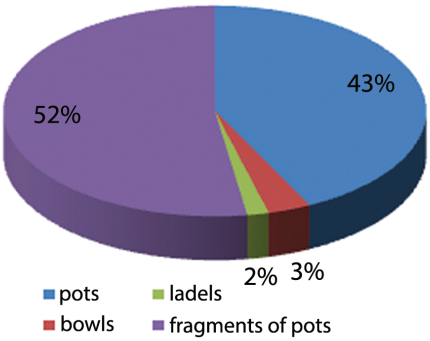

Fig. 5. Turnišče, typological characteristics of ceramic assemblage from Pit PO 118 (created by A. Tomaž).

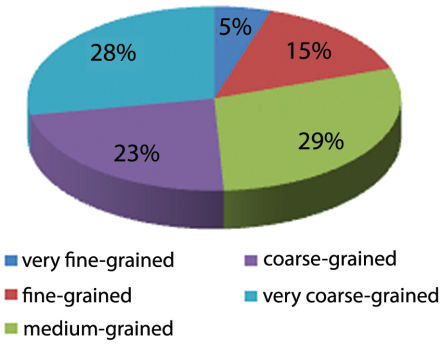

Fig. 6. Technological characteristics of ceramic assemblage from Pit PO 118 – graininess (created by A. Tomaž).

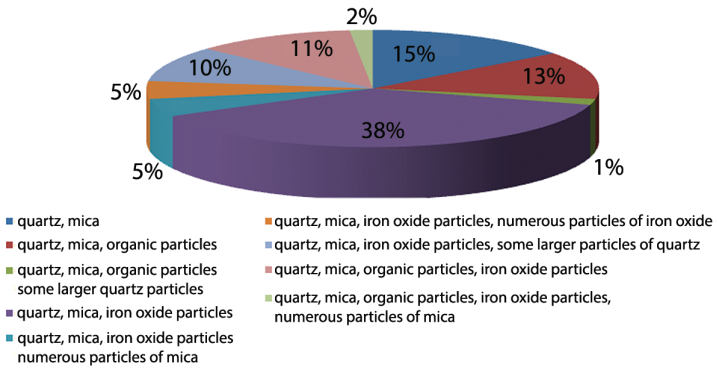

Fig. 7. Technological characteristics of ceramic assemblage from Pit PO 118 – inclusions (created by A. Tomaž).

handle (Fig. 11.1) are rare (Ormož-Škoršičev vrt (*Tomanič Jevremov* et al. *2006a.item no. 7*)); however, they are more frequent in Hungary, at Zalaegerszeg-Andráshida, Gébárti tó (II) (*Barna, Kreiter 2006. Fig. 5.2, 4*), Sormás, Mántai-dűlő near Nagykanizsa (*Straub 2006. Fig. 5.3; Fig. 8.1–3*), Zalavár-Basasziget (*Virág 2005.Tab. 3.5*), Gellénháza-Városrét (*Horváth, Simon 2003.Abb. 24.2, Abb. 27.13*) as well as at the Nedelišće-Stara ves site in north-east Croatia (*Bekić 2006.235, T. 3.2*). Biconical bowls (Fig. 11.2) are known from several sites in the Pomurje and Štajerska regions, such as at Hajndl (*Žižek 2006b.item no. 46*), Ptujski grad (*Tomanič Jevremov* et al. *2006b.items no. 32, 34*), Brezje near Zreče (*Pahič 1956.T. 1.9*) *etc*. They are frequent also in Hungary (*e.g.*, Zalaegerszeg-Andráshida, Gébárti tó II (*Barna, Kreiter 2006.Fig. 5.5*), Dobri – Alsó-mező (*Horváth, Simon 2004.Abb. 16.8, Abb. 17.3*), Gellénháza-Városrét (*Horváth, Simon 2003.Abb. 25.2*), Zalavár-Basasziget (*Virág 2005. Tab. 2.6, 9, 10, Tab. 3.1*)), in north-west Croatia (Košaka, pjeskana II; *Marković 1976. T.6.7*) and in Austria in the Bisamberg-Oberpullendorf (*Ruttkay 1995.Abb. 4.6, Abb. 6.5–8*) and Kazianiberg groups (*Ruttkay 1996.Abb. 1.8*). Pots or jars are numerous, and for some of them there are plenty of comparisons at other early Eneolithic sites, but for some, there are only few. Comparisons for barrel-shaped pots (Figs. 11.7–11, 12.12–16) with one or two handles are found at Hungarian sites (Sormás, Mántai-dűlő; (*Straub 2006.Fig. 4.6, Fig. 4.7*) and Dobri – Alsó-mező (*Horváth, Simon 2004.Abb. 10.18, 19, Abb. 25.3*)). Biconically shaped pots (Fig. 13.22–24) are numerous at Slovenian sites (*e.g.*, Šafarsko (*Šavel 1994.Fig. 11.5, 7*), Hardek (*Žižek 2006a.items no. 23, 24*), Bukovnica (*Šavel 1994.Fig. 21.2, Fig. 20.1*)), as well as at other Early Eneolithic sites (*e.g.*, Zalaegerszeg-Andráshida, Gébárti tó II (*Barna, Kreiter 2006.Fig. 8.4*), Sormás, Mántai-dűlő (*Straub 2006. Fig. 4.4*), Zalavár-Basasziget (*Virág 2005.Tab. 6.4*), Gellénháza-Városrét (*Horváth, Simon 2003.Abb. 23.8*), Zalaszentbalás-Pusztatető (*Bánffy 1996.Tab. 26.1–2*), Pórszombat-Medes (*Horváth, Simon 2003. Abb. 27.16*), Tekenye-Öcse (*Horváth, Simon 2003. Abb. 27.15*) and Jakšić (*Dimitrijević 1961.items no. 45d, 45e*) *etc*.). Ceramic ladles are one of the most common finds at Neolithic as well as early Eneolithic sites in the region and the comparisons are numerous (*Tomaž 2012a.35–36*).

Discussion and conclusion

The ceramic repertoire of Pit PO 118 fits very well within material culture of the First Phase of the settlement at Turnišče, as well as within early Eneolithic material culture of the last quarter of the 5th millennium BC. What differentiates the context of Pit PO 118 from other archeological contexts at Turnišče are its different deposition practices, as well as a clear selection of deposited ceramic items. Pit PO 118 contained numerous whole pots of similar, almost identical shapes and similar sizes, of similar technological characteristics, mostly undecorated.

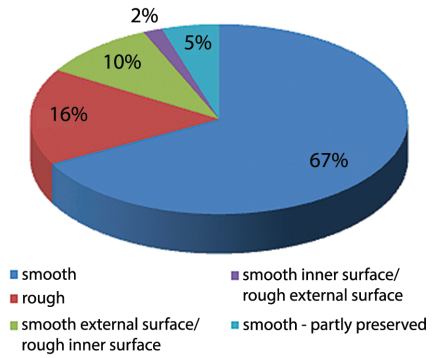

Fig. 8. Technological characteristics of ceramic assemblage from Pit PO 118 – surface treatments (created by A. Tomaž).

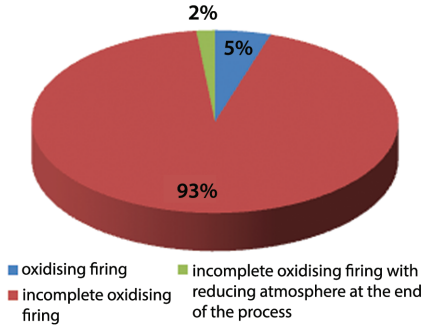

Fig. 9. Technological characteristics of ceramic assemblage from Pit PO 118 – firing techniques (created by A. Tomaž).

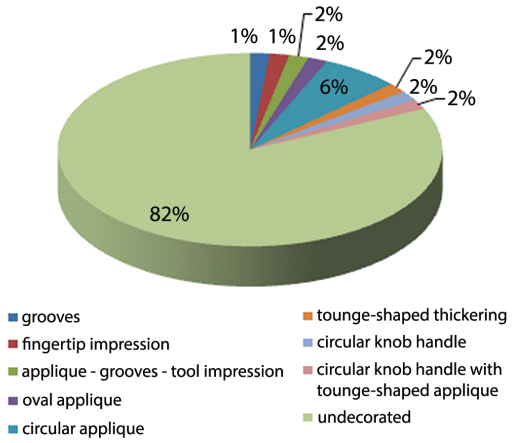

Fig. 10. Technological characteristics of ceramic assemblage from Pit PO 118 – decoration techniques (created by A. Tomaž).

According to fragmentation analysis, the assemblage has the highest proportion of matching fragments (59.30%). Only the assemblage from Pit PO 174 has a similar degree of fragmentation (54%); all other archaeological contexts of the first settlement phase at Turnišče have a ratio of fragments matching around or below 20%, while the assemblage from Eneolithic layer has levels below 10% (*Tomaž 2012b. 28, Fig. 23*). Depending on the size of each ceramic fragment in the ceramic assemblage of Pit PO 118, we can also assume that this deposit can be regarded as so-called 'original waste', according to Macháček's categorisation (*Macháček 2001*), meaning that it was deposited *in situ*.

As already noted, according to the level of fragmentation, there is another interesting example at Turnišče. Pit PO 174 is one of the smallest pits at the site, measuring only 0.8m in diameter and 0.16m in depth. It had a circular ground plan and U-shaped cross-section. Its location was even more isolated than PO 118 on the southwestern border of the excavation area, far away from other Eneolithic contexts. The filling of the pit consisted of greyish black sand with numerous ceramic fragments, as well as a stone pounder, one of three stone tools discovered at the site. The filling of pit PO 174 contained 165 ceramic fragments. The degree of fragmentation of each ceramic assemblage (PO 118 and PO 174) is comparable (*Tomaž 2012b.28, Fig. 23*). In Pit PO 174, however, only two complete pots were deposited, as well as parts of several other ceramic containers (at least 13), a miniature bottle and a fragment of a ceramic ladle (*Tomaž 2012a.items no. G62-G78*). In general, the variety as well as the number of deposited pots of the whole ceramic assemblage of Pit PO 174 is much lower than in Pit PO 118. Nevertheless, it appears that the deposition practices of pits PO 118 and PO 174 were similar, yet different from other pits and structures at the Turnišče site. In one of the previous publications about the site (*Tomaž 2012b.29*), we interpreted Pit PO 118, based on known data, as a potential remnant of an abandoned storage pit; however, not all the evidence fits well within this interpretation. After careful deliberation of all the acquired data, we would like to propose that Pit PO 118 should perhaps be seen as a pottery hoard.

Pottery hoards (ger. *Keramikdepotfunde*), meaning groups of buried vessels, are well known in Bronze Age archaeology; but rarely appear in Neolithic and Eneolithic archaeology. Pottery hoards are defined as closed contexts consisting of varying amounts of pottery vessels and, frequently, also of other types of material as well. The majority of pottery hoards are discovered within settlements, in dugout structures/pits. They can contain complete or broken vessels, as well as only certain parts of vessels. Vessels can often be found in an inverted position or lying on the side (*Stapel 1999*). The term 'pottery hoard' is not new; it appeared as early as the 1930s (*Palátová, Salaš 2002.8–9*), but the number of published finds interpreted as pottery hoards increased only

at the end of the 20th and the beginning of the 21st century (*Karavanić 2011*). According to Snježana Karavanić, pottery hoards can be found in Copper Age settlements, but are particularly numerous in the Bronze Age (*Karavanić 2011.16*). To define a 'closed' archaeological context containing a collection of pottery vessels buried in a pit is usually not difficult; however, interpreting them is often challenging because they can be interpreted either as storage pits, waste pits or in some instances also as pottery hoards. It is sometimes difficult to decide between these potential interpretations, especially if contextual data are lacking[1]. Over the years, the debate on this topic defined some criteria based on which groups of finds can be defined as pottery hoards (*Karavanić 2011.16*). According to Andrea Stapel, the criteria comprise the location of the find (specific geographic features, *e.g.* caves), accumulation of similar finds in a limited area, atypical finds in a pit, use of fire, special treatment of items (intentional destruction, intentional arrangement) *etc.* (*Stapel 1999.18–19*). As Karavanić already noted, the majority of authors, dealing with this topic agree that pottery hoards are probably material remains of ritual activities, and have been interpreted in various ways as material remains of libations, building sacrifices, ritual feasts or other forms of worship *etc.* (*Palátová, Salaš 2002.145–153; Karavanić 2011. 17*); therefore, the so-called 'sealing of the pit' as a closing part of a certain ritual activity may be an important feature with regard to pottery hoards as well (*Stapel 1999*). Another important criterion when considering pottery hoards was given by Lindinger (*Lindinger 1998–1999.79–87*); it concerns the combination of vessels according to their functions. His study revealed that the most numerous combination of vessels in Bronze Age pottery hoards in Lower Austria is of drinking vessels (small jugs and cups), followed by a combination of storage vessels, although in general there are quite varied assortments of different combinations in individual cases (*Lindinger 1998–1999.Taf. 2*).

If we consider the aforementioned criteria, Pit PO 118 meets quite a lot of them. First, is its location within the settlement area. The location of PO118 was somewhat isolated from the centre of the settlement, and at the beginning of the slightly elevated area. No other Eneolithic structures were in its immediate vicinity. Although its ground plan was quite large, Pit PO 118 was rather shallow, which is why the vessels were very carefully positioned in the centre of the pit. Although evidence of 'sealing of the pit' is also a very important criterion, there is no such evidence regarding PO 118: the upper part of the pit was damaged due to intensive modern agricultural activities on the site. The criterion 'accumulation of similar finds in a limited area' was confirmed through detailed analyses of the ceramic assemblage in Pit PO 110. Also, the selection of vessels deposited is in evidence, given the similar typological as well as technological and ornamental traits of the vessels. Most of them are pots or jars (types of storage vessel) and it appears that they also were pre-selected according to size; namely, measurements of their volumes[2] showed that most of them range between 4 and 6 litres; only two of them were bigger. Another important observation of the PO 118 ceramic assemblage, as already mentioned, is its fragmentation. The ceramic assemblage of Pit PO 110 has the highest rate of matching fragments of all the Eneolithic structures discovered at Turnišče, confirming that the deposition practice employed upon the formation of Pit PO 118 differed from all other structures at Turnišče, thereby showing its exceptional character.

When observing data regarding Pit PO 118, several different interpretations were considered. One of them was very general; we regarded PO 118 as the remains of past economic activities; another was somewhat more refined: we regarded PO 118 as a potential remnant of an abandoned storage pit, but when taking into consideration all the aforementioned criteria regarding 'pottery hoards', Pit PO 118 meets quite a lot of them. Although the archaeological context in question was formed in the Eneolithic period, and archaeological interpretations of such structures as 'pottery hoards' are almost non-existent, we would like to stimulate other researchers to think within this frame as well.

1 Karavanić discussed these instances in detail (see *Karavanić 2011.16-17*).

2 To avoid miscalculations, only whole containers were analysed. Altogether, the volumes of 12 pots were measured.

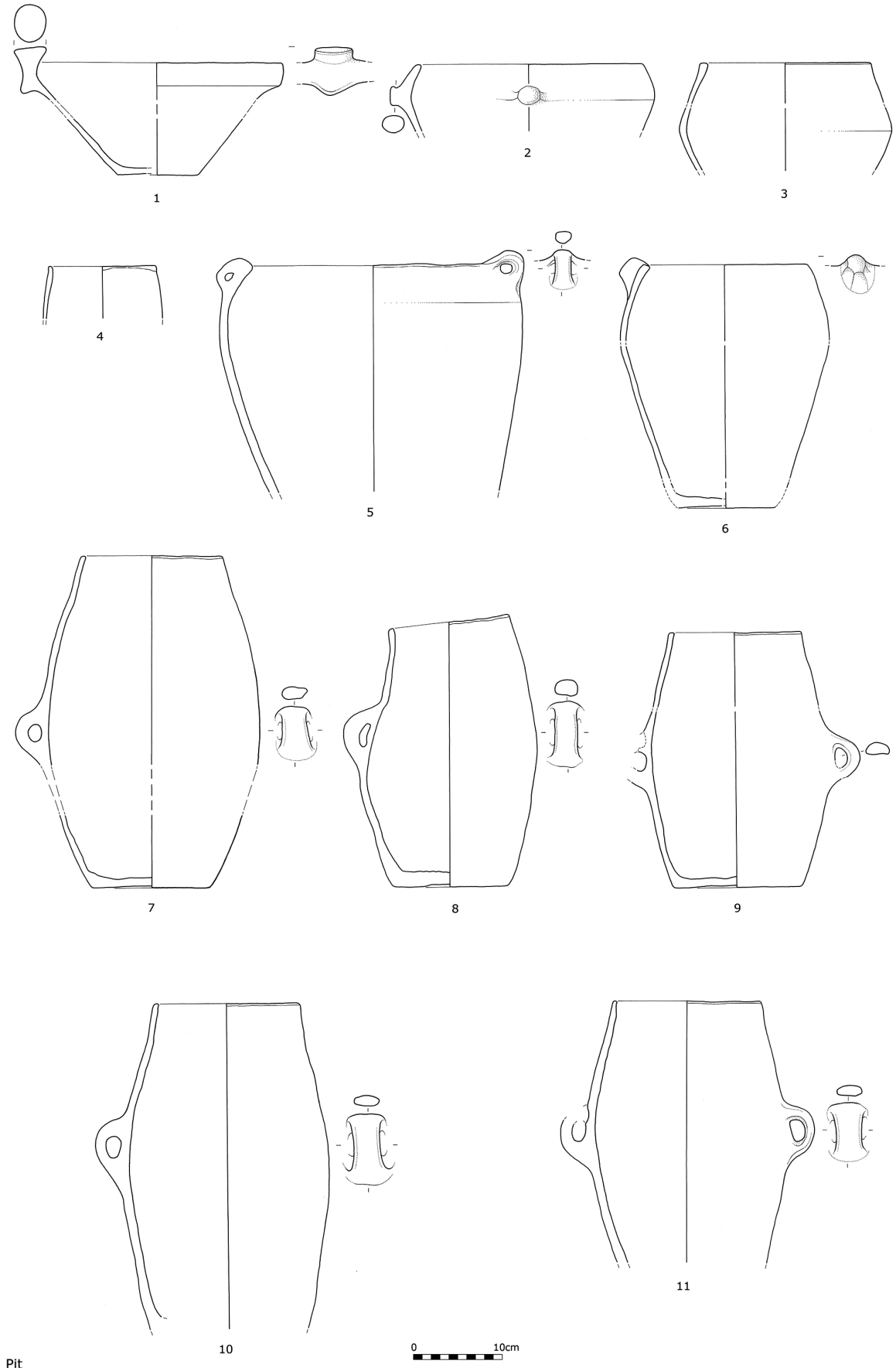

Fig. 11. Ceramic finds from Pit PO 118 (drawing J. Tratnik Šumi).

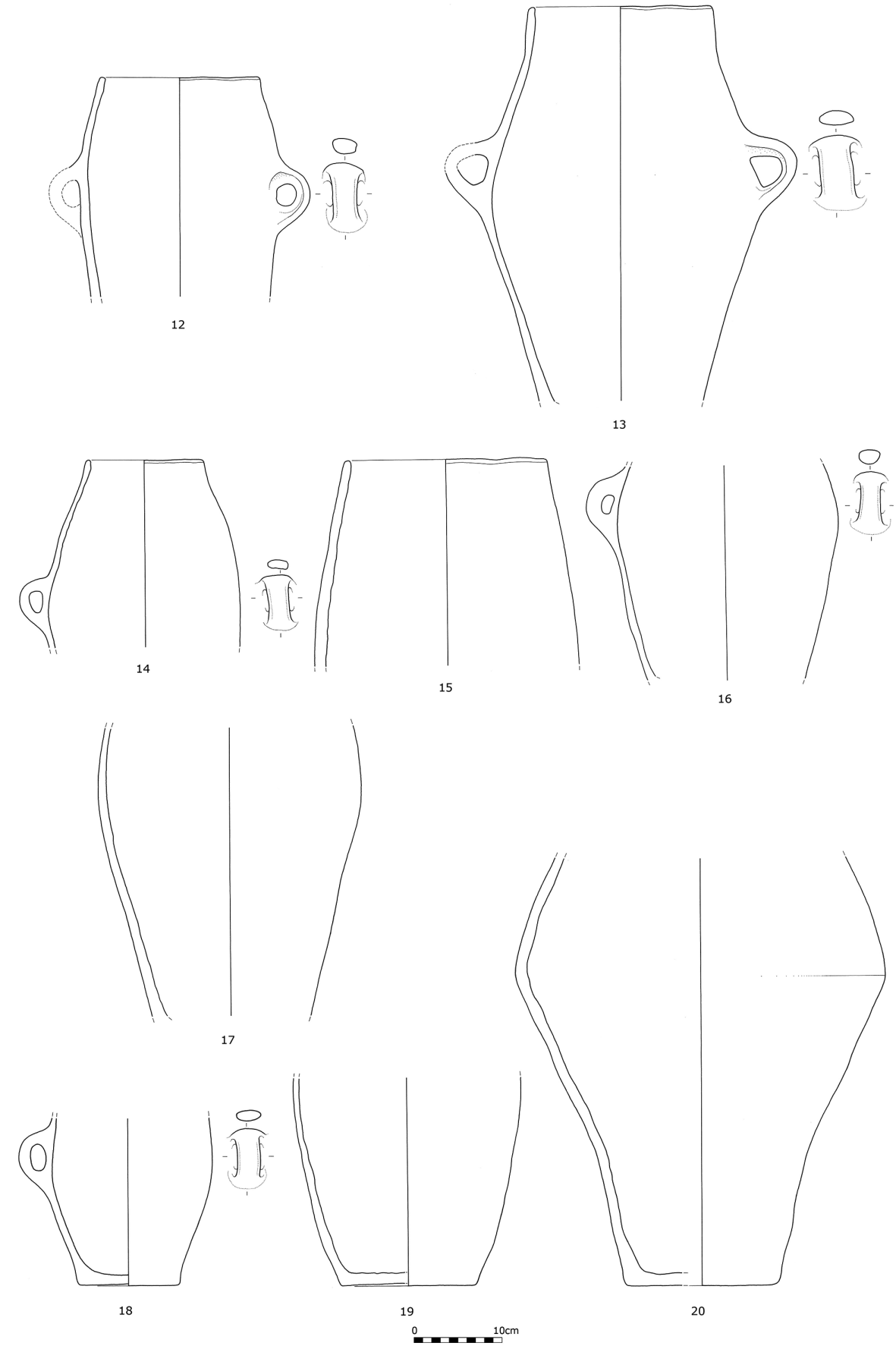

Fig. 12. Ceramic finds from Pit PO 118 (drawing J. Tratnik Šumi).

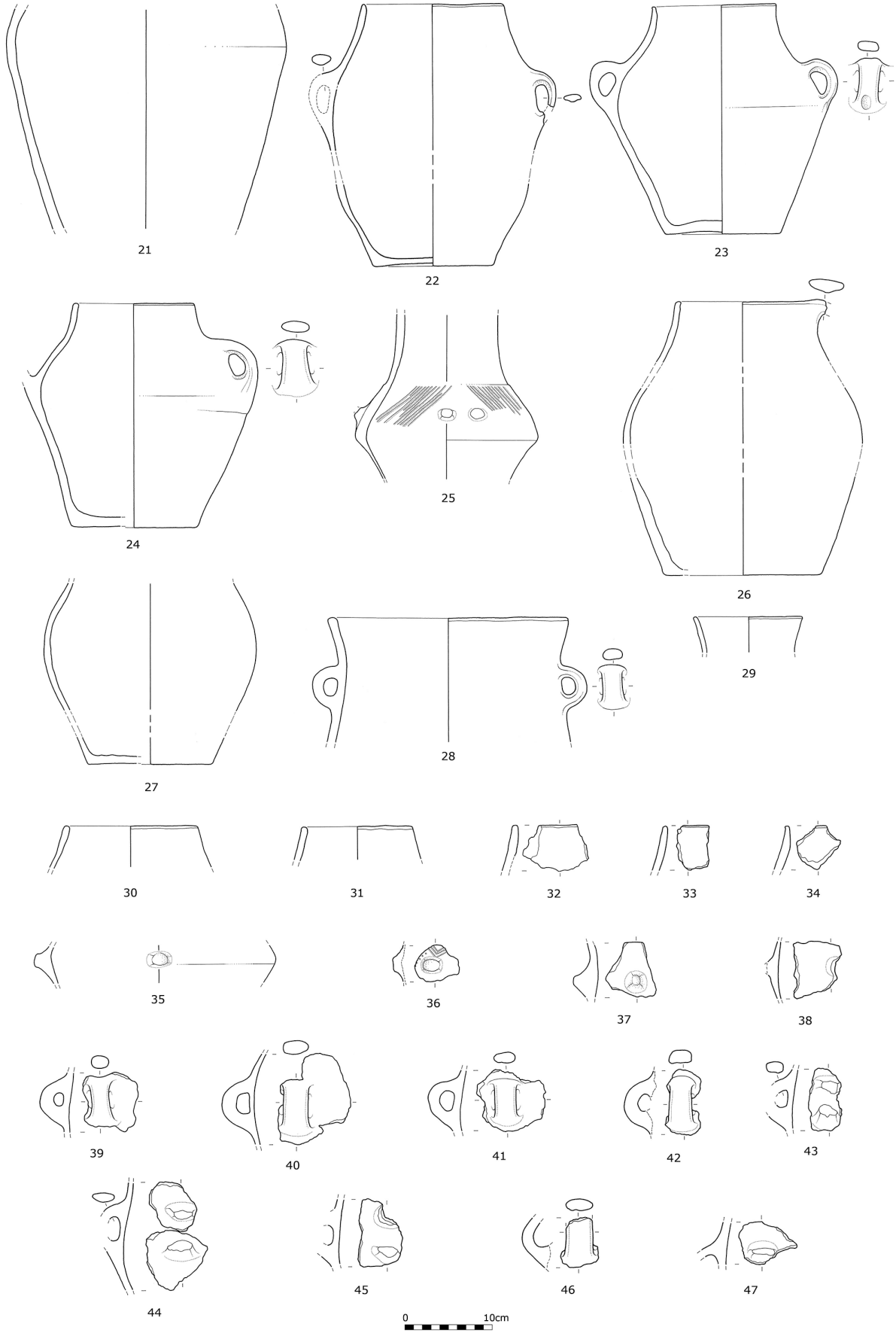

Fig. 13. Ceramic finds from Pit PO 118 (drawing J. Tratnik Šumi).

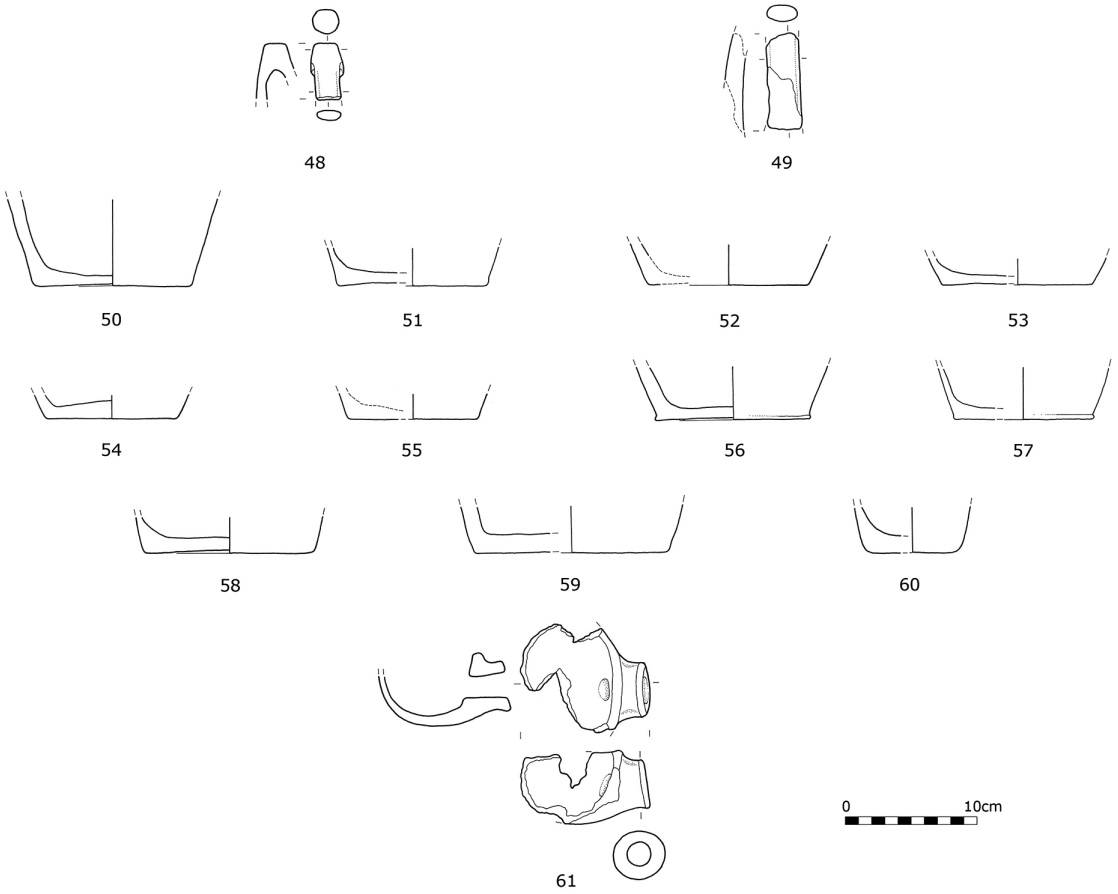

Fig. 14. Ceramic finds from Pit PO 118 (drawing J. Tratnik Šumi).

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Seeking the Holy Grail: robust chronologies from archaeology and radiocarbon dating combined

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ABSTRACT – *The strengths of formal Bayesian chronological modelling are restated, combining as it does knowledge of the archaeology with the radiocarbon dating of carefully chosen samples of known taphonomy in association with diagnostic material culture. The risks of dating bone samples are reviewed, along with a brief history of the development of approaches to the radiocarbon dating of bone. In reply to Strien (*2017*), selected topics concerned with the emergence and aftermath of the LBK are discussed, as well as the early Vinča, Ražište and Hinkelstein sequences. The need for rigour in an approach which combines archaeology and radiocarbon dating is underlined.*

KEY WORDS – *radiocarbon dating; bone samples; laboratory methods; Bayesian chronological modelling; earliest LBK; Vinča; Ražište; Hinkelstein*

Iskanje svetega grala: združevanje robustnih kronologij iz arheologije in radiokarbonskega datiranja

IZVLEČEK – *Utrjujemo moč formalnega Bayesovega kronološkega modeliranja z združevanjem vedenja iz arheologije z radiokarbonskim datiranjem skrbno izbranih vzorcev znane tafonomije in diagnostične materialne kulture. Ponovno preučimo nevarnosti datiranja kostnih vzorcev skupaj s kratkim pregledom razvoja pristopov k radiokarbonskemu datiranju kosti. Razpravljamo tudi o izbranih temah, povezanih s pojavom in posledico LTK ter sekvencami zgodnje Vinče, Ražišča in Hinkelsteina kot odgovor na Striena (*2017*). Poudarjamo tudi potrebo po natančnosti/doslednosti pri združevanju arheologije in radiokarbonskega datiranja.*

KLJUČNE BESEDE – *radiokarbonsko datiranje; vzorci kosti; laboratorijske metode; Bayesovo kronološko modeliranje; najzgodnejša LTK; Vinča; Ražište; Hinkelstein*

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Introduction

Recently in this journal, Hans-Christoph Strien (*2017*) suggested that there are discrepancies between archaeological and ^{14}C-based chronologies, particularly in relation to a series of new studies considering the early and middle Neolithic sequences across a swathe of Europe from Serbia in the south-east to the lower Rhineland in the north-west (*Jakucs* et al. *2016; Oross* et al. *2016a–c; Tasić* et al. *2016a; 2016b; Denaire* et al. *2017*). He ended his paper by stating that "*radiocarbon dating is not the Holy Grail of prehistoric archaeology, especially as long as environmental influences on its results are neither fully recognised nor understood*" (*Strien 2017. 279*).

We consider this critique to be problematic on a number of levels, the most fundamental being the implicit oppositional dualism of archaeology and radiocarbon dating. All these new studies have formal statistical modelling of archaeological chronologies at their heart, and employ explicit Bayesian methodologies to weave together the available archaeological information with the scientific dating evidence (*Bayliss, Whittle 2015; 2018*). This is a holistic approach, and so there can be no opposition between archaeological and ^{14}C-based chronologies. The choice is between archaeological chronologies that cross-refer to each other and make only informal reference to scientific dating evidence, and modelled chronologies which formally combine all the different strands of evidence. We restate the strengths of a formal approach.

Before investigating certain aspects of Strien's approach, it is important to stress that there is, in fact, a long tradition in continental European research of combining radiocarbon dating and archaeological information (see, for example, *Breunig 1987; Weninger 1995; Müller 2009*), although so far, few studies have undertaken a detailed critique of the character of the dated material and its archaeological associations that we consider essential for constructing robust chronologies (*Bayliss* et al. *2011; 2016*). But the study of both forms of evidence together is certainly a vigorous strand in this tradition.

Strien's critique implies that "*archaeology*" is led principally by chronotypology, whereas we argue for a much wider and more inclusive set of evidence, including understandings of context, stratigraphy, taphonomy and associations; but importantly, we agree on the key value of detailed knowledge of the material. Although it is not fully explicit in the article (*Strien 2017*), it is also relevant to note some of the key assumptions and approaches underlying Strien's vision of the earliest Neolithic, specifically the earliest LBK, in central Europe, which he has set out at greater length elsewhere (*Strien 2018*; reviewed critically at length in *Cladders 2018*). We will deal with selected aspects of this perspective below, but note by way of introduction an apparently sceptical if not hostile attitude to radiocarbon dating in general, and the accuracy of measurements on bone samples in particular (*Strien 2018.17–18, 27–28, 65–66*). This is combined with the belief, based on informal inspection of selected radiocarbon dates, reinforced in part by reliance on a very speculative estimate for the well at Mohelnice in Moravia, that the earliest LBK goes back to towards 5600 cal BC (*Strien 2018.28*). A belief is also evident that chronotypology, especially through detailed study of arrangements of decorative motifs on pottery, can serve to outline a succession of so-called house generations, with equal validity across a wide swathe of central Europe (*Strien 2018.32, Abb. B5–B12*). And there is an inherent tendency to prefer continuity in material development over possibilities of interruption, gap or hiatus. Since two of the previous studies (*Tasić* et al. *2016a; Denaire* et al. *2017*; see also *Tasić* et al. *2016b*) are regarded as generally unproblematic by Strien (*2017.272–273*), it seems clear that reservations and doubts about the results of the third study (*Jakucs* et al. *2016*) are driven by other factors than just scepticism about radiocarbon dating in general, including a desire to defend an alternative, "*higher*" chronology for the earliest LBK.

Risk and radiocarbon dating

In paradise, all radiocarbon samples date the target event intended and all radiocarbon measurements are accurate to within their quoted uncertainty. The real world is not like this. Few radiocarbon samples, and even fewer sampling strategies, are perfect. There is always some element of risk in dating a group of samples. These risks are of two kinds – archaeological risks and scientific risks – both of which must be managed during a programme of radiocarbon dating.

The major archaeological risk is the association between the dated event and the target event (*Waterbolk 1971*). Except in rare cases where the item dated is itself the topic of interest (*e.g.,* a carbonised food crust on a pottery sherd with diagnostic decorative

motifs), this relationship is never known, but is inferred on the basis of archaeological evidence. This is why stringent archaeological criteria have been developed to assess the security of the relationships between potential samples and the contexts from which they were recovered (*Bayliss* et al. *2011; 2016*). It is also possible to mitigate the risk of residual or intrusive samples by selecting single-entity samples for dating (*Ashmore 1999*), or dating multiple fragments from a single deposit (*Bayliss* et al. *2014*).

Scientific risks are more varied. They include the potential for age-at-death offsets and reservoir effects, heterogeneity in bulk samples, diagenesis (stressed especially by *Strien 2017*) and contamination of sampled materials, and laboratory inaccuracy. Again, these risks should be identified and managed. Some can be avoided by, for example, obtaining botanical identifications of charred plant material and selecting only short-lived, single fragments for dating. Others cannot always be avoided, and so mitigation strategies are required. Where models rely heavily on samples of human bone, for example, the potential for reservoir offsets related to human diet may be investigated through stable isotopic analyses (*e.g., Fernandes* et al. *2014*) or the dating of "*perfect pairs*" of contemporaneous human and herbivore bone (*e.g., Bayliss* et al. *2016.Fig. 6*). Diagenesis and contamination of sampled materials and potential laboratory inaccuracy are also issues which cannot be avoided, and so have to be mitigated. Radiocarbon dating of archaeological materials involves a variety of complex processes, which have been, and remain, an active area of scientific research. Methods therefore develop over time, and it is essential that interpretations of radiocarbon measurements take full and proper account of these methodological developments.

Laboratories themselves take the issue of measurement accuracy extremely seriously, employing the international standard reference material, Oxalic Acid II (*Mann 1983*), background standards that are devoid of ^{14}C (*e.g., van der Plicht* et al. *2000. Fig. 5*), and a range of secondary standards which are dated repeatedly, both as a check to identify when something may have gone wrong in processing a particular batch of samples, and to determine over the long term how the actual scatter of results compares with those expected on the basis of the quoted errors (*e.g., Staff* et al. *2014.Fig. 1*). Over the past 30 years, a series of formal international inter-comparison exercises have been undertaken (*e.g., Scott* et al. *2017*), and recently there have also been several smaller inter-comparison exercises specialising in specific material types (*e.g., Naysmith* et al. *2007*). These procedures can, and do, identify problems and allow them to be eliminated (*e.g., Bronk Ramsey* et al. *2002.2*).

The accuracy of a suite of radiocarbon dates can also be assessed once they have been obtained, both individually and as a group. There are a number of methods that we can use as a check on our results:

- the consistency of replicate results on the same or similar material (see *Ward, Wilson 1978*);
- the coherence of a suite of related radiocarbon dates – are there any clear outliers or misfits (see *Bayliss* et al. *2016.56*)?
- and the compatibility of a series of results with the relative chronological sequence known from archaeological information (such as stratigraphy) (*e.g., Bronk Ramsey 2009a; 2009b*).

Alex Bayliss and Peter Marshall (*submitted*) have recently reviewed groups of replicate measurements on 1089 archaeological samples. They found that overall approx. 12% of results lay more than 2σ from the true value (rather than the 5% expected on statistical grounds alone). Some materials are clearly more problematic than others (Tab. 1). For example, approx. 30% of results on carbonised residues on the interior of pottery sherds are problematic, but replicate results on single-entity charred plant remains vary only according to statistical expectation (5% lie more than 2σ from the true value).

Sample Material	Archaeological Risk	Scientific Risk
Pre-1993 measurements	Variable	Medium
Sediments	Low	High
Carbonised residues	Low	High
Wood (multi-ring, mostly waterlogged)	Low	Medium
Wood (single-ring, mostly from buildings)	Low	Low
Single-entity charred plants	High	Low
Waterlogged plants	Variable	Low
Bone & antler	Low	Low
Calcined bone	Low	Low

Tab. 1. Risks in radiocarbon dating of different archaeological sample types. Archaeological risks have been assessed informally following Bayliss* et al. *(2011.56–58); scientific risks have been quantified by Bayliss and Marshall (submitted: High, more than 20% outside 2σ; Medium, 10–20% outside 2σ; Low, less than 10% outside 2σ).

The accuracy of radiocarbon measurements on bone and antler samples

Such considerations should allay fears about, and suspicion of, the reliability of radiocarbon dating in general, but they underline the need for vigilance and rigour throughout the dating process.

The replicate analysis summarised in Table 1 does not suggest that samples of bone and antler are particularly problematic but given the concerns raised about the accurate dating of this material type by Strien (*2017*), it is worth delving into the evidence in a little more depth.

Of measurements on bone or antler made before 1993 and replicated randomly, some 20% appear to lie more than 2σ from the true value. Of conventional measurements made after 1993 and similarly replicated randomly, approx. 12% lie outside the 2σ limits. These findings reflect the pretreatment protocols available for conventional dating and the difficulty of providing sufficient material for this process. This is exemplified by the series of radiocarbon dates on human bone from the Trebur cemetery undertaken at the Heidelberg laboratory in the 1980s, which appear to be anomalously recent (*Spatz 2001*). This probably results from poorly preserved bone with low collagen yields, where diagenetic alterations include the attachment of exogenous humic materials to the protein strands (*Hedges, van Klinken 1992*). Humic acids are generally, but not invariably, younger contaminants.

The advent of Accelerator Mass Spectrometry initially did little to improve this situation, as the new technology simply allowed results to be obtained on low-collagen samples that were previously undatable. This was particularly problematic when large samples were processed for conventional radiocarbon dating, but produced such low collagen yields that they had to be dated by AMS. This was the case, for example, with the series of animal bone samples prepared for liquid scintillation spectrometry at the University of Zürich, but dated by AMS at ETH Zürich (Irka Hadjas, *pers. comm.*, October 2018) from the settlement at Rottenburg "*Fröbelweg*". These results again appear anomalously recent for the associated *älteste* or earliest LBK ceramics (*Bofinger 2005; Jakucs* et al. *2016*). Early AMS dating of bone from Trebur produced mixed results (*Bronk Ramsey* et al. *2002.16–17*), with measurements on compact femurs appearing more reliable than those on spongy vertebrae (*Spatz 2001.283*).

Considerable attention was paid to improving methods of bone pretreatment throughout the 1980s and 1990s (*Hedges, van Klinken 1992; Tisnérat-Laborde* et al. *2003*). The first significant advance was the realisation that some bones are simply too poorly preserved for accurate radiocarbon dating, and that thresholds for minimum collagen yield (*van Klinken 1999*) and maximum C:N ratio (*DeNiro 1985*) should be employed. Although a wide variety of methods have been suggested for bone pretreatment, for samples of Holocene age from temperate climates, those commonly employed basically can be divided into variants of that outlined by Robert Longin (*1971*) and those that utilise ultrafiltration (*Brown* et al. *1988*). In most circumstances, these produce comparable results. For example, approx. 8% of results on bone and antler samples in the 359 AMS replicate groups considered by Bayliss and Marshall (*submitted*) appear to lie more than 2σ from the true value. No significant difference is observed between the results from samples processed by both methods (the mean difference is 8.2±10.8 BP). Ultrafiltration may, however, be more effective when dating older samples (*Higham* et al. *2006; Talamo, Richards 2011*).

This comparability of results is also observed with the radiocarbon measurements on bone samples from the studies considered by Strien (*2017*), all of which were processed using ultrafiltration. Figure 1 illustrates the differences between pairs of measurements on the same sample from these sites. Of the 28 pairs of results on bone samples, 25 are statistically consistent at the 5% significance level, and the mean difference is 11.1±13.3 BP (all six pairs of results on charred plant remains are statistically consistent at the 5% significance level, and the mean difference is 0.5±18.0 BP).

This inter-laboratory reproducibility gives us confidence in the reliability of the radiocarbon measurements on bone since, if the samples were too poorly preserved for accurate dating, it is extremely unlikely that the laboratory processes in two different facilities would fail to remove exactly the same proportion of contamination in each sample. The consistency of the results suggests that both laboratories have succeeded in removing exogenous carbon from the samples, and have dated carbon purely derived from the archaeological specimens. Inter-laboratory replication therefore provides one strategy for mitigating the scientific risks of sampling strategies that are highly dependent on one type of datable material (in this case, bone).

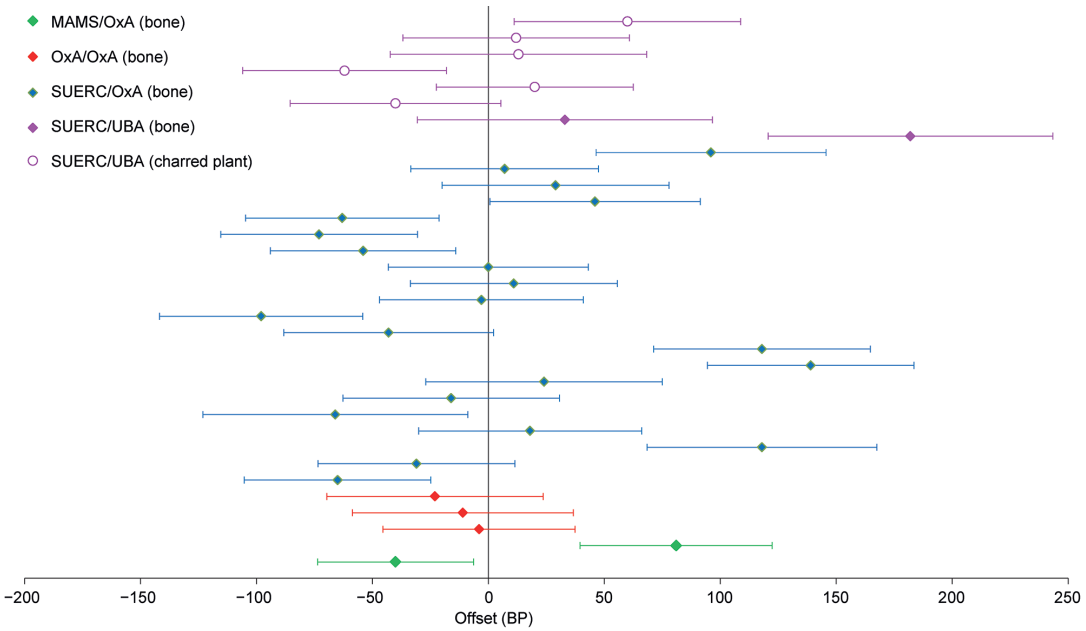

Fig. 1. Offsets between pairs of replicate radiocarbon values (error bars at 1σ), data from Jakucs* et al. *(*2016.Tab. 1*), Oross* et al. *(*2016.Tab. 1*), Tasić* et al. *(*2016a.Tab. 2*), Tasić* et al. *(*2016b.Tab. 1*), and Denaire* et al. *(*2017.Tabs. 1 and 2*).

There are other approaches which we can use to validate the accuracy of a suite of radiocarbon dates. One of these is the compatibility of the dates with the prior information included in a Bayesian model, which is particularly powerful when the archaeological evidence provides a secure relative sequence. An example of this approach is provided by the 101 radiocarbon measurements on samples taken from the approx. 7 metre-deep section through the tell of Vinča-Belo Brdo excavated in 2004–2005 and 2012–2014 (*Tasić* et al. *2016b.Fig. 10*). Ninety-three of these results are included in the chronological model described by Nenad Tasić *et al.* (*2016b.Figs. 3–8*), with eight results on short-lived, single-entity charred plant remains excluded, as the samples were clearly intrusive in the contexts from which they were recovered. Thirteen further results are included only as *termini post quos* for overlying deposits; one sample of calcined bone appears to have incorporated a component of old wood during the cremation process (*Olsen* et al. *2013; Snoeck* et al. *2014*) and 12 samples appear to be residual (two disarticulated animal bones and ten single-entity samples of charred plant material). The dates on all 11 animal bone samples included in this model have good individual agreement (A > 60; *Bronk Ramsey 1995.426*), and the model itself has good overall agreement (Amodel: 72; *Bronk Ramsey 2009a.356–357*). These statistical indicators show that the dates on the bone samples are compatible both with the dates on other materials included in the model (overwhelmingly short-lived charred plant remains), and with the relative sequence of deposits known from stratigraphy.

This application also illustrates the balance between different kinds of risk that must be assessed in constructing a sampling strategy for radiocarbon dating. Bones require complex chemistry in the laboratory, but when articulating or refitting specimens are selected for dating (*Bayliss* et al. *2016.Fig. 7*), the archaeological risks of intrusion or residuality are very low. The scientific risk is therefore mitigated by dating a selection of specimens at two facilities. Charred plant remains are generally easier to process in the laboratory, but are much more likely to be intrusive or residual. At Vinča, where this risk can be quantified by reference to the stratigraphic sequence, 9% of single, short-lived charred plant remains are intrusive and 11% residual. This combined archaeological risk is mitigated by dating two separate single-entity samples of short-lived charred plant remains from every deposit. Residual and intrusive samples cannot be avoided, but they can be identified and modelled appropriately. This requires replication, which is clearly an essential tool in mitigating risk in radiocarbon dating.

The accuracy of radiocarbon dates on bone samples is also validated by the quality assurance procedures undertaken by laboratories. Typically, this involves the repeat preparation and dating of a Pleistocene bone sample that is known to be so old that all the radiocarbon within it has decayed away. Any mea-

sured radiocarbon within it thus represents either natural contamination which has not been adequately removed from the sample or carbon introduced during laboratory processing. These "*processed blanks*" quantify any possibility that radiocarbon may be present in a bone sample that is not derived from the bone itself (*e.g., Brock* et al. *2007.Fig. 3*). Many laboratories also undertake repeat preparation and dating of a more recent animal bone sample, often one that is of known age. These bone standards provide a check that the radiocarbon content of a sample has not been diluted by the introduction of radiocarbon-free carbon of petro-chemical origin in the laboratory (*e.g., Brock* et al. *2007.Fig. 2*). The radiocarbon content of the known-age bone sample can also be compared to that of contemporaneous wood samples whose date is known from dendrochronology, thus providing a direct check on the calendar accuracy of the bone date.

Finally, the accuracy of radiocarbon dates can be compared with calendar dates from equivalent contexts provided by dendrochronology (*cf. Ullrich 2008.73–79*). We are, frankly, puzzled by the contention that there is any inconsistency between the typological evidence, the radiocarbon dating of the bone samples considered in this paper, and the available tree-ring dates. Figure 2 shows the available tree-ring dates from LBK contexts that can be related typologically to the dated sequence from Lower Alsace (we note the possibility that changes between ceramic phases may not be exactly synchronous in different LBK groups). The first well at Leipzig-Plaussig is not related to any diagnostic sherds, but must date to after the settlement was founded in LBK II. The second well here is later than the first, and associated with pottery that is equivalent to phase IV in the Alsace series (*Friederich 2017*). The first well at Erkelenz-Kückhoven must date to after the beginning of LBK II (as there is no LBK I in this area), and is earlier than the second well, which is associated with pottery whose decoration can be paralleled with phase IVb in Alsace (*Weiner 1998*). The use of another well at Altscherbitz in eastern Germany is associated with younger LBK pottery and Šárka ceramics, and can be tentatively equated with phases IVb or V in Alsace (*Tegel* et al. *2012*). In all cases, the tree-ring dating is clearly compatible with the chronological modelling of the Alsace sequence. In this light, it is the very tentative cross-dating of the extremely short tree-ring series from Mohelnice, Moravia, that stands out as anomalous, and we agree with Michael Friedrich that it should not be regarded as absolutely dated (*Schmidt, Grühle 2003.58; Friedrich 2017.430–431*; see also *Cladders 2018.4*).[1] Only the later part of the middle Neolithic sequence

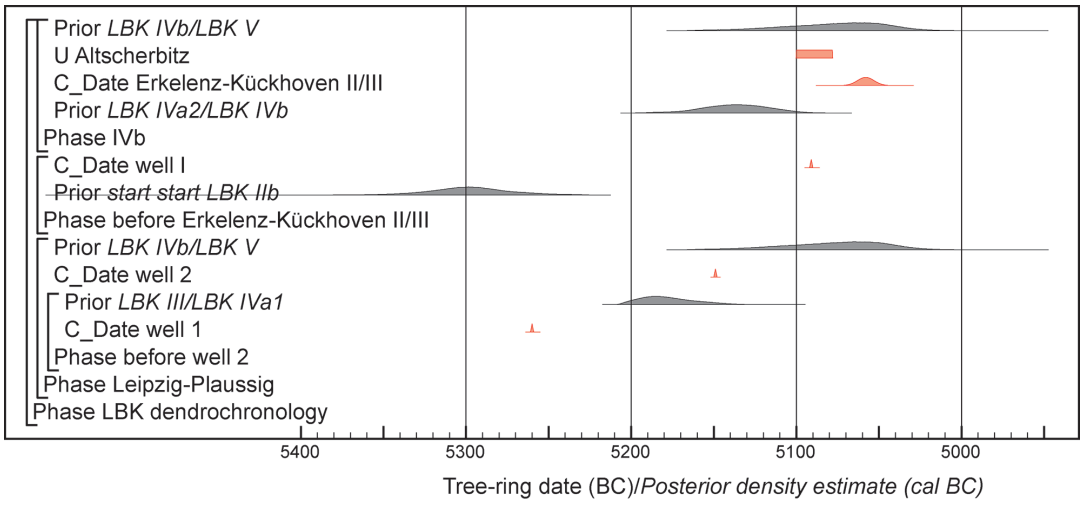

Fig. 2. Comparison between tree-ring dates for features containing diagnostic assemblages of LBK pottery and posterior date estimates for equivalent ceramic phases in Lower Alsace, derived from the model presented by Denaire* et al. *(2017.Fig. 8). Modelled parameters are given in italics.

1 Several wells were found at the Mohelnice "*Volutenkeramik*" site (*Tichý 1972*), of which only that numbered CCXXIV is relevant here, because Tichý regarded it as an older LBK feature. The timber fragments were very fragmented, as they were found in the waterlogged soil of the well. They were kept wet, and even deep frozen, in order to prevent further damage, while being delivered to Cologne for tree-ring analysis. Out of seven small wooden pieces, only two were suitable for dating, but given the relatively small number of tree-rings, secure tree-ring dating of the well was not possible (*Schmidt, Gruhle 2003.56*). Two samples from this same well have also been radiocarbon dated: GrN-6610: 6240±65 BP and KN-4339: 6580±75 BP; Schmidt and Gruhle (*2003.56*) hazarded the opinion that the earlier result might be "*closer to the real date of the well*" (our translation). Strien (*2017. 277*) claims, in our view without sufficient support, that the well in question is "*not later than 5400 den BC*".

in Alsace can be associated with dendrochronology. In the wetland settlement of Egolzwil 3, a cultural layer containing local pottery along with two imported vessels with Bruebach-Oberbergen decoration is dated to between 4282 BC and 4274 BC (*Denaire* et al. *2011*). Two wells from Dambach-la-Ville in Lower Alsace contained assemblages of Bischheim Occidental du Rhin Supérieur I (BORS I) pottery (*Croutsch* et al. *2016*). Again, in these cases, the tree-ring dates are clearly compatible with the chronological modelling (Fig. 3).

Other issues: classifications and concepts

On this basis, we stand by our published papers (*Jakucs* et al. *2016; Oross* et al. *2016c; Tasić* et al. *2016a; 2016b; Denaire* et al. *2017*). There is no space here to deal with each and every individual site raised by Hans-Christoph Strien (*2017*). From his list, we have discussed Mohelnice, Rottenburg[2] and Trebur above, and it is also the case that the radiocarbon dating so far of samples from Herxheim (*Strien 2017.277*) has been hampered by very poor collagen preservation in bone from the site (see *Riedhammer forthcoming*).

Two further cases do, however, deserve a little more comment. First, it should be noted that the human bone from the "*founder*" burial at Schwanfeld which gave a very early date (Hd-14219; Feature 704/760-138: 6580±20 BP; see *Stäuble 2005*) has now been redated (*Fröhlich, Lüning 2017.43–49*; Tab. 1). The three new AMS measurements on this male skeleton are not statistically consistent at the 5% significance level, although they are at the 1% significance level (OxA-25035, 6300±40 BP; OxA-26143, 6351±37 BP; MAMS-15659, 6228±26 BP; T' = 7.9, T'(5%) = 6.0, T'(1%) = 9.2, ν = 2), and are all considerably younger than the original measurement, which appears to have been contaminated by Paraloid B72. We have combined the sub-set of radiocarbon dates from Schwanfeld listed by Fröhlich and Lüning (*2017. Tab 1*) with the sequence of house generations suggested by them. This model has good overall agreement (Amodel: 85; Fig. 4), and the weighted mean (6276±19 BP) of the AMS results on the "*founder*" grave has good individual agreement (A: 101). All three conventional measurements on bone in this model, however, have very low probabilities of falling in the house generation suggested (P: 2, P: 0, P:2 respectively; Fig. 4). This suggests that their accuracy cannot be relied upon. This means that the model contains only four fully effective likelihoods (two on bone samples dated recently by AMS, one on a charred cereal grain, and one on a carbonised residue on a pottery sherd). Consequently, the date estimate for the start of occupation at Schwanfeld, which occurred in *5680–5220 cal BC (95% probability; start Schwanfeld*; Fig. 4), probably in *5420–5245 cal BC (68% probability)*, is insufficiently precise to contribute meaningfully to this debate. It should be noted, however, that the limited number of reliable radiocarbon dates currently available are compatible both with the sequence of house generations suggested for Schwanfeld (*Fröhlich, Lüning 2017*) and with the first appearance of the LBK in this region in the mid-54th century cal BC (*start west; Jakucs* et al. *2016.Fig. 23*).

Secondly, although the Vinča – Belo Brdo chronology is deemed to "*pose no obvious problems*" (*Strien 2017.272*), there are persistent attempts to under-

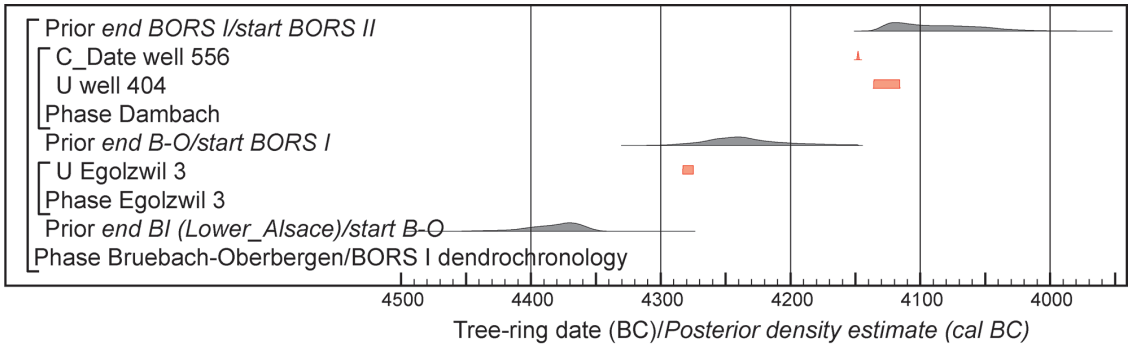

Fig. 3. comparison between tree-ring dates for deposits containing diagnostic assemblages of middle Neolithic pottery and posterior date estimates for equivalent ceramic phases in Lower Alsace, derived from the model presented by Denaire* et al. *(2017.Figs. 15–16). Modelled parameters are given in italics.

2 We should record that in Jakucs *et al.* (*2016.53*) we referred to the possibility of "*a so far unresolved problem with the detection of later activity*", whereas it is now clear that the difficulty lies in the very low level of collagen preservation in the bone samples.

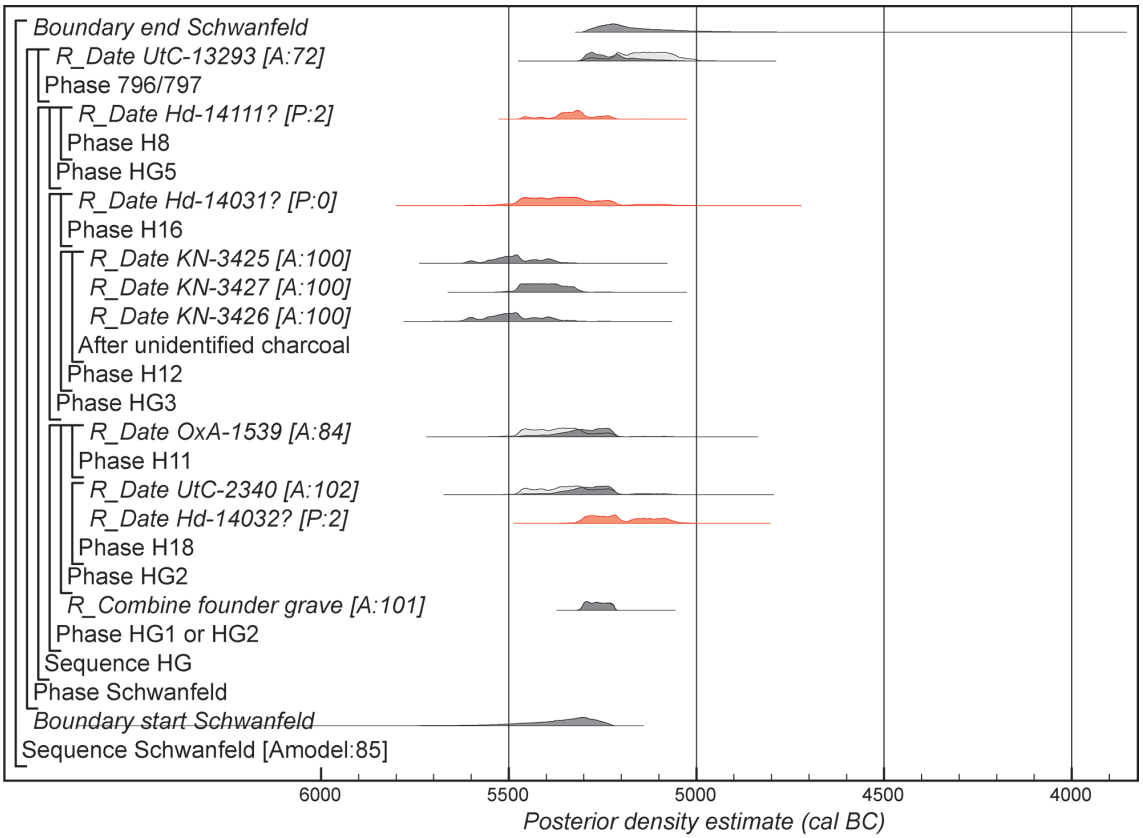

Fig. 4. Probability distributions of radiocarbon dates from Schwanfeld. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates, two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one, based on the chronological model used. Distributions other than those relating to particular samples correspond to aspects of the model. For example, the distribution "*start Schwanfeld*" is the estimated date when occupation at Schwanfeld began. Measurements followed by a question mark and shown in red have been excluded from the model for reasons explained in the text, and are simple calibrated dates (*Stuiver, Reimer 1993*). The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

mine the wider implications of the formally modelled chronologies. The first one concerns the start of Vinča A at the eponymous site and at Szederkény. Unsubstantiated claims for a ground-water offset affecting the lowest levels of tells are aired, and the possibility of a "*too late*" start to Vinča A is mooted (*Strien 2017.277*). Interestingly, there is no comment on such possible effects on the samples from the earlier Starčevo samples from Belo Brdo. Should the hydrological effects have been unkind to the Vinča A samples only and not to Starčevo samples[3], then there should be either an overlap between the periods at Belo Brdo, or the gap between the periods should be much shorter. The presence of a gap has been shown in two places at Belo Brdo: at the base of the deep sounding excavated in 2004–2005 and 2012–2014, where radiocarbon dates were obtained on short-lived charred plant material (*Tasić* et al. *2016b.Tab. 1*), and at the base of the sequence excavated by Miloje Vasić, where radiocarbon dates were obtained on bone samples (*Tasić* et al. *2016a. Tab. 2*). In the latter case, its duration has been estimated as *45–220 years* (*95% probability; gap; Tasić* et al. *2016a.Fig. 18*), probably *120–200 years* (*68% probability*). It therefore seems unlikely that local hydrological conditions affected a range of different materials from only Vinča deposits at Belo Brdo, and thus the gap between the Starčevo and Vinča occupation at these two different locations should be considered as genuine, and the beginning of Vin-

3 The earliest Vinča phase at Belo Brdo lies just above the prehistoric humus, which is of chernozem type. The Starčevo phase contexts are cut down from the chernozem itself on to the loess-like sediments below. One of the main characteristics of the chernozem soil is its porosity, so it is highly unlikely that either early Vinča or Starčevo samples would have been waterlogged long enough to influence their diagenesis. Furthermore, the existence of loess-like sediments immediately below would draw the water even deeper down.

ča A at Belo Brdo put in the first quarter of the 53rd century cal BC (*Tasić* et al. *2016a.Fig. 17*).[4]

We agree with Strien, however, that vigilance and rigour need to be exercised in each and every case, and as we stressed in our paper (*Jakucs* et al. *2016*), the current quality and quantity of radiocarbon dating for the earliest LBK as a whole undoubtedly have room for improvement. Nonetheless, we see no basis from the evidence currently available for as "*high*" or early a chronology for the emergence of the LBK as proposed by Strien, back towards 5600 cal BC. This matter seems to us also to raise other questions both of classification and conceptualisation, which we now briefly address.

Questions of classification

The formative LBK

There is a clash of classification in how to order and group material, especially pottery, at the start of the LBK. The "*formative phase*" was proposed in order to distinguish the beginnings from the "*älteste*", or earliest, LBK identified in the German literature. It is based, on the one hand, on the Starčevo presence in southern Transdanubia and the Balaton area, ending perhaps in the 56th century cal BC (*Oross* et al. *2016a.Fig. 8*). On the other hand, two longhouses in a style otherwise very typical in the earliest LBK were excavated at the site of Szentgyörgyvölgy-Pityerdomb west of Lake Balaton, associated with a pottery assemblage with strong Starčevo affinities (*Bánffy 2000; 2004*). All the features and the pottery coming from the individual features, some 15 000 sherds in total, have been described in detail, and there are now dozens of other comparable sites in the region suggested by small excavations or surface finds. Although all the usual domesticated plants and animals were present at Szentgyörgyvölgy-Pityerdomb, these small sites suggest scattered communities, not yet settled on loess soils and perhaps not fully dependent on agriculture (*Kreuz 1990*). The Szentgyörgyvölgy-Pityerdomb material (both its pottery and flints) is closely related to site IIa at Brunn near Vienna (*Stadler 1995; Stadler, Kotova 2010*). There is currently no clear modelled evidence for any non-formative LBK sites in Transdanubia predating the middle of the 54th century cal BC (*Oross* et al. *2016b. Fig. 9; Jakucs* et al. *2016*). Following settlement of the loess plateaus of the River Marcal and elsewhere in the western Carpathian basin, a rather rapid expansion, creating the spread of the LBK, appears to have begun. The speed and the nature of this spread have been attested by both mtDNA and whole genomic DNA analyses (*Szécsényi* et al. *2015; Lipson* et al. *2017*). Archaeologically, one of the best examples of the scenario is the case of Vedrovice in Moravia, where the first migrant generations can be distinguished from the later ones, which appear to have encountered and mingled with local groups (*Zvelebil, Pettitt 2008*).

In contrast, Strien simply reduces the proposed "*formative phase*" of the LBK to a regional variant, creating a "*Balaton älLBK*" group, separated from a "*Danube älLBK*" group (*Strien 2017.273, 278–279; 2018.35–40*). It is not clear how his own proposed start date for the earliest LBK of around 5600 cal BC is derived, other than by selective use of visual inspection of radiocarbon dates (arbitrarily switching between calibrated ^{14}C dates and uncalibrated ^{14}C determinations), aided and abetted by acceptance of a speculatively early date for the Mohelnice well (as discussed above); the issue is further muddied by claims that a much earlier start date than we have proposed would solve alleged problems with the demography of expansion. We reflect on that issue below.

Sopot and Vinča

The second non-explicit criticism of Strien (*2017*) of the Vinča-Belo Brdo chronology concerns more broadly the formal chronological models for the use and development of Vinča ceramics, namely the relationship between different ceramic styles like Sopot and Vinča. It is claimed (*Strien 2017.276*) that, allegedly on typological grounds, Sopot IB-II is related to Vinča C1 (Schier phase 6 at Vinča – Belo Brdo; *Oross* et al. *2016c.158–159*), while radiocarbon dating relates it to Vinča A1 at Szederkény. Both of these statements are incorrect.

4 In relation to the start of Vinča A at Szederkény, the subdivision of the major Vinča phases is based on statistical analysis of pottery from the layers of the Vinča-Belo Brdo tell (*Schier 1995; 1996*). However, the sub-phases established on Belo Brdo are extremely difficult to reproduce in a large-scale flat settlement which is located at the northernmost edge of the Vinča distribution in the contact zone of multiple cultural units. In the very first publication of the Szederkény settlement (even without radiocarbon dating: *Jakucs, Voicsek 2015*), we proposed, on typological grounds, that the beginning of the site can be equated with the earliest Vinča phase (Vinča A1a, *sensu* Schier), although in general there are also comparisons with the whole of Vinča A (*Jakucs, Voicsek 2015*). Radiocarbon data later confirmed this first observation; and in the eastern part of the settlement, there are pots matching the Vinča A ceramic style as a whole (*Jakucs* et al. *2016*).

First, Krisztián Oross *et al.* (*2016c.158–159*) do not simply equate Vinča C1 with Sopot IB-II, but followed the development of scholarly opinion on the chronology of the Sopot (initially Sopot-Bicske) distribution in Hungary. The entity was regarded as coeval with Sopot Ib and II by Nándor Kalicz and János Makkay at the time of its recognition, later connected more precisely to the Vinča B2–C horizon. As a result of the re-evaluation concerning the initial phase of the younger Vinča culture by Schier and inspired by his Vinča C1 phase (*Schier 1996. 147–148*), further Hungarian Sopot sites were dated similarly. Recent dating programmes for Vinča – Belo Brdo and for the Alsónyék Sopot occupation can only reinforce this context. Secondly, the particularities of Sopot ceramics in Croatia and Hungary, together with the largely unpublished early Sopot assemblages and the uncertainties of the radiocarbon dates (*Balen* et al. *2009.58*), are entirely overlooked.

Ražište, Sopot and Vinča

It is, in fact, an anomaly that in the literature, Ražište sites (equivalent to Vinča A and B1 horizons) and Sopot sites (Vinča B2/C and Vinča C horizon) have both been labelled sometimes as Sopot IB-II. All the alleged contradictions discussed by Strien, in the section "*Too young, but sometimes old: the case of Ražište/Sopot IB-II*", come mainly from the fact that he ignored this anomaly. The role of the Ražište-type in the biography of the Sopot culture is still debated today (*Jakucs, Voicsek 2015; Jakucs* et al. *2016.299*). As Ražište-type ceramics are one of the main components of the Szederkény settlement, Jakucs *et al.* 2016 examined the original view that assigned the Ražište-type to the Sopot IA-IB or IB-II horizons (*Marković 2012.58–59*). Thus, we examined the coherence of the data specifically related either to the Ražište-type or to the Sopot IB-II (*Jakucs* et al. *2016.300, Tab. 4*). This obviously should not have been an arbitrary selection, and so we could not omit the samples of Ivandvor-Šuma Gaj, since they were clearly listed as Sopot IB-II (*Burić 2015*), though they were apparently young. However, precisely for the above reasons, Jakucs *et al.* (*2016*) never mentioned Ivandvor-Šuma Gaj as a "*Sopot IB-II/Ražište-site*", as Strien asserts in his paper (*Strien 2017.273*). We have also never tried to find a correlation between the Ražište finds of Szederkény and the Sopot finds of Alsónyék, as Strien suggested (*Strien 2017.276*), since these obviously differ typologically and cannot belong to the same Sopot horizon in any case. Once again, there appears to be no solid basis for arguing that radiocarbon dates are both too old and too young.

Other conceptual issues: demography; and hiatus

Demography

Strien asserts (*2017.273*) that accepting our modelled results "*is not so much a chronological as a demographical problem*". In his view, a very rapid earliest LBK expansion would have entailed an improbably large number of people, with some 3000 people leaving the Balaton-Vienna area in the first year for south-west and central Germany, and thousands of immigrants between Bavaria and Volhynia, "*an obviously unrealistic number*" (*Strien 2017. 273*). These demographic speculations are then used to cast doubt on the modelled 54th-century date for the major earliest LBK diaspora, with an informal estimate of "*not later than 5500 cal BC*" given instead (*Strien 2017.273*). This is hardly the place to go into the many difficulties involved in trying to reconstruct population levels in the earliest, or, indeed, the established LBK. Suffice it to say that there are so many uncertainties and imponderables involved, with classic questions of the numbers of occupants in longhouses, the numbers of longhouses in contemporaneous use in a given settlement, and the numbers and durations of individual settlements in any given region among many others (see *Soudský 1969; Moddermann 1970; Coudart 1998; Dubouloz 2008; Bocquet-Appel* et al. *2014*). We did not propose any specific figures, but considerable numbers in certain parts of the landscape are plausible in general (see also *Shennan 2018*), and the aDNA evidence now available (*e.g., Lipson* et al. *2017*) is also compatible with an LBK diaspora of considerable size. Demography is hardly the kind of "*dealbreaker*" which Strien claims.

Gaps and hiatus: the case of Hinkelstein

In a last effort to cast doubt on the reliability of radiocarbon dating, Strien addresses the question of the date of the Hinkelstein phase, supporting the conventional view that there was unbroken continuity from LBK to Hinkelstein (*Strien 2017.275, 278*).

We can note, first, that for the early and middle Neolithic as a whole in Lower Alsace and by extension in a large part of the Upper Rhine valley, radiocarbon dating and archaeology (mainly typo-chronology and stratigraphy) have basically agreed in establishing the same sequence. Strien himself (*2017. 273*) appears to accept the modelled results of Anthony Denaire *et al.* (*2017*) overall. The position of Hinkelstein in this sequence (*Denaire* et al. *2017.*

1130–1137; see also *Riedhammer in press*) is the bone of contention. This takes us far from the earliest LBK, but is central to questions of dating as a whole.

In our view, the archaeological evidence for contacts between users of late LBK and of Hinkelstein pottery is limited to the middle Rhine valley, more specifically the Worms region and its Hinkelstein graveyards (*Meier-Arendt 1975; Jeunesse 1999; Spatz 2001*). Outside this region, there is no definite evidence of contact, because it is impossible to rely on the usually cited "*mixed assemblages*" containing both LBK and Hinkelstein finds as closed contexts, except that from Köln-Lindenthal (*Buttler 1935; Spatz 2001*); and in the latter case, we should underline that Köln is located outside the normal distribution of Hinkelstein pottery. Nothing that we are aware of definitely proves that the Hinkelstein style had emerged when the LBK ended in Lower Alsace or other regions, and the map distributions of late LBK and Hinkelstein respectively are also no proof of direct contact (see also *Ritter-Burkert in press*, on the situation in the Wetterau; and *Riedhammer 2018.69*).

We believe that the existence of a gap between the early and middle Neolithic should not be a surprise. In the Rhineland, a similar situation exists in the region of the Aldenhovener Platte, where the middle Neolithic sequence categorically starts with Grossgartach – recent Grossgartach in the Spatz chronology, though earlier in the Denaire system (*Spatz 1996; Denaire 2009*). The existence there of a gap between LBK and Grossgartach appears to be supported by pollen diagrams (*Kalis, Zimmermann 1988*). Transitions between the early and middle Neolithic in general are neither simple nor universal. We can also note the situation in the north of Franche-Comté, where the Danubian sequence starts with Roessen (*Denaire 2009*), while in Lower Saxony, Roessen succeeded Stichbandkeramik (*Lönne 2003*).

Other concepts in the Strien approach

Finally, we note, but for discussion elsewhere, other facets underpinning Strien's schema (*2017; 2018*) for the character and development of the earliest LBK. These include the concept of house generations, an assertion of considerable input by local hunter-gatherers into the formation of the earliest LBK, and the existence, right from the beginning, of marked regionalisation in the distribution of preferred decorative motifs on earliest LBK pottery. All these, which are part and parcel of the Strien schema, could in their turn be disputed, but that would take more space than we have available here. We simply note the many critiques of the *Hofplatz* model from which the house generation concept is derived (*Birkenhagen 2003; Rück 2007; 2013; Lefranc, Denaire in press*); though the notion of human generations is useful (references in *Whittle 2018*), house generations identified only by study of ceramic motifs seem to us at present a hazardous chronometer for tracking change across wide regions. Likewise, the new aDNA evidence already referred to (*Lipson* et al. *2017*) appears to reduce very considerably the likely input of hunter-gatherer populations into the formation and spread of the LBK. Finally, there are also questions about the extent of regionalisation in the earliest LBK (see also *Cladders 2018*), and we have already noted our classificatory differences with Strien, especially with regard to the proposed formative LBK.

Conclusions

Clearly we consider that virtually all the alleged "*discrepancies*" between archaeological and ^{14}C-based chronologies postulated by Strien (*2017*) can be questioned when all the strands of evidence are subject to the detailed and careful scrutiny that is required – constantly and without exception – if we are to come closer to revealing the prehistoric reality that should be the aim of our research. We challenge the apparent opposition of archaeological evidence and ^{14}C dating, considering them rather to be complementary sources of information that, when explicitly combined using a rigorous statistical methodology, together can forge a more reliable understanding of past lives.

We welcome the rigorous questioning of our taken-for-granteds, but suggest that this rethinking has to be applied not only to radiocarbon dating, but also to the varied forms of archaeological evidence at our disposal. Dating bone collagen, particularly on the seasonally wet and acidic sands and gravel terraces of the Rhine valley, is undoubtedly challenging. But the accurate dating of such samples has been a major focus of radiocarbon research for the past generation, and it is essential that the existing corpus of dates be interpreted, and new dates obtained, with the benefit of the methodological insights that have been gained. As high-resolution radiocarbon calibration (*e.g., Pearson* et al. *2018*) and high-precision radiocarbon dating by AMS (*e.g., Wacker* et al. *2010*) become available to archaeologists, accuracy must never be assumed, but must always be rigorously tested and evaluated.

Strien (*2017.278*) is certainly correct in suggesting that cross-checking radiocarbon results on contemporaneous samples of different materials is an effective strategy for testing scientific accuracy, although this is only valid where the taphonomic security of each sample is equivalent. At present, articulating and refitting bones are the most archaeologically secure type of material available to most archaeologists (although we note recent developments in obtaining accurate radiocarbon dates on absorbed fatty acids from pottery (*Casanova* et al. *accepted*), which may mean that in future, refitting groups of sherds will provide samples that are as taphonomically secure). But this is only one strategy for assessing the accuracy of radiocarbon dates. We also have at our disposal the routine use of appropriate standard materials in laboratories; inter-laboratory replication; the rigorous archaeological, scientific, and statistical identification of misfits and outliers in groups of related dates; formal statistical evaluation of the compatibility of different strands of evidence in a model; and comparison with dendrochronology. All these methods are of value, and we must employ them routinely. Again, we agree with Strien (*2017.278*) when he asserts that "*financial constraints concerning the number of dates are not an excuse for methodological deficits*".

It is equally important to be clear about the taken-for-granteds of the chronotypological approach. At its best, this is based on expert, detailed knowledge of the material and its associations, and a related ability to identify securely closed contexts reliably. These virtues can be seen in Strien's wider study of the earliest LBK (*Strien 2018*; see also critique in *Cladders 2018*), and they are behind numerous successful correspondence analyses of important assemblages. But this approach also tends, other things being equal, to assume continuity of use in the material of a given tradition, and to present the results of analysis in such a fashion as to gloss over any possible disruptions or hiatuses (see also critique in *Shennan, Wilkinson 2001; Pechtl 2015*). In that, it is not alone, since many prehistorians of all shapes and sizes have thus far tended to work, often unthinkingly, with default perspectives of slow change and continuity (*Bayliss* et al. *2007; 2016; Whittle 2018*). That is often to work away from the nuanced and diverse trajectories of change which we should be attempting to capture in our narratives.

Imagine, however, how much more robust and more effective still our collective efforts could become if the strengths of the various approaches reviewed in this paper were to be applied more regularly and more systematically. In that happy land – perhaps not yet paradise – detailed sequences could be constructed by combining all the strands of information. Short-life samples of known taphonomy, be they animal bones in anatomical order or deposits of cereals, say, in association with diagnostic material culture from assemblages themselves closely ordered by typology or correspondence analysis, or in future the relevant decorated pottery itself, can provide the radiocarbon measurements to input into formal models, along with prior information in the form of detailed archaeological knowledge of context, stratigraphy, and typochronological sequence; the resulting model outputs can then form the basis of interpretation and detailed narrative. That is a Grail worth seeking.

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Redefining the role of metal production during the Bronze Age of south-eastern Iberia. The mines of eastern Sierra Morena

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ABSTRACT – *Researchers have traditionally paid little attention to mining by Bronze Age communities in the south-east of the Iberian Peninsula. This has changed recently due to the identification of new mineral exploitations from this period during archaeo-mining surveys carried out in the Rumblar and Jándula valleys in the Sierra Morena Mountains between 2009–2014, as well as the excavation of the José Martín Palacios mine (Baños de la Encina, Jaén). The analysis of the archaeological evidence and the archaeometric results reveal the importance of mining and metallurgical activities undertaken by the communities that inhabited the region between 2200 and 900 cal BC, when it became one of the most important copper and silver production centres during the Late Prehistory of south-eastern Iberia.*

KEY WORDS – *Bronze Age; south of the Iberian Peninsula; prehistoric mining; copper; silver; archaeo-mining surveys; excavation; lead isotope analysis*

Preoblikovanje vloge pridobivanja kovin v bronasti dobi na območju jugovzhodnega Iberskega polotoka. Rudniki vzhodne Sierre Morene

IZVLEČEK – *Raziskovalci so v preteklosti posvečali le malo pozornosti rudarstvu bronastodobnih skupnosti v jugovzhodnem delu Iberskega polotoka. Do spremembe je prišlo nedavno s prepoznavanjem novih sledov izkoriščanja mineralov iz tega obdobja, in sicer med arheo-rudarskimi terenskimi pregledi v dolinah reke Rumblar in Jándula v gorah Sierre Morene v letih 2009–2014, kot tudi z izkopavanji rudnika José Martín Palacios (Baños de la Encina, Jaén). Analiza arheoloških podatkov in arheometričnih rezultatov je pokazala pomembnost rudarskih in metalurških aktivnosti skupnosti, ki so živele v tej regiji med 2200 in 900 pr.n.št., ko je le-ta postala eden najbolj pomembnih središč za pridobivanje bakra in srebra na jugovzhodnem Iberskem polotoku v času pozne prazgodovine.*

KLJUČNE BESEDE – *bronasta doba; južni Iberski polotok; prazgodovinsko rudarstvo; baker; srebro; arheo-rudarski pregledi; izkopavanja; analiza stabilnih izotopov svinca*

Introduction

Metallurgy has traditionally been considered a key aspect in the study of Early Bronze Age societies (2200–1550 cal BC) in south-eastern Iberia, otherwise known as the Argaric Culture. The Argaric communities were the result of a long process of growing inequality that began in the Copper Age and led to deep-seated social inequalities and individualized identities (*Lull 1983; Chapman 2008*). During the Argaric period, major changes came about in the domestic and funerary spheres, as well as in the settlement pattern with respect to the previous period. Settlements of circular huts became sites built with artificial terraces and rectangular dwellings. Most villages were established on steep hills, although some are attested on the plains. Burials were individual and inside dwellings. Artefacts also changed typologically, including the standardized shapes of copper, silver and gold ornaments, and weapons

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such as swords and halberds (*Lull 1983; Chapman 2008; Aranda* et al. *2015*).

These changes are also observed in agricultural practices, where an intensification of production occurred in the southeast of the Iberian Peninsula. There is an increase in the cultivation of species such as hull-less barley (*Hordeum vulgare L.*) and naked wheat (*Triticum aestivum/durum*), together with various legumes or plants such as flax (*Buxó 1997; Montes 2014*). At the same time, pollen studies carried out in some settlements have shown a retreat of forested areas as a result of land being brought into cultivation (*Rodríguez-Ariza 2011*). This intensification has been related to the spread of extensive monoculture dryland cereal farming in coexistence with garden areas (*Araus* et al. *1997*), although other authors have proposed a more extended use of irrigation (*Mora-González* et al. *2018*).

During this stage, the production of metal objects also intensified, with an almost five-fold increase over the Copper Age (*Montero 1993; Murillo* et al. *2015*). There were important technological innovations, such as bronze and tin alloys, the development of silver metallurgy, goldwork and improved control over the techniques of forging and annealing objects (*Montero 1991; Rovira, Gómez 2003*). We also observe a change in the typology of metal objects. Ornamental objects (bracelets, pendants, earrings, rings and diadems) reflect new design concepts for personal adornment. Such items comprise more than half of all Argaric metal objects (*Murillo, Montero 2012*). Finally, some tools made of metal (copper and bronze), such as knives, awls and axes, began to gain in importance and to replace those from the preceding period made of bone and stone (*Lull* et al. *2010*).

Research into the Argaric culture dates back to the late nineteenth century (*Siret, Siret 1887*), which has made it the most thoroughly researched Bronze Age culture in Iberia (*Aranda* et al. *2015*). Since the 1970s, various scholars have claimed that craft specialisation in metallurgy was a crucial factor in the appearance of social inequalities (*Lull 1983; Lull* et al. *2010*). Other researchers attribute a secondary value to metallurgy, stating that it did not require full-time specialisation. Its expansion would have been the result, not the cause, of a developing social hierarchy. That cause was more likely to be found in changes that came about in the organization of subsistence production (*Gilman 1987; Montero, Murillo 2010*).

The fact that there are no traces of prehistoric mining to be found in the south-east of the Iberian Peninsula has been used as a key argument for both hypotheses. In the first one, the lack of prehistoric exploitations is explained by the purportedly scarce use of these mines, as they would have been rendered unnecessary by the existence of the large metal production centre in the Sierra Morena region, which would have supplied the whole south-east (*Lull* et al. *2010*). In the second line of research, the lack of evidence is explained by the abundance of mineral resources, mainly copper and silver, throughout the south-east, and the scarce production would have left little evidence of extractive activities, with those there were being almost unrecognizable today (*Montero, Murillo 2010.41*).

In this whole debate, a fundamental aspect of the process of copper- and silver-based metal production has been overlooked: mining itself. Research focusing on metallurgical mining production on the Iberian Peninsula is rather scarce, apart from a few exceptions (*Blanco, Rothenberg 1981; Hunt-Ortiz 2003; Blas-Cortina* et al. *2013*). Until the 1980s, we had only sporadic, general information on south-eastern Iberia. The exceptions include the mining engineers in the late nineteenth and early twentieth centuries, such as Pedro Mesa y Álvarez (*1890*), who pointed out the possible existence of prehistoric mining, although they did not offer any archaeological data. Claude Domergue (*1987*) was the first to analyse prehistoric mines with archaeological evidence. In his catalogue of ancient mines and foundries of the Iberian Peninsula, he mentions 11 mining sites distributed throughout the south-east with remains of ophite and diorite hammers, which he dates to the Late Prehistoric Period.

This situation has started to change recently thanks to the research that the La Bastida team is carrying out in Murcia, and the Peñalosa team in the eastern Sierra Morena Mountains (Jaén). The fieldwork of the La Bastida project in the coast mountain ranges of Murcia have allowed the discovery of two new mining areas with macrolithic objects: one in Filón Consuelo (Cartagena) and the other in Mina Balsitas (Mazarrón) (*Escanilla, Delgado 2015*). In the Cerro Minado mine (Huercal-Overa, Almería), archaeological evidence (stone tools) was also found, and ^{14}C dated its use to the Copper Age (*Delgado* et al. *2014*).

Since 2001, within the Peñalosa project, we have been studying prehistoric mining in the south of the Iberian Peninsula, more specifically in the eastern

Sierra Morena Mountains (*Contreras* et al. *2004; Arboledas, Contreras 2010; Arboledas* et al. *2015; 2017*). One of the main objectives was to find and analyse the copper and silver mines that existed in the region. The fieldwork and lab-work have provided us with important data and information, which are analysed in this article. The new data proves the existence of a major copper production centre in this area during the Bronze Age. The analysis of the archaeological remains and the analytical data have enabled us to propose new hypotheses and to highlight the need to revisit already existing hypotheses about the organization of metal production and its role in the development of the second millennium BC communities in the south-eastern Iberian Peninsula.

The prehistoric mines in the eastern Sierra Morena Mountains

This research focuses on the mining area known as Linares-La Carolina, which is located in the eastern part of the Sierra Morena Mountains, to the north of the province of Jaén. Geologically, this area is part of the southern part of the Iberian Central Plateau, which features predominantly Paleozoic material (schist, slate and quartzite) and plutonic rocks, and which is cut through by a network of fractures and veins (*IGME 1977.3–4*).

Mineralization appears in veins and seams rich in lead-silver and copper minerals, most of which are contained in granites in the areas of contact between plutonic and sedimentary rocks, and in quartzite and slate of the Ordovician. This fact determined the methods and techniques used to exploit these mineralized deposits throughout history, with a predominance of trenches (trench) and small galleries rather than open pits or galleries and rooms-and-pillars, as happens in the southwest of the Iberian Peninsula.

The seams present mineralization of lead (Pb), lead-silver (Pb-Ag), copper-lead (Cu-Pb) and copper-iron (Cu-Fe), as well as some tin-tungsten (Sn-W). The mineralization in this region presents a great variety. Thus, there are areas where the seams are rich in lead sulfides, mainly argentiferous galena, with important silver grades, such as El Centenillo, and others with important copper mineralization, such as the Jándula valley, the middle valley of the Rumblar and Linares (*Azcarate 1972*). All the prehistoric mines documented archaeologically until now in the eastern Sierra Morena Mountains were dug in the copper seams of those areas that are embedded in granites of the Pedroches batholith of the province of Jaén.

During the first stages of mining in this region, only the copper mineralizations, both native and simple

No.	Site	Evidence mining	Material culture	Relative chronology
01	Candalares	T, E	Mar, CP, CR, ML, EP	PR-EB, R
02	Peñón del Águila	T, P, G, E	Mi, CMPR, ML	PR-EB y PRO
03	Barranco Valpeñoso	S, E, P	Mi, Mar, CMR, ER	PR-EB, R
04	Revuelta Molinicos	T, E	Mi, Mar, ML	PR
05	Los Castellones	T.E	Mi, Mar,	PR
06	Arroyo de la Grieta	T.E	Mi, Mar, EP	PR-EB
07	Mingorramos	T, E, G	Mi, Mar, CR	PR, R
08	Navalasno	T, E	Mi, Mar, ER	PR, R
09	Nava de la Cabrera	T, E	Mi, Mar	PR
10	Las Minetas	T, E	Mi, Mar	PR
11	Las Minetas II	T, E, S	Mar	PR
12	Laguna de los Llanillos	T, E	Mi, Mar	PR
13	Casa mina de Valquemado	T, E,	Mi, Mar	PR
14	Casa vieja de Valquemado	T, E	Mi, Mar,	PR
15	Cerro de los Venados	T, E	Mar	PR
16	Los Escoriales	T, E, Es, P, S	Mi, Mar, ER, CR	PR, R
17	Arroyo Aliseda	T, E,	Mi, Mar	PR
18	Arroyo Fresnedillo	T, E	Mi, Mar,	PR
19	El Polígono	T, E, S, P	Mi, Mar, ML	PR-C, PR-EB
20	José Palacios-Dña Eva	T, P, G, E	Mi, Mar, CMP, CPR-EB, CR	PR-EB, PROT, R
21	Mina Arrayanes	T, E	Mi, Mar, CR	PR, R

Tab. 1. Mining exploitations in eastern Sierra Morena Mountains. Mining evidence: T trench, P mining shaft, S survey/pit, G Gallery, E mining dump. Material Culture: Mi Mineral, Mar Hammer, ML lithic material, CP Prehistoric pottery, CR Roman pottery, CPR Protohistoric pottery, CMP Prehistoric metallurgical pottery, CMPR Protohistoric metallurgical pottery, CMR Roman metallurgical pottery, EPR Late prehistoric slag, ER Roman slag. Chronology: PR-C Late Prehistory, Copper Age, PR-EB Late Prehistory, Bronze Age, PRO Protohistory and R Roman (from* Arboledas *et al.* 2017.52*).

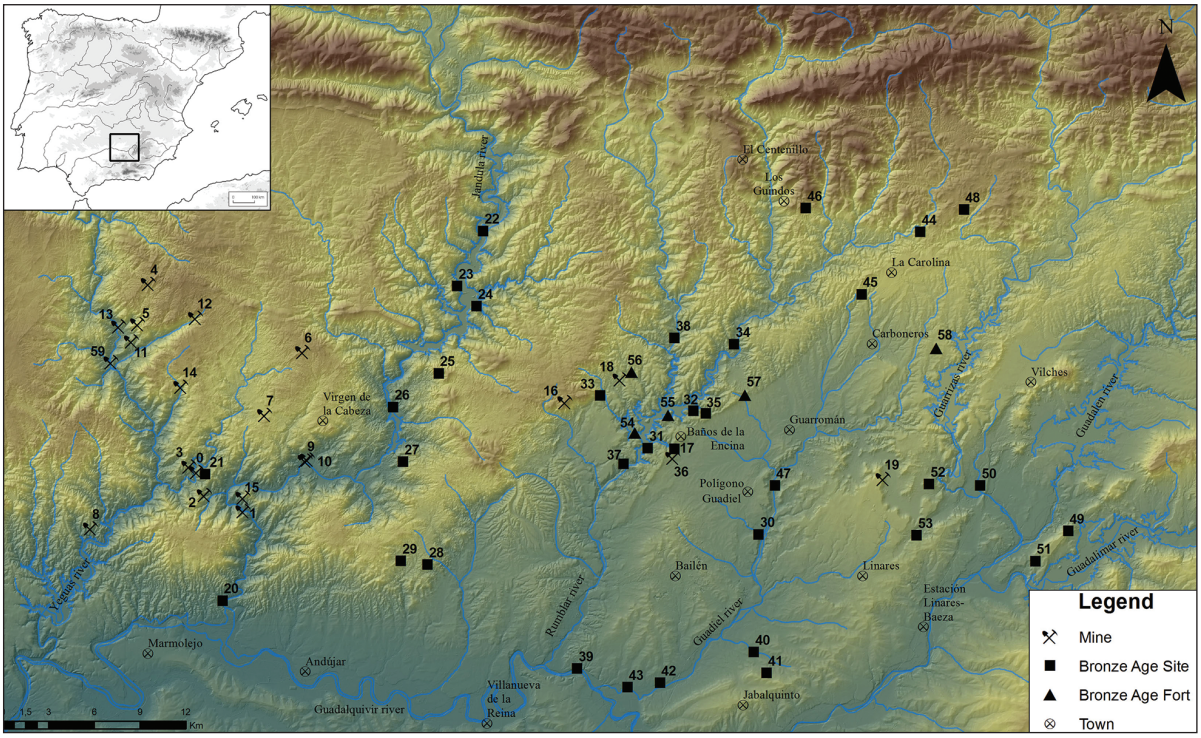

Fig. 1. Map with prehistoric mines and Bronze Age settlements in eastern Sierra Morena Mountains. 0 Los Candalares, 1 Peñón Águila, 2 Barranco Valpeñoso, 3 Revuelta Molinicos, 4 Los Castellones, 5 Arroyo Grieta, 6 Mingorramos, 7 Navalasno, 8 Nava de la Cabrera, 9 Las Minetas, 10 Las Minetas II, 11 Laguna Llanillos, 12 Casa Valquemado, 13 Cerro los Venados, 14 Arroyo Aliseda, 15 Fresnedillo, 16 Salas de Galiarda, 17 Poligono, 18 José Palacios, 19 Arrayanes, 20 Cabrerizas, 21 Candalares, 22 Contadero, 23 Valtravieso, 24 Atalayón, 25 La Lancha, 26 Casa Peral, 27 Lagunilla, 28 Cerro Tornero, 29 Cerro Atalaya, 30 Cerro Buenaplata, 31 Peñalosa, 32 Verónica, 33 Los Castillejos, 34 Cerro de la Atalaya, 35 Basurero, 36 Castillo de Baños de la Encina, 37 Cerro de las Obras, 38 La Majada, 39 Sevilleja, 40 Ctjo. Sancho, 41 Fuente Nueva, 42 Est. Espeluy, 43 Guadiel Norte, 44 El Castillo, 45 Torrecillas, 46 Cerro Castellones, 47 Cerro Pelao, 48 Cerro del Cura, 49 Giribaile, 50 Piélago, 51 Atalayuela, 52 Cerro de las Casas, 53 Castro Magdalena, 54 Morquigüelo, 55 Piedras Bermejas, 56 Cerro Burraca, 57 Ctjo. Salcedo, 58 Cerro Barragán, 59 Casa Vieja Valquemado (map by M. I. Roger and L. Arboledas).

oxides (cuprite, azurite, malachite, *etc.*), and polymetallic ores were exploited, as well as some native silver, which were present in the upper levels of the mineral seams. This is the case of the Peñalosa (Baños de la Encina, Jaén) site, in which compositional analysis indicates the use of minerals from two polymetallic mine groups: one with cupriferous ores, copper being the dominant metal (José Palacios and Salas de Galiarda mines), and another with lead-cupriferous ores (Polígono mine) (*Moreno* et al. *2010; Moreno, Contreras 2010.60*).

The main problem in studying prehistoric mining operations lies in identifying them, as in most cases, subsequent workings, especially in the industrial era, have obscured, altered or destroyed the earlier remains. This being said, during the last fieldwork season carried out in the eastern Sierra Morena, we were able to identify the remains of 21 mines, most of which were unknown until now. Material culture, mainly stone tools and pottery from Late Prehistory, was documented (Tab. 1; Fig. 1) (*Arboledas* et al. *2017.52–53*).

As mentioned above, the documented mining tended to work veins with cupriferous mineralizations found in granite outcrops situated to the north-west of Baños de la Encina, Linares and Sierra de Andújar. More specifically, two mines were found in the Rumblar Valley, one in Linares, while the other 18 were distributed along the valleys of the Jándula and Yeguas rivers (Andújar). The mines were open cast, mainly in the form of trenches and shallow galleries, exploiting surface outcrops rich in oxide and carbonated copper minerals, with an almost certain presence of some native copper. Prehistoric miners would have been able to recognize easily the veins on the surface thanks to the white colour of the quartzite outcrops, with streaks of minerals such as azurite (blue), malachite (green) or copper

in them. On some of the trench walls, it is still possible to see the remains of cupriferous mineralizations, mainly malachite (*Arboledas* et al. *2017.52*).

This type of open-cast work leaves irregular traces and variable spaces as a result of the exploitation of the richest parts of the veins. These are typical traces of the systematic, small-scale 'pillage mining' carried out in antiquity, even in the contemporary epoch. The morphology and dimensions of the trenches depend on the direction and thickness of the mineralizations, the location of the mineral, its thickness and other physical and geological conditions. Consequently, trenches longer than 50m and with widths of up to 6m have been found at the Polígono, Los Candalares and Navalasno mines, as well as smaller mines measuring approximately 10m long, 3.5m wide and 10m deep, such as those documented at the José Martín Palacios mine (Figs. 2 and 3) (*Arboledas* et al. *2017.53*).

Each one of the 21 mines documented in this region are composed, on the one side, by what remains of the open-air working activity and, on the other, by

Fig. 2. Trench at the prehistoric mine of Las Minetas (Lugar Nuevo, Andújar) (photo: L. Arboledas and Peñalosa Project).

appended slag dumps that may be very integrated into the landscape or, on the contrary, could be considerably altered because of exploitation dating to the Industrial Epoch. Both inside and outside the mine, material culture corresponding to the different phases of exploitation of these mines has been identified. But, above all, numerous stone tools used to extract and grind the minerals were found. They are mainly ophite and diorite mallets and hammers, some stone bowls, polished adzes, hand-mills and mills (Fig. 4). The hammer-mallets found complete or almost complete had grooves in their middle for handles. The differences in morphology and weight are important with regard to functional interpretations. Hammers of average weight (0.8 to 5kg max.) were used for both direct and indirect percussion. Their typology is similar to mining hammers found at other mines, such as those in south-western Iberian Peninsula (*Hunt 2003; Blanco, Rothenberg 1981*) and the area of Asturias-León (*Blas-Cortina 2007–2008*). The large hammers (over 5kg) are thought to have been used in slinging structures placed directly in front of the rock (*Blas-Cortina 2007–2008; Pickin, Timberlake 1988.Fig. 2a*). These large hammers could also have been employed to extract mineral with the help of some kind of leverage system similar to a shadoof used to obtain water from wells (Fig. 4.1) (*Arboledas* et al. *2017.54*).

A first petrographic analysis of the objects confirms that most of the tools were made of intrusive igneous rocks with a very hard ophitic composition. The tools have naturally smooth surfaces, common in typical boulder-type supports. This means that the raw materials used to produce these artefacts must have come from secondary deposits, not from primary outcrops. Many ophite stones can be found in the streambeds (the Yeguas or Cabrera rivers) near the mines, evidencing clearly which areas were used to obtain these raw materials. The identification of a hammer with a groove among other stones in the bed of the Cabrera River (Andújar) during a survey of the Jandula Valley could confirm that nearby riverbeds were the provenance of these tools (Fig. 4.3).

The tools used to prise out the minerals were probably made of bone or deer antler and wood, although no remains of such tools have been found or evidenced in mines in south-east Iberia. However, we do have evidence of the use of fire to facilitate the extraction of mineral from seams, a practice that is well established in other sites in Europe, such as in the mines at Copa Hill and Cwmystwyth in Wales

Fig. 3. Trench 1 of the José Martin Palacios mine (Baños de la Encina) after its excavation (photo: L. Arboledas and Peñalosa Project).

(*Timberlake 2003*) or Pioch Farrus IV in Cabrières, France (*Castaing* et al. *2005*). The first evidence found in south-east Iberia is at the mine at José Martín Palacios (Baños de la Encina). A blackish stain was found on the southern quartzite wall of Trench 1, as a result of the method of heating the rock with fire in order to extract the mineral (*Arboledas* et al. *2015.150*). The second evidence is indirect, and comes from the Polígono mine (*Arboledas, Contreras 2010*). In the Argaric settlement of Peñalosa, mineral fragments from that mine have been identified that showed abundant fissures in which bubbles could be observed. These features are evidence that the mineral was exposed to relatively high temperatures without making the ore melt (*Moreno* et al. *2010.309–310*).

In short, the prehistoric mining found in this region is characterized by the exploitation of open-air mines (trenches and open-pit) that do not require large-scale infrastructure. On the contrary, underground mining needs more means such as lighting, wells and access galleries, among others. This exploitation system, as well as some of the techniques employed, *e.g.*, the use of fire, have survived throughout ancient times until the 20th century, due to its simplicity and profitability.

Current issues in dating prehistoric mines

The aforementioned twenty-one mines are considered to date from Late Prehistory due to several archaeological indicators: the typology of the mining work, the technology used for mine exploitation, the link between the mining and nearby prehistoric settlements, and, above all, the material culture found in the dumps and trenches. The most significant elements are lithic artefacts, mainly mining hammers, as well as various pottery objects. The identification of only one of these factors cannot be ascribed *per se* to a certain period, but the combination of different aspects and data, such as excavation or isotopic analysis, can help in the chrono-cultural identification of mining-metallurgical activities.

Most of the evidence we have so far identified allows us merely to ascribe these exploitations to Late Prehistory (Copper and Bronze Ages) or the Iron Age. For example, stone tools, especially hammers, are the main dating element documented in mines. However, these hammers offer only general information about these contexts, as they could be found in different mining archaeological records throughout the Iberian Peninsula and Europe, and can be traced from the Copper Age to the Late Bronze Age (*Ambert* et al. *2009; Blas-Cortina* et al. *2013; Blanco, Rothenberg 1981. lam. 30; Timberlake 1990*). Variations in their typology cannot normally be used as chronological identifiers (*Hunt 2003*).

Characteristic Argaric pottery, fragments of deep crucibles and immature slag with the same characteristics as those documented at different Argaric settlements in this region have been found at four mines (Candalares, Arroyo la Grieta, Peñón del Águila and José Martín Palacios). They are indisputable indications that these mines were at some point exploited during the Argaric Bronze Age. Other indicative elements are the flint flakes found in Trench 5 at José Martín Palacios and another found in a small dump at the Polígono mine (Fig. 5). These flint flakes can be linked to a Copper Age and/or Early Bronze Age mining phase (*Arboledas* et al. *2015; Arboledas, Contreras 2010*).

In two of the twenty-one cases, the José Martín Palacios and Polígono mines, Bronze Age exploitation is clearly identified thanks to indirect information from lead isotope analyses. The correspondence of the isotopic fields of these two mines with miner-

als and the two copper ingots found at Peñalosa confirms that both were worked during the Bronze Age. Aside from this fact, analyses have also shown that there was at least one other mine supplying raw material to this settlement (*Hunt* et al. *2011.198–201*).

The only radiocarbon dates for prehistoric mining in the south-east are those obtained from the Cerro Minado (Huercal-Overa) and José Martín Palacios mines (Baños de la Encina) (Tab. 2). In the first case, the mining was dated to the late Copper Age (*Delgado* et al. *2014.30*). In the second, we have three different, although not contradictory, dates. They confirm the results of the fieldwork and lead isotope analyses, showing that mining took place both during the Bronze Age and subsequently. The first evidence of mining at this site, or at least the first that could be identified in Trench 1, dates from the Early Bronze Age (CNA-1004). This date was obtained from a carbonized sample found in the first and deepest stratum, which corresponds with the gangue dump generated during the mining, and which was associated with Bronze Age pottery. The chronology given by the other two charcoal samples date respectively two fill layers corresponding to the interior of Trenches 1 and 2 once mining activities were no longer in operation. Although, these dates are an indication that this mine could have been frequented and exploited during the Protohistory (*Arboledas* et al. *2015*).

To summarize, of the 21 mines identified as prehistoric, two of them, José Martín Palacios and Polígono, present a clear Bronze Age exploitation phase. Another three mines have been dated to the Bronze Age from the Argaric material culture identified at them. The remainder have been classified as mines exploited during Late Prehistory. The existence of a large number of metallurgical settlements in the Bronze Age leads us to believe that the mines were being worked during this period, although we are still not able to specify their exact chronology. The Iberian Peninsula has other examples of pre-Iron Age mines. Most of them are in the Asturias and León regions, and include mines such as El Aramo and El Milagro (Asturias) and La Profunda (León) (*Blas-Cortina 2007–2008; Blas-Cortina* et al. *2013*). We can also add the mines of Moçissos in Portugal (*Hanning* et al. *2010.289*), those of the south-western Iberian Peninsula (*Hunt 2003*) and Sa Mitja Lluna on Illa de Colom (Menorca) (*Hunt* et al. *2014*). Outside of the Peninsula, we could highlight, among many others, the prehistoric mining exploitations of Cabrières (*Ambert* et al. *2009*) or Ross Island (*O'Brien 2004*).

The control and exploitation of a mining territory: metallurgical villages and working areas or mining camps?

The exploitation of mineral resources in the eastern Sierra Morena Mountains directly and indirectly affected both the landscape and the settlement pattern of this area. The first significant evidence of occupation of this region dates to the Chalcolithic, with settlements such as Siete Piedras and Cerro del Tambor (Baños de la Encina, Jaén). They were probably linked to the exploitation of the nearby copper mines at Salas de Galiarda and Polígono, respectively. It was during this period that the mines began to be worked, as attested at Polígono mine (*Arboledas, Contreras 2010*).

However, it is in the Bronze Age that we see a genuine 'colonization' of the eastern valleys of the Sier-

Laboratory code	Mine	Material	Context	Conventional date BP	±	$\delta^{13}C$ (‰)	Date calibrated (1 σ) (68 % probability)	Date calibrated (2 σ) (95 % probability)
CNA-1004	José Martín Palacios	Rosacea coal	UEN 6, layer lower of the slag heap, Trench 1-Sector 1	3726	31	–16.74	2196–2029 cal BC	2205–2030 cal BC
CNA-1017	José Martín Palacios	Rosacea coal	UEN 12, inside Trench 1-Sector 1	2359	41	–21,29	488–389 cal BC	730–691 cal BC 659–651 cal BC 543–366 cal BC
CNA-4006	José Martín Palacios	Rosacea coal	UEN 6, superficial level Trench 2-Sector 4	2695	32	–18,85	894–810 cal BC	903–805 cal BC
MAMS-18508	Cerro Minado	Coal *Pistacia sp.*	North slag heap	3905	21		2466–2347 cal BC	

Tab. 2. ^{14}C dates from prehistoric mines in the south-eastern Iberian Peninsula (*Arboledas *et al.* 2015; Delgado *et al.* 2014*).

ra Morena, with the founding *ex novo* of medium-sized settlements (< 1ha) such as Peñalosa in Baños de la Encina, Cerro Pelado in Linares and Las Cabrerizas in Marmolejo. These settlements occupied strategic positions with extensive territorial control of the mineral valleys, and they all have remains attesting copper-based metallurgical activity. Near these settlements, there is a series of small forts (*e.g.*, Piedras Bermejas) with a dual function: to enhance the interconnection between settlements and to provide greater control of the natural passes between the Guadalquivir Valley and the inner valleys of the eastern Sierra Morena Mountains. During this period, these societies evolved towards a more stratified model, with stronger political control (*Lull 1983; Chapman 2008*). It has been proposed that the reason for this 'colonization' was the presence and exploitation of the copper and silver mineral resources, which were redirected towards the large political centres in the Guadalquivir and Guadalimar valleys (Baeza and Úbeda) (*Lull 1983; Contreras 2000; Contreras, Cámara 2002*).

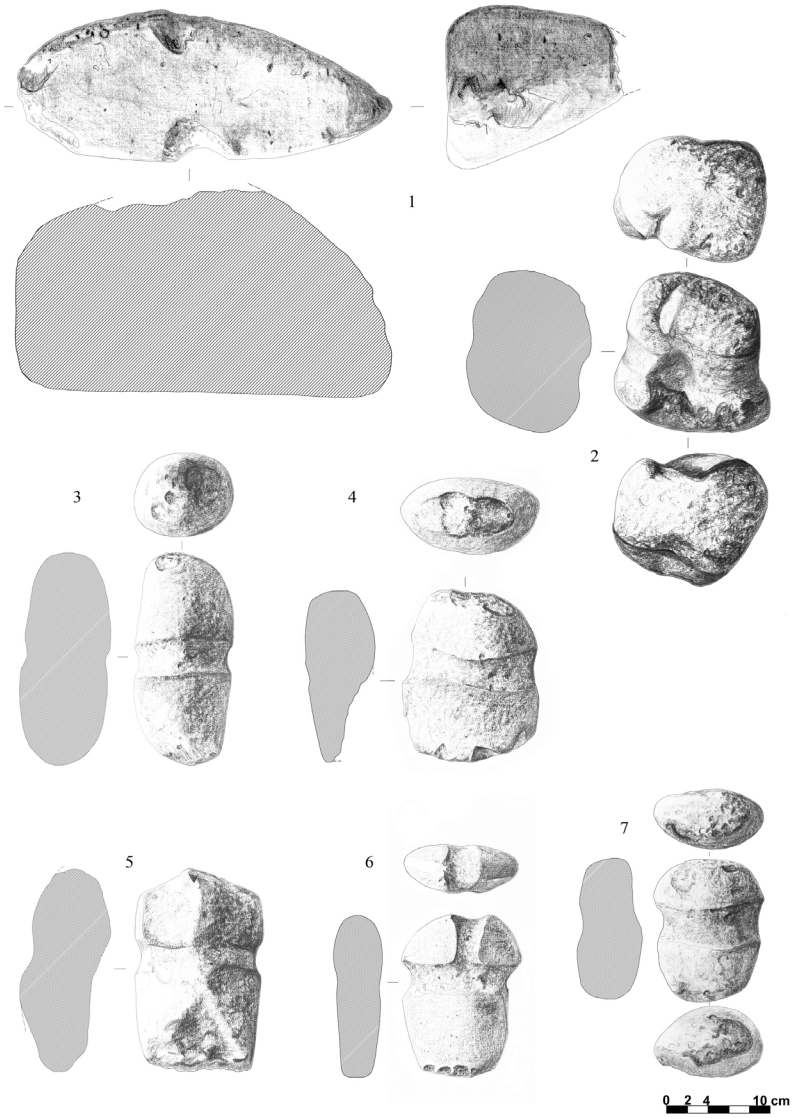

Fig. 4. Mining hammers with central grooves from the prehistoric mines of eastern Sierra Morena: 1 El Polígono, 2 José Martin Palacios, 3 Río Yeguas, 4 and 6 Los Candalares, 5 Arroyo de la Grieta, 7 Polígono (elaborated by Luis Arboledas.)

This intensive occupation appears to be linked to an expansion of mining, which is documented at the Polígono and José Martín Palacios mines, and, therefore, to an increase in metal production. Copper mining and production appears to have been the basis of the distribution and correlation of settlements, which evidence a hierarchical organization (*Contreras, Cámara 2002*). Although the location of settlements does not appear to be directly linked to the spatial distribution of the mines or their exploitation, as has been confirmed in the Rumblar Valley, they do seem to be related to the territorial control of natural passes and to the processing, production and distribution of metal (*Jaramillo 2005. 474*).

The entire production process of copper-based metallurgy, from the extraction of the mineral to the creation of the final metal item (objects and ingots) has been documented archaeologically in excavations of Argaric settlements at Peñalosa and Castillo de Baños de la Encina, both in the Rumblar Valley. Material remains of metallurgy (mineral, slag, crucibles, *etc.*) have also been found in the majority of the Argaric settlements located in this valley (*Contreras 2000*). Vestiges of metallurgical production have been documented in most of the domestic units (slag, minerals, crucible-furnaces, melting pots, *etc.*). They are in roofless areas, co-existing and sharing space with other productive activities, such as the storage of grain and other foodstuffs, food preparation and consumption, spinning and weaving, pottery making, the manufacture of cork, wood and bone objects, *etc*. (*Alarcón 2010*). However, in the

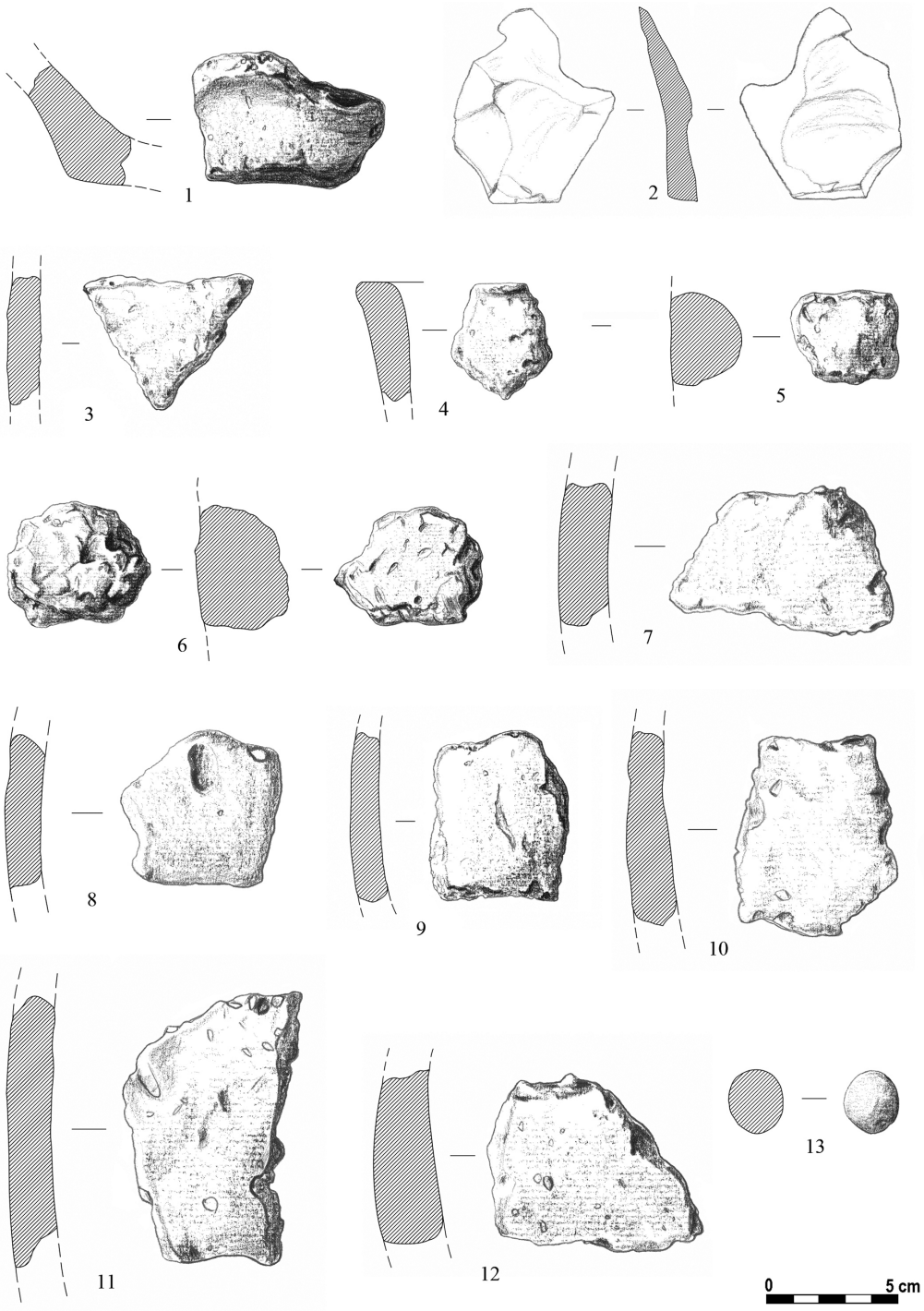

Fig. 5. Bronze Age material culture from the mines and working areas documented in eastern Sierra Morena Mountains: 1, 3-5, 9 Argaric ceramic, 2 flint shards, 6 technical ceramic, 13 clay ball, José Martín Palacios mine; 10-12 Bronze Age ceramics, Peñón del Águila; 8 Bronze Age ceramics, Candalares (elaborated by L. Arboledas).

most recent excavation campaigns at Peñalosa, a metallurgical waste dump was found outside the walled precinct. This is the first late-prehistoric site with such evidence, and it indicates the importance of metallurgy in daily life, as well as the presence of different phases of the metallurgical process beyond the residential areas of the site (*Contreras* et al. *2014*).

Recent excavations at the José Martin Palacios mine and the archaeo-mining survey of the Sierra de Andújar Mountains have contributed important data regarding the existence of possible working areas near the mines, with evidence of metallurgical activities. This is the case of Candalares, Revuelta de los Molinicos and Arroyo de la Grieta, in the Upper Yeguas

River basin. Judging from the size of these new sites, they do not seem to be settlements such as those documented in other areas of the Jándula or Rumblar Valleys, but rather small, multifunctional workshops, where the main activity would have been mineral extraction and processing. The identification of immature slag, hand-mills and grooved hammers at two of these sites indicates that such specialised activities were carried out adjacent to the mines (*Arboledas* et al. *2017*). Parallels to this kind of site have been identified at Loma de Tejerías (Albarracín) (*Montero, Rodríguez 2008*) and Les Campa de Mines (Sierra del Aramo) (*Blas-Cortina* et al. *2013*).

Two fragments of technical vessels have been documented at the Jose Palacios mine, one of which (Archaeological Survey 2) (Fig. 5.6), with an adhered slag layer, was found in the oldest stratigraphic level next to several fragments of Argaric pottery. This level could have been associated with a multifunctional area in which the miners from nearby Argaric settlements would have undertaken various daily activities alongside major mining and metallurgical tasks. On a structural level, this case is very different from previous examples, as no structures that would differentiate one space from another have been identified. Therefore, it seems we are dealing with different situations, or at least with other ways of organizing work and space, perhaps due to the large number of metallurgical settlements in the Rumblar Valley (*Arboledas* et al. *2015.155–156*).

This is the first evidence of metallurgical working spaces at prehistoric mines in the south-eastern Iberian Peninsula; activities which, based on our current knowledge of the subject, must have been completed with the different metallurgical phases are documented at settlements such as Peñalosa (*Moreno, Contreras 2010*). To explain the presence of slag fragments and crucible-furnaces, we offer two possible hypotheses, having previously taken into account, on the one hand, that only a small area was excavated at the José Palacios mine and, on the other, that the remaining data come from archaeological surveys. The first hypothesis is that these objects could be related to trial smelting to ascertain the quality of the mineral, and the second could be related to minor but frequent metallurgical activity carried out at the mine, especially in the case of the Candalares mine. In any case, the practice of metallurgical activities, as well as the existence of working areas near the mines, would have depended on certain factors, such as the mines' location and their proximity to a settlement (*Arboledas* et al. *2017*).

Other evidence of metallurgical activity in the Late Prehistory of the Iberian Peninsula has been identified at the Moçissos mine (Portugal) (*Hanning* et al. *2010.289*) and the aforementioned camps of Les Campa de Mines in the Sierra del Aramo (Riosa, Asturias) (*Blas* et al. *2013*) and Loma de la Tejerías in Albarracín (*Montero, Rodríguez 2008.163*). In the latter two cases, the mines are located in isolated areas atop high mountains, far from the region's main settlements. This fact explains why camps were set up near the mines, especially in the case of Les Campa de Mines, which is more than 2000m a.s.l. The mineral would have been processed at these camps, as proven by the existence of metallurgical remains, with the aim of obtaining the metal in situ to make it easier to transport to the settlements.

The settlement patterns in the regions where the aforementioned camps were located are very different from those documented in the mining valleys of the eastern Sierra Morena Mountains. For example, in the Rumblar Valley, a large number of Argaric settlements are located near mines (> 3km). This would have made seasonal mining camps unnecessary, as a person would have been able travel to and from the mine in less than a day. Nevertheless, this does not rule out the possibility that at certain times people could have stayed at the mine for a few days, which would explain the domestic archaeological remains found at the José Palacios mine (Baños de la Encina). On the other hand, in the Sierra de Andújar (Jándula and Yeguas valleys), the mines are in isolated areas, long distances from the Bronze Age settlements located to date, which could explain the presence of these camps or workshops (*Arboledas* et al. *2017*).

The scale of metal production and its distribution

The excavation of the metallurgical site of Peñalosa has so far yielded more than 20kg of slag and 95kg of metallurgical pottery. This volume exceeds the total metallurgical evidence found at all the other Late Prehistoric sites on the Iberian Peninsula. This data, added to the twenty-one newly identified prehistoric mines and about twenty settlements with metallurgical remains, clearly reflects the high volume of production at this site in particular and in the whole of the eastern Sierra Morena Mountains in general. This scale of production would have exceeded the demand from this region, and implies the exchange/distribution of metal on a supra-regional scale. All this evidence, as well as the presence of

ingots, an indication of the amassing of metal for storage and trade, justifies the definition of this site as a metallurgical settlement that specialised in copper production (*Moreno, Contreras 2010.56–58; Moreno* et al. *2017*).

Lead isotope analyses have proven to be the best technique for identifying or ruling out areas supplying and distributing minerals. In the South-East, more than a hundred lead isotope analyses of minerals, metallurgical elements and copper and silver objects belonging to both prehistoric mines and settlements dated to the Bronze Age (Argaric Culture) have been published to date (*Stos-Gale 2001; OXALID; Hunt* et al. *2011; Bartelheim* et al. *2012.Tab. 6; Murillo, Montero 2014; Murillo* et al. *2015*). For the Upper Guadalquivir, 34 analyses have been carried out so far, with samples from the settlement of Peñalosa (21), the José Martín Palacios mine (7) and the Polígono mine (6). The results of all these analyses suggest that, for the most part, the samples from Peñalosa are isotopically consistent with the Polígono (10 samples) and José Palacios mines' (2 samples) fields. However, some of the Peñalosa samples come from a different mine that has yet to be isotopically characterized (*Hunt* et al. *2011.197–201*).

For the remainder of the Iberian south-east, we have a total of 79 analyses of copper and silver objects from various Argaric sites (Bronze Age), most of them from funerary contexts. To date, 53 analyses of copper objects from the sites of El Argar, Fuente Álamo and Gatas in Almería, La Bastida, Cabezo Negro, Monteagudo and Rincón de Almendricos in Murcia, and Cuesta del Negro, Cerro de la Encina and Cerro de San Cristóbal in Granada have been published (*Stos-Gale 2001; Stos-Gale* et al. *1999; OXALID; Murillo* et al. *2015*). The number of analyses of silver objects is considerably lower. Only 26 objects have been analysed thus far from the sites of Cerro de la Encina (8 objects), Cuesta del Negro (5), Cerro de la Virgen (2), Terrera del Reloj (1) and Pantano de los Bermejales (1) in Granada, Peñalosa (8) in Jaén, San Antón (1) in Alicante, La Bastida (1) in Murcia and El Oficio (1) in Almería (*Bartelheim* et al. *2012.298–302, Tab. 6; Murillo 2013; Murillo, Montero 2014.214*).

The results of the analyses of the copper objects from settlements in the South-East present a wide diversity of isotopic ratios in the metals. This indicates various origins, meaning that several copper mines were being worked. It has not been possible to determine the probable origin of more than half of the existing samples. This can be explained by the large number of small exploitations in the mining areas of Jaén, Granada and Almería that have not yet been defined. At present, the possible origin of only 32% of the samples (17 of the 53 analysed samples) has been determined (Tab. 3; Fig. 6). Eight objects show isotopic consistency with the Linares area and, more specifically, the Fuente Álamo dagger (FA1477-1) came from the Polígono mine; four objects came from the Los Pedroches mining district, two are connected to the Alcudia Valley, one with a mine in Alcolea, another with the district of Cartagena-Mazarrón, and the last with the mines of Santomera and Sierra de Cabrera (*Montero, Murillo 2010. 44–46; Murillo* et al. *2015.152–154, Fig. 11*).

The isotopes show the wide diversity and dispersion of copper mineral sources. This fact rules out the hypothesis of a single large metal production centre (the Upper Guadalquivir) for the whole south-east of the Iberian Peninsula during the Argaric period. We actually have a much more complex picture in which other unidentified exploitations could have played an important role. However, it is very significant that from the high percentage of samples with a confirmed origin (17 of the analysed samples), eight of them (46%) come from Linares. If the known evidence from the Valle de Alcudia and Los Pedroches is added, it becomes clear that copper from the central and eastern Sierra Morena, with 82.35% of the total, played a major role in the metallurgical

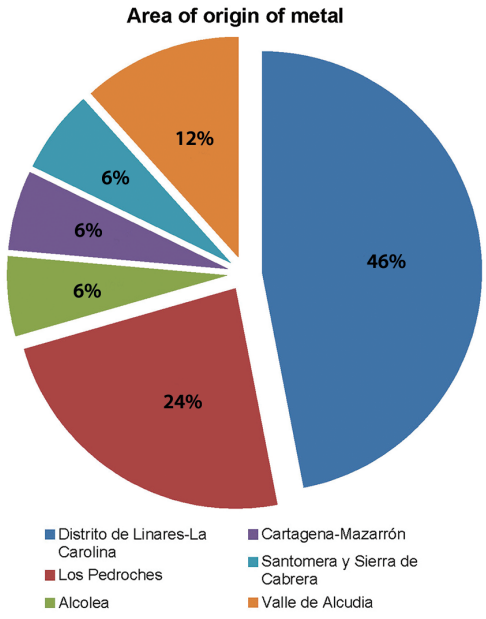

Fig. 6. Graph with percentages of each mining area with clear links to LIA analysis of objects from the Argaric sites of the South-East (elaborated by L. Arboledas).

production of the south-east (Fig. 6). Thus, the analyses so far show that the Sierra Morena Mountains was the main production centre for the south-eastern Iberian Peninsula. This does not, however, rule out other sources, as can be seen from the isotopic results.

The development of silver metallurgy is one of the most characteristic innovations of Argaric society, when compared to previous periods. During this time, a large increase in the number of silver objects is documented (700 objects), which contrasts sharply with the rest of Europe during the second millennium BC and the Copper Age. Ornaments are the most common silver items, along with rivets used for swords, halberds and knives. Composition analyses of silver objects from several Argaric sites have proved the use of native silver rather than the cupellation technique used for lead sulfurs (*Bartelheim* et al. *2012; Murillo, Montero 2014*).

Traditionally, it was thought that native silver came from three of the most important silver mines on the Iberian Peninsula: Herrerías (Almería), El Horcajo (Alcudia Valley) and Hiendelaencina (Guadalajara). However, lead isotope analyses of 26 silver objects from Argaric sites in the South-East show a different story: Bronze Age silver objects are isotopically remote from the south-eastern area and have more in common with the isotopic fields of Linares and the Alcudia Valley (El Horcajo). Native silver was traditionally obtained in both these geologically related areas, although in larger amounts from the Alcudia Valley than from Linares. The analyses also show that silver from mines in Almería and Cartagena would not have been used to manufacture artefacts found in Jaén and Granada. This seems logical, because of the mines' distance from those sites (*Bartelheim* et al. *2012.303–305*). Less logical is the fact that silver from the Spanish Levant was not used even in the settlements of La Bastida (Murcia) and San Anton (Alicante). The only sample that bears a similarity to the isotopic area of the South-East is a ring from El Oficio (*Murillo, Montero 2014.165*).

These results show a similar panorama to the case of copper analyses, thus strengthening the idea that the central and eastern Sierra Morena would have been the main producer of copper and silver metals. In the case of silver, the analyses of sites in Jaén and Granada so far indicate that all the objects came from this region. However, more silver samples, particularly from the provinces of Murcia and Almería, need to be analysed to complete this panorama.

Concluding remarks

Our research in the Sierra Morena Mountains area is giving us new insights into the subject, and is allowing us to obtain a better image of the role of metallurgical production in the development of the prehistoric communities of the south-eastern Iberian Peninsula.

Thanks to the field and lab work of recent years, we have been able to identify and analyse 21 mines and date them to Late Prehistory (mainly the Bronze Age), thanks to the identification of the material cul-

Site	ID	Object	Context	Metal	Area of origin of metal
Cerro de la Encina	MO 39258	Bracelet	Grave 21	Cu	Linares
Cerro de la Encina	MO 39279	Bracelet	Grave 21	CuAs	Linares
Cerro San Cristóbal	OSC 7002	Bracelet	Grave 12	CuAs	Linares
Fuente Álamo	FA 15/1477-1	Dagger	Grave 58	Cu	Linares
Fuente Álamo	FA 12ž1494/6	Dagger	Grave 54	Cu	Linares
Gatas				Cu	Linares
Gatas				Cu	Linares
Cabezo Negro				Cu	Linares
Cerro de la Encina	MO 39264	Dagger	Grave 21	CuAgSn	Los Pedroches
Cerro de la Encina	MO 39257	Awl	Grave 21	CuAs	Los Pedroches
Cerro de la Encina	MO 39261	Bracelet	Grave 21	CuAs	Los Pedroches
Cerro San Cristóbal	OSC 15014	Dagger	Grave 12	CuAs	Los Pedroches
Cerro de la Encina	MO 39255	Bracelet	Grave 21	CuSn	Alcolea
Gatas	G 26	Awl	G89-2B-14A1-Cd5 (M2)	Cu	Cartagena-Mazarrón
Cerro de la Encina	MO 39281	Knife	Grave 21	Cu?	Santomera y Sierra de Cabrera
Cerro de la Encina	MO 55195	Axe	Grave 18	CuAs	Alcudia Valley
Fuente Álamo	FA 600/ 5+33029	Dagger	Grave 52	Cu	Alcudia Valley

Tab. 3. List of objects found at Argaric sites and their possible area of origin (based on* Montero, Murillo 2010.44–46; Murillo *et al.* 2015; OXALID*).

ture and lead isotope and ^{14}C analyses. This is the largest known group of mines in south-eastern Iberia; in quantitative terms, its only peers elsewhere in Iberia are the major mining areas of Asturias and León (Sierra del Aramo, La Profunda, *etc*.), and in typological terms, those to be found in the province of Huelva.

The mining of copper and silver resources and their processing appears to have been a key factor in the intensive occupation and control of this region during the Early Bronze Age, when the number of settlements increased compared to the previous period. They were medium-sized settlements such as Peñalosa, La Verónica and Las Cabrerizas, of which the whole process of transforming mineral into metal has been archaeologically documented. Their locations would have been linked to territorial control, the processing and distribution of the metal, and the spatial distribution and exploitation of the mines.

One of the most important facts is the evidence of metallurgical tasks being carried out adjacent to the mines in three different cases, being the first time that this feature has been identified in southern Iberia. The purpose of these sites has been explained as metallurgical trials or occasional smelting. In some cases, such as Candalares or Arroyo La Grieta, this may have been common practice. If so, the purpose would have been to make the metal easier to transport to settlements located farther from the Jándula Valley. In any case, this is very new information that questions the existing idea that all metallurgical processes were carried out within settlements. Future fieldwork will have to focus on defining both the internal structure of these working areas and their role in the structuring and exploitation of these mining territories.

Lead isotope analyses of copper and silver objects show that metal from the eastern Sierra Morena Mountains was distributed throughout the entire south-east of the Iberian Peninsula. We need to continue carrying out isotope analyses and include other areas from the south and centre of the Peninsula to see whether the distribution also extended beyond the Argaric territories. Copper objects originating from the same mineral source are found at different sites located far away from each another. The mines of the central and eastern Sierra Morena Mountains stand out, as they are the most frequent source in the analysed samples, with the Linares-La Carolina mining district being the main producer of copper and silver for the entire south-eastern Peninsula.

Thus, the archaeological record (mines and settlements with metallurgy remains) shows a certain specialisation in metal production in the settlements of those valleys of the eastern Sierra Morena Mountains, although we cannot speak of full-time specialisation on the part of the inhabitants of settlements such as Peñalosa, as metal production did not take place in specific areas, but in dwellings, alongside other productive activities (textile making, food preparation, *etc.*). These sites would have produced more metal than they needed for their own use, and the surplus would have been traded for finished items and ingots, as shown by the lead isotope analyses. All this justifies considering the Alto Guadalquivir region as an area specialising in copper and silver production within the territory of Argaric culture (*Contreras, Cámara 2003; Moreno, Contreras 2010*).

Control over metal production and distribution was probably in the hands of elites, and could have been a fundamental factor, although not the only one, in the accentuation of social asymmetry seen in the so-called Alto Guadalquivir Argaric group. The increase in production would not only have been linked to the need for ornamental artefacts and 'arms' as a means of accumulating and displaying wealth and power (plus their use in coercive activities), but also for other items linked to productive activities that until then had been manufactured with other materials.

In conclusion, both the archaeological data and the archaeometric analyses presented in this article show the importance of the Sierra Morena Mountains as the main focal point for copper and silver production in south-eastern Iberia during Late Prehistory, especially in the Argaric Bronze Age. Nonetheless, we must point out that it would not have been the only production centre, although it was clearly the most important. Lead isotope analyses have also determined the existence of other mining areas in the south-east that provided material to various Argaric settlements. These have yet to be identified. Therefore, the hypotheses regarding Argaric metallurgy proposed by the two main lines of interpretation need to be revisited, as the archaeological and analytical data present a much more complex picture than was originally thought. Within this new framework, it seems that large, highly specialised production centres, such as those in the Sierra Morena Mountains, would have coexisted with other mining areas.

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Hillforts, rocks and warriors: breaking boundaries with the past, building boundaries with the present

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ABSTRACT – *During the Late Iron Age, monumental stone statues of warriors were established in the northwest of Iberia, 'arming' landscapes, which ultimately encouraged specific types of semiotic ideologies in the region. This paper deals with how these statues on rocks not only worked in the production of liminality in the landscape – creating transitional zones on it – but also how they functioned as liminal gateways to the past, absorbing ideas from the Bronze Age visual culture up to that of the Late Iron Age in order to create emotional responses to a new socio-political context.*

KEY WORDS – *liminality; performativity; iconography; Late Iron Age; north-western Iberia*

Gradišča, kamni in vojščaki: podreti meje s preteklostjo, postaviti meje s sedanjostjo

IZVLEČEK – *V času mlajše železne dobe so na območju severozahodnega Iberskega polotoka začeli postavljati monumentalne kamnite kipe vojščakov, ki so 'oborožili' pokrajino in nazadnje tudi spodbudili poseben tip semiotskih ideologij v regiji. V članku razpravljam, kako so ti kipi v pokrajini delovali ne le kot produkti liminalnosti – z ustvarjanjem prehodnih območij – ampak so delovali tudi kot liminalni vhod v preteklost, tako da so sprejeli ideje iz vizualne kulture od bronaste dobe do mlajše železne dobe in s tem izzvali čustvene odzive na nove družbeno-politične kontekste.*

KLJUČNE BESEDE – *liminalnost; performativnost; ikonografija; mlajša železna doba; severozahodni Iberski polotok*

Introduction

The communities of north-western Iberia underwent critical changes in their socio-material structure during the second and first centuries BC. Subsequently, a much more hierarchical and complex social system was adopted there. A crucial factor in this transformation was the presence of Rome in the region through its commercial, exploratory and military activity. Maritime trade – inherited from Phoenician routes in the Atlantic – encouraged social and territorial differences through the asymmetrical access of the native people to Mediterranean commodities. Meanwhile, the growing pressure of the Roman army in the region from the second century BC, as well as the participation of people from the northwest in wars and military expeditions beyond its borders, entailed the definite transformation of the socio-political structure of the local communities.

The effects of trade and war stimulated, ultimately, the transformation of the Northwest within what can be defined as a 'tribal zone' (*González 2009*), that is, a peripheral and unstable area affected by the Roman state, but not under its political and administrative control (*Ferguson, Whitehead 1992*). Just as Ferguson and Whitehead have pointed out, in these contexts, the state used a combination of coercion (mi-

DOI: 10.4312/dp.45.12

litary threat) and enticement (opportunities to interact) to establish control over the local population. In north-western Iberia, this double interaction implied a rupture in 'ontological security' (*Giddens 1991*), provoking an escalation of competition in the form of intertribal conflict (*González-Ruibal 2006–2007*). Archaeological evidence shows that the expansion of Rome had irreversible effects on these local communities. Firstly, the population regrouped into large settlements (synoecism). The population not only increased, but also became socially more heterogeneous. Secondly, the monumentalisation of defensive enclosures (encastellation of the landscape). Hillforts became the visual references of a strongly defended landscape. And thirdly, armed groups appeared within communities (militarisation). Interaction with Rome stimulated the development of chiefdoms in the northwest, as was the case elsewhere where Rome was involved on the periphery of the Empire (*Mattingly 2002*).

A monumental art emerged in this context. Large warriors made of stone, which embodied the local elites of these chiefdoms, were placed in hillforts. They consist of groups of thirty-four outsized statues made of stone. Most are more than two metres high, in some cases reaching almost 4 metres. Therefore, they are truly monumental sculptures, without parallel in Iberia. They represent males with a short sword or dagger, a small round shield (*caetra*), torc, bracelets (*viriae*), decorated belt, and dress (Figs. 1–2). Their emergence was closely linked to the reconfiguration of the social and emotional space of the communities living in Late Iron Age hillforts. The aim of this paper is to argue that there is not simply an elite identity behind these visual images – which are traditionally said to be its results – but that this identity is performatively constituted by the very visual images working in a liminal context. To ensure this, attention will be paid, through socio-material and iconographic paraphernalia, to how the communities of these hillforts handled liminality to build evocative spaces that allowed them to manage their anxiety in the face of the changing situation.

Replacing emotions in the landscape

As stated by Clifford Geertz (*1973*), material activities such as icons and ritual were 'public images of sentiment' that structured and reflected the emotional experience of the people. A dialectical logic governed this interweaving: social relationships created material relations and vice versa. Emotions are at the centre of this dialectic. The physical, formal, aesthetic or semiotic characteristics of objects and material forms were active agents in the production of being-in-the-world of communities (*Damasio 2000; Gosden 2005; Fleisher, Norman 2016*). These characteristics can channel the intentions of individuals and affect others in a strategic manner (*Gell 1998*); they can be 'gateways' to the past (creating memories), 'bridges' that allowed the meeting of points in space (creating places), and they could filter and animate ideas or values on their own (cre-

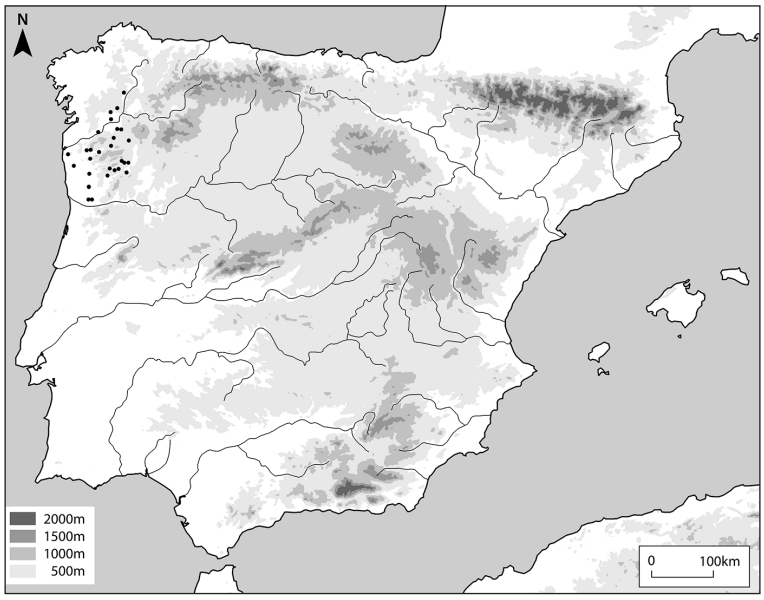

Fig. 1. Distribution map of warrior statues.

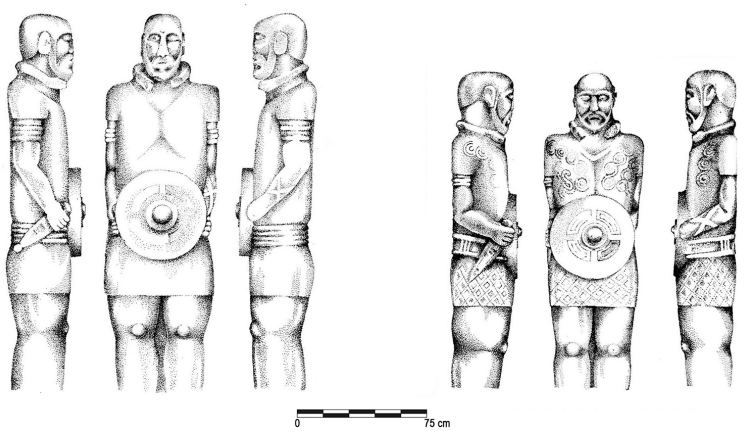

Fig. 2. Warrior statues from Lezenho, Vila Real, Portugal (modified after* Silva 1986*).

ating a kinetic moral) (*Latour 2005*). Agency is situated in the resources of time/space; agency is a being-in-the-world whose actions carry the past into the future (*Barrett 2000.61*).

The materiality generates links between individuals, communities, events and places, and works ultimately to create society. The capacity of the statues to become active participants in the world of the living is undeniable. More than simple representations of reality, they became social agents. They could be ascribed features and capacities that are usually considered characteristic only of human beings. For this reason, rather than being preoccupied with how this iconography reflects social constructions, our interest lies in trying to understand how they were involved in the construction of society. Their location in the landscape is the key in this regard. The warrior statues were located in relation to two topographical elements: the walls of hillforts and rocks. The double connection allows them to be linked with two types of liminality, respectively: one temporal, the other spatial. As a result, the iconography worked in the creation of what Oliver Harris (*2010*) has called 'emotional and mnemonic geographies' that orientated bodies, created memories and evoked feelings in the landscape. The emotional and moral power of this performance helped to build the sociability of individuals and local communities in the Late Iron Age. It has been many decades since Malinowski (*1948.90*) argued the psychotherapeutic quality of rites of passage. Such rituals give people social support in confronting the anxiety they may feel when facing new social changes. These affective capacities were the result of the overlapping of two scales of reality: the socio-political context in which they operated (macro-scale level) and the physical context in which they emerged (micro-scale level). In the first case, I am referring to a context that has been defined as a tribal zone, which characterises the region of north-western Iberia from the end of the second Iron Age; and in the second case, I am referring to the socio-materiality of the hillforts, walls and rocks.

Rocks: breaking boundaries with the past

Generally, statues do not autonomously transmit their meaning; nor are the places where they are displayed neutral settings. The relationships between the iconography and their socio-material surroundings play a key role in the creation of meaning. In this sense, the stone warriors were inextricably attached to the rocks – a feature characteristic of the landscape – as well as the architecture of the hillforts (Fig. 3). Here, diverse metaphoric and mnemonic processes highlight relationships and connections of different types, contributing to the formation of a tangible sensibility and morality in connection with liminal landscapes. Material signifiers, unlike other types of signifiers, typify or produce something by association or by sharing similar attributes (*Tilley 1999*). Physical attributes and uses of material culture do not fully delimit the symbolic dimension of material forms, although they do play a significant role in their sense and meaning. In this way, the set comprised of the rock and the warrior should work on two levels: the rock as the 'place' and the stone as 'material'. Both elements represent two key vectors in creating the meaning of this type of iconographic installation.

Ontological security is related to the distinction between space and place. Cartesian coordinates define space without having any real significance for the individual. However, a 'place' is made from 'living', and is an accumulation of feelings and emotions in which individuals develop a ritual routine and, ultimately, their ontological security (*Giddens 1991*). In this sense, the reconfiguration of this ontological security operated at a liminal level. At the end of the Iron Age, the rocks in question were powerful places of memory, functioning as gateways that connected local communities with the past, updating warlike ideologies in order to face the new situation of instability.

Fig. 3. Rocky landscape: hillfort of Saceda, Ourense, Spain.

The relevance of rocks in the prehistory of north-western Iberia is the key to understanding why they were

chose as the location for the warriors. Rocky ledges functioned as places for numinous, religious and ritual activity for communities during the Bronze Age (*Bradley 2000; 2002*). Rock engraving, as well as the deposition of arms and prestige items, were among the common socio-material practices that helped to monumentalise them. The meaning of the engraved rocks in prehistoric times has been interpreted by three basic proposals. The first hypothesis argues that the engraving of weapons played an important part in the construction of rocky ledges as places where rites of passage occurred. More specifically, the weapons depicted on the rocks would have been closely related to aggregation, the ritual gathering of warriors (*Vázquez 2000*). According to this hypothesis, they were a key space in the production and legitimisation of warriors. The second hypothesis considers these spaces as numinous places where local communities carried out rituals. The depositing of prestigious items in the rocks reflected the consolidation of elites, who made offerings to the gods to seek their support. As noted by Kristian Kristiansen (*2000.115*) for similar cases, such ceremonies could have been communal, but through offerings hidden in the rock, the leader would obtain a sacred position as a representative of the gods. Richard Bradley (*1998*; see also *Alves, Comendador 2009*) has proposed that the engravings of arms on the rock could also have functioned as metaphors for ritual deposits. Whatever the case, this line of interpretation has led to defining the role of the rocks as places of connection with the gods and the legitimacy of elites. Finally, the third hypothesis, perhaps the most traditional, considers the petroglyphs as mere territorial markers (*Bradley 1997*).

To move forward, two ideas must be assumed to provide the phenomenological framework. Firstly, in our view, the engravings and rocks had to work together both materially and conceptually: as pointed out above, the material environment cannot be considered as a simple backdrop that had no significant relationship with the weapons that are represented. Conversely, these monuments should be seen as 'armed' rocks rather than as engravings on the rocks (Fig. 4). Secondly, the 'armed' rocks do not merely have a communicative or representational logic in the landscape, but an enactive one. They were generators of thought and action during prehistory; they 'armed' landscapes. From the beginning of the Bronze Age, individuals were forced or encouraged by the 'armed' rocks to assume beliefs or moral visions related to weapons and the violence in which they were trapped. Or, they spread warrior morality and emotionality in the landscape of the Bronze Age and Iron Age.

Liminal entities are neither here nor there; they are betwixt and between the positions assigned and arrayed by custom and convention (*Turner 1969*). As such, during the Late Iron Age, rocks were to be conceived as an 'abode of the ancestors'. As sacred places, rocks served to generate worlds of difference, entered by the faithful to engage with the reality of a transcendent order. Sensations of transcendence may be encouraged through material forms that transcend 'ordinary human frames of reference in space and time', and material images that seem to derive from sacred domains (*Garwood 2011.275*). Thus, they would have functioned as a powerful locus for legitimation and empowerment, creating a physical and psychological connection between the present and the past. Taking into account the different interpretations stated above, it seems logical to think that the location of the stone warriors on the rocks at the end of the second Iron Age is associated with a retro-ideological meaning, a re-enactment of ancestral practices and legitimisation of the new elites.

The second factor mentioned earlier is related to the metaphoric value of stone as a substance, which adds depth to what has just been proposed. The appreciation of stone as a sensually potent material has re-

Fig. 4. 'Armed' rock from Agua da Laxe (Vincios, Spain) (photo by X. Pereira).

curred throughout history, as the anthropological literature confirms (*Hamilton* et al. *2011*). Due to characteristics such as hardness, resistance and perdurance, this material has usually been linked to the bodies of men, acting as a material metaphor of lineage and ancestry (*Parker Pearson, Ramilisonina 1998*). In the case of the stone warriors, the iconographic installation should have generated performative effects to give the impression that they were an inseparable part of the landscape. A double mechanism functions here. On the one hand, the location of the statue on the rocks produced an exceptionally powerful metaphoric setting, creating the impression that the warriors had sprouted from the rock itself (Fig. 5). On the other hand, the substance of the warrior came from the rocks, since the stone that created him was extracted from the rocky ledges of his own landscape; therefore, it could generate a strong phenomenological meaning: the body of the warrior for its substance, and liminal location as an intrinsic part of the immutable and timeless realm of the landscape (rocks) as opposed to other changing aspects. For the local community, this ensemble must have underlined a temporal depth in the landscape.

Walls/thresholds: making boundaries with the present

I would like to focus now on the other material setting with which the stone warriors are associated: the enclosures. A powerful connection between a number of elements is produced here: while walls created differentiated ontological spaces (exterior/interior), doorways were a sort of transitional space between both domains. As a result, within a regional context of instability and conflict, entrances become unstable places, perceived or experienced by the community as anxiety zones (*Alfayé, Rodríguez-Corral 2009*). Liminality is put into practice in this spatial environment through at least three types of socio-material strategies.

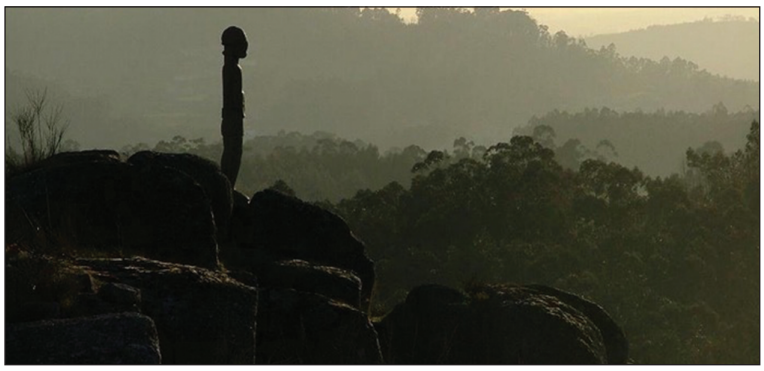

Fig. 5. Stone warrior on rocks (Sanfins, Portugal).

Monumentalization and prophylactic rituals

The first strategy is connected to the monumentalization and ritualisation of the material forms of the enclosures. At the end of the Iron Age, the dimensions of the settlements – in some cases, twenty times bigger than Early Iron Age hillforts – grew considerably as a consequence of population growth and processes of synoecism (*González-Ruibal 2006–2007*). From this moment on, their boundaries and thresholds were monumentalized, and life inside remained, more than ever, visually hidden and protected from the exterior world (Fig. 6). Taking into account that the hillfort was the only type of settlement in this region, it can be argued that its architecture encouraged a very specific type of panoptic topography that determines a particular experience in this landscape. Life now appears to exist within the walls, underlining the strong boundaries between the interior (the community) and the exterior (the other).

The rituals performed in the context of the borders and threshold are defined by two notions: protection and transfiguration. The frequent discoveries of deposits and material images on walls and entrances in prehistoric settlements (*Edmonds 1993; Gheorghiu 2003; Hingley 2006; Alfayé Villa 2007*) suggest that liminal architecture became spaces that needed prophylactic and foundational ritual practices (*González-Ruibal 2006–2007; Alfayé, Rodríguez-Corral 2009; Rodriguez-Corral 2009.178–180*). In the Northwest, along the same lines as the deposited metal objects found immediately next to the walls in forts such as Saceda (*González-Ruibal 2005*), their purpose may have been as supernatural protection of the walls (*Alfayé Villa, Rodriguez-Corral 2009*). Moreover, despite the acidity of the soil, human bones have been documented in the settings of the walls and entrances of hillforts, such as La Campa Torres (Gijón) (*Maya, Cuesta 2001.295*), Castromao (Celanova) (*García 2004.10*), San Millan (Cualedro) (*Rodríguez, Fariña 1986.62*) and Baroña (A Coruña) (*Calo, Soeiro 1986.35*). In Chao Sammartin (Grandas de Salime), one of the settlements that had an earlier monumentalization, a cist containing a human skull was built near the gateway to the acropolis during the early Iron Age (*Villa, Cabo 2003*). Possibly, a conceptual link existed between the human skull in this deposit and the group of human heads carved in stone and associated with the walls

Fig. 6. Aerial view of San Cibrán de Las hillfort, Ourense, Spain (photo by T. Arqueos).

and entrances of hillforts at the end of the Iron Age. Therefore, ideas, rites or socio-material practices that were petrified at this time appear to have had much deeper roots.

Rituals and liminality

Outsiders are significant, as Anne Haour has pointed out, because they do not quite 'fit'. "*The significant quality of an outsider is a position on the threshold: an in-between, dangerous state*" (*Haour 2013.12*). The liminal zone is potentially dangerous, as the individual is between social roles. Thresholds involve individuals crossing critical points where different levels of reality – physical, political, cultural, religious – converge. Mobility in the enclosure environment requires processes of adaptation and transformation, which are conventionally called rites of passage (*Van Gennep 1909*). The encounters between divergent identities are complex and problematic, and in these socio-material contexts of intersection, two notions, which intermix and confound, conceptualised the half-open space that needed to be managed and negotiated: hospitality and war. In the ancient world, for example, the term hospitium shared its Latin root with hospes (the foreigner) and the hostis (the enemy). Under these circumstances of stress and encounters with the exterior world, cultural and socio-political negotiations required a culturally recognisable presentation or an easy and interpretable translation for the participants (*Inomata, Cohen 2006*). This contributed to breaking the circle of the community at different levels – religious, political, emotional, *etc*. – and established social relationships between members of the community and those welcomed into it (hospites).

The individuals who arrived or left the hillfort had to perform a sequence of ritual acts. Their execution allowed a dialectic game consisting of externalising and internalising the culture, and through highly significant and emotional actions, underlining the process being carried out. These rites highlight and validate changes in a person's status. A number of deposits made up of weapons and ritual items seem to indicate the performance of rites of passage (*Bradley 1998b*). The ritual deposition of weapons was a common practice on the slopes or near the walls of the hillforts. This is the case, for example, of the deposit of daggers discovered outside the hillfort of Sofán (*López 1989*), or the deposit of Montefortino helmets – the same type as those worn by the warrior statues – located in the hillfort of Neiva. In the latter, just a few metres from where the Montefortino helmets were deposited, a set made up of two situlas and three metallic glasses were also found. Feasts also became a significant element in the negotiation of the liminal boundaries between the community and 'the Other'. In addition, the deposition of small objects, such as beads or spearheads at the entrance of hillforts like Saceda (*González-Ruibal 2005.277*), can be interpreted as minor rituals carried out by individuals when crossing the threshold of the hillfort.

Transition rites often involve a period of segregation from everyday life, a liminal state of transition from one status to the next, and a process of reintroduction to the social order with a new standing. In the access zones to the settlements, buildings with so-called pedra formosa (literally, beautiful stones) (Fig. 7) were erected and used as saunas (*Rodríguez-Corral 2009.189–193*). Their architectural designs and structural features must be interpreted in terms of the spatial organisation of ritual performance. These buildings are liminal places due to their location at the entrances, and their semi-subterranean architecture with internal divisions. Movement within the sauna involves a synaesthetic transformation. Bodily sensations demand a very specific type of movement – going through a small opening in the pedra formosa – and take the individual from light into darkness, from cold to heat, from dry to wet or *vice versa*, even bringing changes of odour (sweat and grease) and sound (inner echoes) (*González-*

Ruibal 2006–2007.575; Rodríguez-Corral 2009. 189–193). Whether the pedra formosa divides and creates areas of privacy, change or sensorial creation or not, the same symbols and pattern on the surface of the houses and the warrior bodies at the entrances appear precisely there, working at that liminal moment where the synaesthetic surrounding of the individual mutates and is transfigured. Thus these buildings seem to be linked with specific rites of passage and transformation in the context of hillfort entrances.

Visual images and liminality

The third socio-material strategy is connected with iconography. The material collective consisting of the stone warriors on the rocks next to the walls and gateways, provided a crucial scenario for theatrical events with strong emotional content. This setting encourages specific types of mobility and interaction between the bodies of the participants and material forms of the hillfort. In this sense, three characteristics were common to any participant in this context: first, the participant is outside the hillfort; second, he approaches the settlement going towards its gate, the most critical point, where, as he moves from one ontological space to the next, a space of anxiety emerges; and third, this observer views the statue in motion, altering position as his viewpoint gradually changes during his approach.

This iconography reinforced the experience of participants in the liminal zone of the hillforts. While the strategy of the warrior on the rock was to destroy borders with the past (memory place), the strategy of the warrior next to the wall and gateway was to emphasise boundaries against 'the Other' in the present. In this context, the static body of the warrior on the rock seems to require an observer in motion. In contrast with the movement of the observer, the material logic, hieratism and symbolism underline the stationary position of the warrior, which emanates from the rock itself. This is where the size of these statues ought to be taken into consideration. Most of these figures are over two metres high (*Calo 2003.15*). Their outsize dimensions might increase their power in the liminal context: firstly, because their magnitude would emphasise the values and power of the warrior, and secondly, because it could be seen by anyone approaching the hillfort from a distance. In what way does the materiality of the stone warriors put liminality into practice? The stone warriors acted as efficient mechanisms for intensifying some aspects of reality. Against a background of growing unrest, reordering and confrontation in the late second century BC, after Rome had entered north-western Iberia, the performativity of these images in the liminal context of the entrances to the hillforts makes them powerful actors and negotiating agents.

The material images were involved in the task of emotionalising and empowering these places of transience (Figs. 8–9). Frequently, the aesthetic qualities have been interpreted as a consequence of Roman provincial art, following the theory of traditional Romanisation. The lack or presence of aesthetic traits such as naturalism, movement or realism have led some researchers to consider the statues as imperfect forms of provincial art (*Almeida 1974; Calo 1994*). Nevertheless, various works have recently criticised approaches that interpret provincial or peripheral aesthetics to the Roman world as an incapacity to achieve or assume a Classical canon (*Webster 2003; Gosden 2004; Hodos 2009; Hingley 2009; Revell 2009*). This approach obscures the logic of local values and, therefore, the alternative modes that iconographies may have outside the metropolis or of states that influence peripheral areas (*Rodriguez-Corral 2012*). If this is so, in the context of provincialism, it is even more evident in the context of a tribal zone, such as emerged in north-western Iberia. In other words, in the context of tribal society, aesthetic logics, similar to that of semiotic logics, often mediate emotional relationships, and

Fig. 7. Iron Age ritual sauna from the hillfort of Briteiros, Portugal.

allow communities to manage reality through a system of values.

We must think about these statues from a 'situated' aesthetics/iconography. The very aesthetics of the warriors, moving away from Roman naturalism towards hieratism, could work in playing a part in the construction of a local identity. Materiality, through a series of characteristics such as solidity, firmness and size can, as already stated, be essential in the performative construction of an image. The aesthetic canon, however, may also evoke a powerful social reality. The simplification of the body of a statue is a strong act of concentration. By presenting a minimalist, standardised image of the warrior, an essential and regulatory image is created for one sole purpose: all protagonism is given to iconography – the weapons, gestures and symbolic motifs of clothing – as a key to the efficiency of the image itself set in a liminal zone.

Fig. 8. Modern copy of the stone warrior from the hillfort of San Cibrán de Las (Paços de Ferreira, Porto, Portugal) on the outcrop where the lower part of this statue was discovered (photo by S. Felloza).

One of the most outstanding features of the warrior is the position of the shield: the warrior is holding it in front of his abdomen, showing it to the visitor arriving near the entrance area to the hillfort. Owning a shield shows independence, and announces a willingness to defend the same, acting as a material metaphor of protection. Its loss, as pointed out by Bruce Lincoln (*1991*), involves the renunciation of the defeated group of social boundaries previously maintained. This is consistent with the view of the shield as a movable border separating oneself, the group and the territory from the other. The right hand is of great significance to indigenous sociality, because it is used to represent the most important gestures and materiality in these pre-Roman societies. The right hand is the channel for peace and for war: firstly, it can be used to shake hands with another individual, whether as a personal act or on behalf of the community (fides). It also carries the sword, and is the bearer of violence and of the capacity which an individual and, by extension, the community has – to defend oneself and subdue the other. Both these aspects convert the right hand into a material metaphor on which to work and with which to act in the negotiation of the reality of these communities.

Fig. 9. Modern copy of one of the stone warriors from the hillfort of Lezenho places on the rock (Vila Real, Portugal) (photo by CEDIEC).

We know from Strabo's 'Geography', among other sources, that the pre-Roman communities of this region chopped 'the hands off prisoners and consecrated the right hands' (3, 3, 6). Amputating the right hand of the enemy caused not only humiliation, but, as Sextus Aurelius Victor points out (*De Vir.* III, 58), it also played a part in trials of courage. Diodorus Siculus (*Historias* 12, 56, 5) narrates that in the battle of Selinunte in 409 BC, mercenaries coming from Iberia carried bunches of hands tied to their belts and the heads of enemies stuck on their spears. There is an iconography centred on the symbolic significance of right hands and

shields in the context of the indigenous populations of Iberia, which has also been documented (*Alfayé 2004*). In another instance, on the stela of Palao in Alcañiz (second to first century BC), a vexing and dishonourable act of denying burial to the enemy by the victorious warrior is depicted. A horseman is carrying a spear and a caetra, while at the feet of the horse a corpse is being devoured by vermin. Around the third century BC, this settlement was besieged and burnt, and its inhabitants were murdered. The skeletal remains confirm that the people of this settlement endured mutilation practices involving the amputation of hands and decapitation.

It seems obvious that the violent mutilation of these parts of the body acquires the consideration of a synecdoche amongst the Iberian communities in the Late Iron Age: the right hand as the signifier of the social capacity of individuals renders them useless if it is amputated. In summary, if we accept the relevance of the shield at the front in the creation of a differentiated space against the enemy/foreigner and of the right hand as material metaphors of independence and the political and military capacity of individuals, it then makes sense that the warriors on the walls of the hillforts adopt the two gestures. The right hand always holding the dagger or carrying an unsheathed sword makes the warriors work as active images in the construction and protection of the liminal space.

Conclusions

Late Iron Age iconography worked in connection with liminal places in order to co-create and performatively maintain the ideology of an elite in a new socio-political context that I have described as a tribal zone. Culture is to a large degree enacted. The emotional and cultural life of people is shaped by the scenarios in which that life develops, as well as those values culturally associated with the physical world. Thus, if the emotional lives of individuals are given by their physical relationships with other bodies and material forms, then objects, bodies and emotions are difficult to separate from each other. In Late Iron Age hillforts, they were produced and held through the body-materiality interaction in liminal zones. Or, in other words, a number of socio-material strategies put liminality into practice, allowing people to experience emotions and values in a way that often cannot be conveyed by words.

I have examined how emotions are produced, channelled and evoked performatively through ritual actions, material forms and iconography in the context of hillfort enclosures. In this sense, the stone warriors worked as forms to strengthen group feelings about themselves and their history in a particular context of resistance to the interference of Rome in north-western Iberia. Through a series of socio-material relations, they acted as reservoirs of experiences and memories, both ordinary and extraordinary, and as powerful actors building society. Their ability to act locally and pre-predicatively in a general context of anxiety and ontological insecurity came from a double liminal game: their participation in the management of a temporary and special liminality.

The warrior on the rock is an update of the 'armed' rocks that appeared in the Northwest landscape during the Bronze Age. As areas that were sacred, ritual and iconic, these 'armed' rocks helped to place a moral warrior in the landscape. At the end of the Iron Age, in a setting of insecurity, uncertainty and interaction with Rome, this idea became strong once again, but now the warlike iconography moves from engravings to sculptures on rocks. The three-dimensional form adopted at this moment matches the new monumental scenarios of the hillforts, working together to construct strong emotional and cognitive landscapes. Put more simply, the warriors in relation to the rocks helped to establish emotional and liminal links to the past – underlining the temporal depth of the landscape and the ancestral and religious dependence of the community – while in relation to the walls and entrances to the settlement, they stressed liminal ruptures with the present, producing zones of differentiation with the other that require rites of passage to cross.

In summary, the complexity of the iconography, the link between the stone warriors and the bodies of their observers, the ancestral and numinous strength of the rocks from which they originated, as well as the rites and other actions performed in the surroundings of the individuals put liminality into practice. The setting made people approaching a hillfort aware of the liminal power of the whole performance. The aesthetic and semiotic values were felt in the body as emotions. Therefore, the impact of the formal qualities of the socio-material group formed by walls, rocks and warriors in the bodies of individuals outside that community could produce a range of liminal feelings such as awe or fear, while they could also generate feelings of security and comfort in the members of the community.

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Insignia of power: bird imagery on artefacts of hierarchy and ritual in Iron Age Dolenjska (SE Slovenia)

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ABSTRACT – *Bird symbolism in the Dolenjska Hallstatt culture had strong associations with ritual and hierarchy, as demonstrated by bird imagery on insignia of power such as bronze vessels, wagons, and sceptres. The elaboration of such items with birds may have elevated items of prestige to items of ritual potency, highlighting the sacred and worldly power of the elite males with whom many of these items were associated. Avian depictions on bronze vessels, sceptres, and wagons with important cosmological and ritual associations indicate that birds were deeply entangled in presentations of status, particularly those that blurred the lines between the secular and sacred realms.*

KEY WORDS – *Iron Age; bird imagery; prehistoric art; situla art; Dolenjska Hallstatt culture*

Insignije moči: podobe ptic na hierarhičnih in ritualnih predmetih v železni dobi na Dolenjskem (jugovzhodna Slovenija)

IZVLEČEK – *Simbolika ptičev v dolenjski halštatski kulturi je imela močne povezave z ritualom in hierarhijo, kar dokazujejo podobe ptičev na insignijah moči, kot so bronaste posode, vozovi in žezla. Dodelava predmetov z motivi ptic je morda dvignila pomen prestižnih predmetov na raven predmetov z ritualnim vplivom, in tako poudarila sveto in vsakršno moč elitnih moških, s katerimi povezujemo tovrstne najdbe. Podobe ptic na bronastih posodah, žezlih in vozovih s pomembnimi kozmološkimi in ritualnimi povezavami kažejo, da so bile ptice globoko vpletene v predstave o statusu, predvsem pri predmetih, ki povezujejo sveto in posvetno.*

KLJUČNE BESEDE – *železna doba; podobe ptic; prazgodovinska umetnost; situlska umetnost; dolenjska halštatska kultura*

Introduction

Bird imagery has long interested scholars of European prehistory, in part because birds are ubiquitous in Bronze and Iron Age art in continental Europe, even when artistic motifs are otherwise largely geometric. Previous studies have focused on the common association of birds with solar disks, boats, and wheeled vehicles, and interpreted the significance of avian imagery in relation to the place of birds in prehistoric cosmologies, particularly the role of birds in the daily movement of the sun (*e.g., Kaul 1998; Lang 2002; Hänsel 2012; Bilić 2016*). However, fine-scale examinations of local image regimes demonstrate that birds were cultural referents beyond their solar associations. This study explores additional aspects of these multivalent symbols in one place and time, in particular how bird imagery on certain artefacts referenced secular and ritual authority in the Early Iron Age Dolenjska Hallstatt culture.

Birds were significant animals in the lived experience of the Dolenjska Hallstatt people – they were ubiquitous in daily life and were undoubtedly famil-

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iar creatures, though in most cases they were likely observed rather than interacted with directly (*Frie 2018*). The lifecycles of birds were important seasonal markers, particularly their mating, the laying and hatching of eggs, and their yearly migrations. Many species can also move across water, earth, and air – sacred abilities in what has been proposed as a tripartite cosmos where birds had a role in the movement of the sun (*Kossack 1954; Sturm-Berger 2002; Allinger 2007.10; Serjeantson 2009.338*). Evidence from situla art and comparison to contemporary cultures indicates that birds may have been used for augury as well (*Pauli 1985.24–25; Rankin 1996.277; Haack 2017.360–361; Frie 2018.7*). These attributes of living birds were key to their cultural significance, and separated them from domesticates and other wild animals that populated the Dolenjska Hallstatt world. The perception of birds as distinctive and even extraordinary is expressed in the frequent depictions of birds (*Frie 2018*), particularly on ritually significant items such as bronze vessels, sceptres, and wagons.

The local significance of bird imagery was demonstrated in the context of my broader study assessing animal imagery on Dolenjska Hallstatt artefacts, which were compared to depositions of faunal remains in mortuary contexts (*Frie 2017*). Artefacts depicting birds accounted for over 25% of the zoomorphic corpus, appeared on the widest variety of artefacts, and were deposited with males, females, and sub-adults in mortuary contexts. A previous article presents the broad patterns of artefacts with avian imagery and their local associations (*Frie 2018*); however, here I focus on artefacts that illuminate the ritual significance of avian imagery. I begin by discussing the evidence that bird imagery in this area had solar associations, as demonstrated in other parts of Europe. In addition, I explore other ritual associations of birds, indicated by some of the most ubiquitous items adorned with avian imagery – bronze vessels used for serving alcohol during feasts. Figurative scenes on some of these bronze vessels demonstrate that birds also adorned wagons and sceptres, though such items have not survived in the archaeological record in this region. Bronze vessels, wagons, and sceptres not only have ritual significance in the Early Iron Age, but they are also some of the premier status markers throughout continental Europe (*Teržan 1980; Pare 1989; 1992; Arnold 1995; Eibner 2007; 2009*). I assess the social significance of these items, including a discussion of the contexts in which these images would have been encountered, and what can be gleaned from the final deposition of these objects in graves. I propose that the appearance of birds on these items of ritual and communal display in the Dolenjska Hallstatt area indicate that not only did birds have cosmological associations, but that they may also have served as symbols of consecration that served to blur the lines between worldly and sacral power.

Dolenjska Hallstatt bird imagery

The Dolenjska Hallstatt group was an Early Iron Age archaeological culture (*c.* 800–300 BC) located in south-eastern Slovenia. As indicated by the name, this group is considered part of the larger Eastern Hallstatt cultural complex. The Dolenjska Hallstatt culture shared many of the hallmarks of other continental European Iron Age groups. In this period, settlement shifted to large hillforts, social stratification became much more pronounced in the mortuary record, and inhumations were placed in tumuli (burial mounds), which were likely organised by lineage-based connections. The material culture became much more extravagant and visible in the archaeological record with the coming of the Iron Age, which may have been due to a robust local ironworking tradition, which led to increased prosperity and participation in widespread trade networks (*Gabrovec 1976; Dular 2003; Dular, Tecco Hvala 2007*).

Connections with neighbouring regions and access to new, more elaborate material culture played a role in the development of a vibrant local artistic tradition, which peaked in the fifth century BC. The most well-known expression of these new artistic impulses is the Situla Art style, which originated in northern Italy and the Eastern Alps in the seventh century. This style is characterised by embossed and incised figural imagery on sheet bronze artefacts, particularly the eponymous situlae, which are sheet bronze buckets used for serving alcohol (Fig. 1), as well as belt plates, vessel lids, earrings and, occasionally, scabbards and helmets (*Lucke, Frey 1962; Turk 2005; Križ 2012*). Although the Situla Art style is the most well-known form of artistic expression in this period, other figural artefacts became increasingly common at the same time that Situla Art flourished in Dolenjska, particularly artefacts depicting animals such as fibulae, beads, and other personal ornaments, weaponry and defensive gear, and both bronze and ceramic vessels (*Frie 2017; 2018*). The most common subject of these new figural depictions were birds, animals that played a central role in the belief system of the Dolenjska Hallstatt people (*Frie 2018*).

My doctoral work examined animal imagery on Dolenjska Hallstatt artefacts. The results demonstrated that birds were most frequently represented and appeared on 118 of 440 total artefacts with zoomorphic imagery (Fig. 2; *Frie 2017; 2018*). All but one of these artefacts were recovered from mortuary contexts, which made it possible to assess the demographic associations of bird imagery. Avian depictions were more often associated with males than with females, though they appeared frequently with both genders, as well as in many graves for which gender could not be determined (Tab. 1). Bird imagery is much less strongly gendered in its deposition than most other animal imagery, and its distribution also crosscut age and status (*Frie 2017.136–142*). Birds appeared on a wide variety of artefacts, but were most prevalent on personal ornaments largely associated with women (60 artefacts) and bronze feasting vessels more often associated with men (54 artefacts). Birds were apparently multivalent symbols, appropriate for a wide variety of artefacts associated with a variety of Early Iron Age people (*Frie 2018.3–4, 8*). However, while the artefacts depicting birds were not restricted by social role, birds depicted in Situla Art narratives indicate that birds may nonetheless have had strong associations with ritual and hierarchy, both of which were strongly gendered male. Since the broad corpus of bird imagery including the artefacts, their distribution, and their iconography have been presented in another article (*Frie 2018*), this article will present the relationship between birds, ritual, and hierarchy by focusing in more detail on Situla Art iconography, as well as bird imagery on bronze vessels in general.

Previous research on bird representations has focused on their ties to a widely shared cosmological system (*Lang 2002; Hänsel 2012; Teržan 2013; Bilić 2016*). However, contextual and iconographic analyses of Dolenjska Hallstatt avian imagery highlight its appearance on ritually significant and hierarchically restricted artefacts that played a role in materialising power inequalities, and indicate that cosmological associations are only one piece of the puzzle. I will first discuss how well the Dolenjska Hallstatt avian imagery aligns with previous cosmological interpretations, followed by a discussion of additional patterns that become apparent with nuanced iconographic assessment.

Prehistoric sun birds?

Water birds are religious symbols dating back to the Bronze Age, commonly associated with horses and

Fig. 1. The Vače situla from Grave 1881/1 at Reber near Vače (after* Turk 2005.60, Fig. 90*; © National Museum of Slovenia, photo Tomaž Lauko).

vehicles as well as wheel and sun motifs (*Kossack 1954; Pare 1989; Kaul 1998; Teržan 2013; Bilić 2016*). These symbols are linked to the passage of the sun through the sky – by day, drawn by horses or birds in a chariot or wagon, and by night, in a ship pulled by water birds or snakes (*Kaul 1998; Bilić 2016*). The related belief that prominent dead were carried to the afterlife in a wagon or chariot has been proposed to explain the importance of wheeled vehicles in many Bronze and Iron Age burials throughout Europe (*Pare 1989; 1992; Kuzmina 2006; Kmeťová 2013*). Water birds are considered particularly important in these belief systems because of their ability to travel through the tripartite cosmos: the sky, earth, and a watery underworld associated with the night (*Kaul 1998.262, Fig. 170; Brück 2011.393*). Because of these abilities, birds are thought to act as mediators between humans and extra-human forces (*Kossack 1999.23-27, 96-99; Gleirscher 2013.238; Frie 2018*). However, by the Iron Age the unity of these symbolic associations had broken down to a certain extent, and the symbolism of water birds in particular and birds in general seems to become more polyvalent and ambiguous in south-eastern Europe (*Lang 2002; Teržan 2013.89; Becker 2015.220–221, 265–266*).

The concentric circle motif is considered a representation of the sun in Bronze and Iron Age imagery

	Male/Male Double Grave	Male	Male/Female Double Grave	Female	Indeterminate	N/A
Anklet				3		
Bead				3	2	
Belt		8				
Cauldron	2	4	1	1	5	2
Cist	1	2	1			
Dagger					1	
Earring				1		
Fibula		2	1	7	12	15
Lid				1		
Pendant				1	4	1
Scabbard	1					
Situla	3	16	3	4	6	
Vessel (bronze)				1	1	
Vessel (ceramic)				1	1	

Tab. 1. Numbers of artefacts depicting birds divided according to the probable gender of the deceased. Gender attribution is only listed as probable since gender was determined using grave goods (bones were not preserved in most cases, and osteological analysis has not been undertaken). The final column, N/A, includes artefacts without secure provenience. All the objects listed above are made of bronze, except five amber beads and two ceramic vessels.

(Fig. 3; *Brück 2011; Bilić 2016; De Angelis, Gori 2017*). The larger study tracked the appearance of this motif on the bodies of animals depicted on Dolenjska Hallstatt artefacts, as well as on the same artefacts as animal imagery, but separate from animal bodies. Overall, concentric circles were rarely depicted on animals in this region; however, seven artefacts depicted birds with concentric circles on their bodies, and horses and snakes were elaborated with this motif on four artefacts each (*Frie 2017. 170–171*). The closer association of concentric circle motifs with these particular species aligns with Flemming Kaul's identification of the animals associated with sun symbolism in Scandinavia (*1998. 199–246*). Birds were ornamented with concentric circles on a set of four rooster pendants, a pair of amber beads, and the chape of a scabbard.[1] Concentric circles appeared more frequently in association with animal images when they were separate from the animal bodies. This motif appeared on 15 artefacts that depicted birds,[2] significantly more than the next most frequent co-occurrence with either horse or canid imagery on four artefacts each (*Frie 2017.237–238*).

Interestingly, the association between solar imagery and water birds in particular is not clear-cut in this region. Only 18 artefacts depict identifiable water birds in the study, five of which are associated with the concentric circle motif on either the body of the bird itself or the artefact.[3] In addition, four pendants elaborated with the concentric circle motif depict roosters. However, in Dolenjska Hallstatt imagery there is a lack of clearly identifiable bird species, which could account for the low numbers of clear water birds. In Dolenjska, it seems that the broad category of 'bird' was more significant to indicate in depictions than particular genera or species of birds, which are rarely identifiable in imagery (*Frie 2018.4–5*).

The fact that concentric circle motifs were most commonly associated with avian imagery, on the same artefacts as well as on bird bodies themselves, provides support for the association of birds with the sun in the Dolenjska Hallstatt region. However, the relatively low numbers of such artefacts overall, on 21 of 118 avian artefacts, indicate that solar associations were likely only one part of the broader meaning of bird imagery in this area. What is more read-

1 Rooster pendants: Stična, Gomile Grave VI/7 (*Wells 1981.200, Fig. 137*, see *Frie 2018* for a more detailed discussion of these pendants); amber beads: Novo mesto, Kapiteljska njiva Grave V/35 (*Križ 2000.109, Pl. 23 no. 12*); scabbard: Magdalenska gora, Laščik Grave V/19–20 (*Hencken 1978.153, Fig. 125a*).

2 Concentric circle motifs and bird images co-occur on 15 artefacts. Fibula: Magdalenska gora, Preloge Grave 2/c (*Tecco Hvala* et al. *2004.Pl. 10A no. 2*). Pendant: Brezje pri Trebelnem, Hojbi Grave XIII/6 (*Kromer 1959.Pl. 35 no. 7*). Bronze belt plate: Stična, Gomile Grave VI/30 (*Gabrovec 2006.268, Fig. 71*). Scabbard: Magdalenska gora, Laščik Grave V/19–20 (*Hencken 1978.153, Fig. 125a*). Two cists: Dolenjske Toplice, Branževec 2 Grave V/9 (*Teržan 1976.Pl. 25 no. 1*), Kandija [Znančeve njive] Grave IV/3 (*Knez 1986.Pl. 33 no. 2*). Nine situlae: Brezje pri Trebelnem, Hojbi Grave VII/16 (*Kromer 1959.Pl. 28 no. 10*); Dolenjske Toplice, Branževec 2 Grave II/14 (*Teržan 1976.Pl. 7 no. 14*); Magdalenska gora, Preloge Grave 2/a (*Tecco Hvala* et al. *2004.Pl. 7 no. 5*), Grave 13/55 (*Tecco Hvala* et al. *2004.Pl. 85 no. 17, Appendix 5*), 13/119 (*Tecco Hvala* et al. *2004.Pl. 108 no. 7*); Kandija [Znančeve njive] Grave III/33 (*Knez 1986.Pl. 28 no. 15*), Kapiteljska njiva, Grave VII/19 (*Križ 2012.116, 124*), Grave XIV/7 (*Križ 2013.175 Pl. 29*); Malenškova njiva Grave 3 (*Guštin, Teržan 1975.202, Pl. 4 no. 1*).

3 Two amber beads with concentric circle eyes: Novo mesto, Kapiteljska njiva Grave V/35 (*Križ 2000.109, Pl. 23 no. 12*). Situlae with concentric circle ornaments (separate from the body of the birds): Magdalenska gora, Preloge Grave 2/a (*Tecco Hvala* et al. *2004.Pl. 7 no. 5*), Grave 13/55 (*Tecco Hvala* et al. *2004.Pl. 85 no. 17, Appendix 5*); Malenškova njiva Grave 3 (*Guštin, Teržan 1975.202, Pl. 4 no. 1*).

ily apparent from the Dolenjska Hallstatt evidence is the significance of avian symbols for the materialisation of ritual and hierarchy, particularly on artefacts that played a role in communal display.

Birds at the feast

Vessels for food and drink were frequently ornamented with animal imagery and deposited in graves in the Dolenjska Hallstatt area. It is believed that the 51 bronze vessels with avian imagery were associated with communal alcohol consumption. The association between bronze vessels, alcohol, and feasting is supported by the images on the vessels themselves (*Rebay-Salisbury 2016.233*). Situlae and cists were used for the transport and storage of liquid; cists are shown carried on women's heads in processions,[4] while situlae are carried by men,[5] and both are depicted hung from large racks[6] for storage and also possibly for display. Situlae and cauldrons are shown as serving vessels, often with small ladles or cups for dispensing the alcohol.[7] The burial record corroborates the imagery, and situlae in particular are frequently discovered associated with small cups (*Teržan 1980; Križ 2012.14, 78*). Birds are the animals most commonly depicted on such vessels, and are ubiquitous in stylised form on the handle terminals of situlae, cists, and cauldrons (Fig. 4). All bronze vessels with intact handles in the dataset have terminals that have been shaped to form avian protomes.[8] Although many of these are quite schematic, there are several handle terminals where the birds' heads were carefully modelled, even with the addition of eyes (see Fig. 4). The placement of these bird images is not incidental; when the handles are held vertically, the protome on the handle terminal mirrors the profile of a bird floating on water, giving the impression that the birds were swimming in the liquid contained in the metal vessel. This is even depicted in exaggerated form on the second register of the Certosa situla from Bologna, where two men carry a large situla whose handles terminate in oversize water bird protomes (*Lucke, Frey 1962.Pls. 4, 18, 76*).

The positioning of birds on the vessel handles visually referenced birds floating on water, while also positioning the birds so that they appeared to be observing those using these vessels. Individuals could have interacted with these prominent vessels and viewed bird images as they were serving or

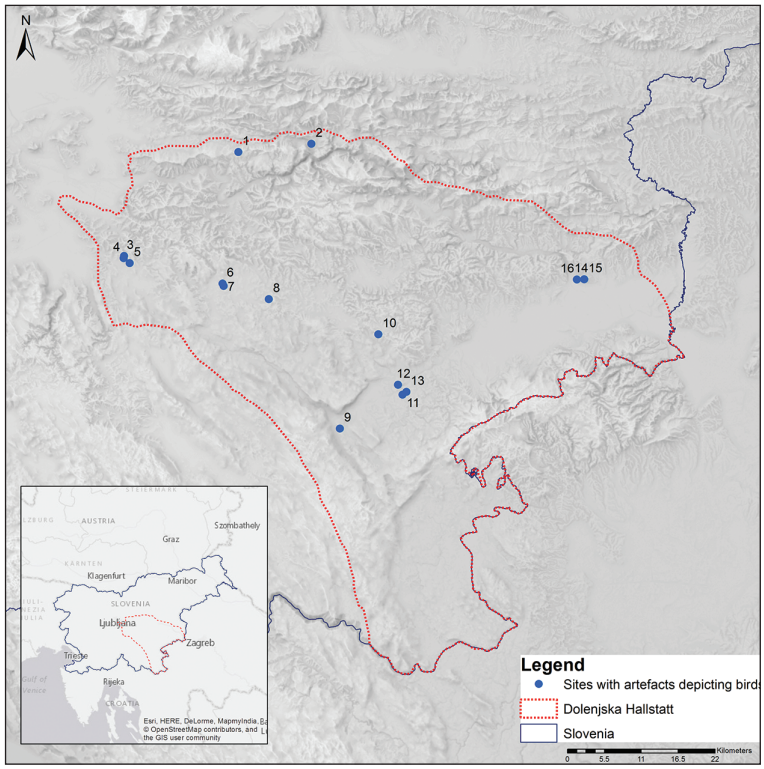

Fig. 2. Dolenjska Hallstatt sites with bird imagery: 1 Reber near Vače; 2 Zagorje by Sava; 3, 4, 5 Laščik, Preloge, and Voselca near Magdalenska gora; 6 Cvinger above Vir near Stična; 7 Gomile near Stična; 8 Medvedjek; 9 Dolenjske Toplice; 10 Brezje near Trebelno; 11, 12, 13 Kandija, Kapiteljska njiva, and Malenškova njiva near Novo mesto; 14, 15, 16 Deržaničev gozd, Špiler, and Volčanškova gomila near Libna.

4 Certosa situla (*Lucke, Frey 1962.Pls. 18, 64*), situla from Welzelach (*Lucke, Frey 1962.Pls. 60, 76*).

5 Certosa situla (*Lucke, Frey 1962.Pls. 18, 64*).

6 Este-Benvenuti situla (*Lucke, Frey 1962.Pls. 24, 65*), Kuffern situla (*Lucke, Frey 1962.Pls. 56, 75*).

7 Situla in Providence (*Lucke, Frey 1962.Pls. 5, 7*), Sanzeno situla (*Lucke, Frey 1962.Pl. 67*), situla from Nesactium (*Lucke, Frey 1962.Pl. 40*), Vače situla (see Fig. 7), Kuffern situla (*Lucke, Frey 1962.Pls. 56, 75*), Dürrnberg-Kranzbichl situla (*Rebay-Salisbury 2016.235 Fig. 7.42*).

8 The dataset includes only artefacts from the Dolenjska Hallstatt region, although bronze vessels from other areas are also elaborated with bird protomes on their handles (*e.g.*, the Providence and Welzelach situlae), and there is an image of a situla with bird protome handle terminals on the Certosa situla (*Lucke, Frey 1962.Pls. 4, 18, 76*).

Fig. 3. Bronze belt plate with concentric circles and water birds, find from near Vače, provenience unknown (after* Turk 2005.11, Fig. 4*; © National Museum of Slovenia, photo Tomaž Lauko).

being served alcohol, an agent of altered mental states and possibly liminality (*Arnold 1999.87; Dietler 2006.241–242; Becker 2018.213*). In these contexts, bird figures may have served not only as observers of communal rituals, but potentially as important guardians or mediators in the liminal state induced by alcohol. Birds themselves may have been perceived as liminal creatures, due to their ability to move securely between water, land, and air. And if indeed they were thought to play a role in the movement of the sun through the sky, they could also move betwixt and between cosmological realms, another potentially liminal role. This ease of movement, whether earthly or cosmological, would have been a potent attribute separating birds from other animals, and perhaps led to their perception as observers as well as guardians in altered states (*Frie 2018.6*).

The elaboration of so many of these bronze vessels with avian imagery is compelling and speaks to the significance of birds in prominent displays at feasts (*Becker 2018.213*). Bronze vessels are associated with elevated status, since they indicate access to skilled craftsmen, but also reference the ritual and social importance of alcohol and communal feasting. The deposition of such vessels in graves may have served to mark those who were hosts, or otherwise involved in the organisation of such events. Bronze vessels are more strongly associated with males than females (Fig. 5), and point to males having greater access to feasting paraphernalia, suggesting a stronger association of males with communal drinking and potentially the gendered role of the host. The two female graves with situlae each contain a pair of elaborately decorated situlae.[9] In contrast, the majority of situlae from male graves (56%) were undecorated, except for the bird head handle terminals (Fig. 6), and male graves usually contained only a single bronze vessel. This implies that females needed to be of higher status than males to be buried with feasting vessels, and the two female graves in this dataset were probably women of premier status. Whereas in contrast even men who did not have access to the highly elaborate decorated situlae were able to symbolise their roles as hosts and important members of the community.

The significance of alcohol in Iron Age Europe and the role of feasting has been discussed extensively. Most studies agree that feasts were probably organised by elite individuals, and facilitated the acquisition, maintenance, and negotiation of influence and prestige (*e.g., Dietler 1990; 1996; Arnold 1999*). This would have functioned in a number of ways: for the hosts, such feasts would demonstrate access to resources, and could also engender relationships of dependence requiring reciprocal favours or services. In addition, these communal feasts would have reinforced social distinctions through differential access to food and drink, seating, or other consumption patterns, including those who served and were served (*Dietler 1990; 1996; 2001; Arnold 1999*). The importance of feasts for marking social differentia-

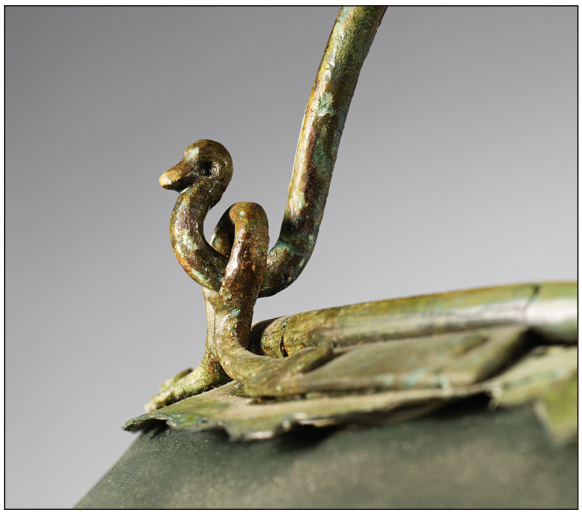

Fig. 4. Terminal of a situla handle in the shape of a bird protome. Novo mesto, Kapiteljska njiva Grave III/12 (after* Križ 2012.49*; © Dolenjski muzej).

9 Magdalenska gora, Preloge Grave 2/a contained a situla decorated in the Situla Art style with four registers, as well as a stamped situla (*Tecco Hvala* et al. *2004.124–125, Pls. 7–8*). Kandija [Znančeve njive] Grave III/33 contained two extremely fragmentary situlae decorated in the situla art style (*Knez 1986.87, Pls. 28, 59*).

tion in the Dolenjska Hallstatt region is eloquently demonstrated by several figurally-decorated situlae that depict enthroned men being served by veiled women and other men (*Rebay-Salisbury 2016.186*). These scenes also depict other practices associated with large communal feasts such as music and dance, and spectator sports such as boxing and chariot racing (Fig. 7) (*Lucke, Frey 1962; Kromer 1980; Eibner 1981; Frey 1986; Rebay-Salisbury 2012*). Not only were feasts apparently used to mark social differences, but at the same time they seem to have been important group events that may have served to highlight the social bonds of the community itself. Feasts where such vessels were used may have been ritualised activities, rather than purely secular community gatherings, where social, political, and sacral powers were co-constitutive and potentially inseparable (*Dietler 2001.71–75; Brück 2011.394*).

The importance of feasting and alcohol in Iron Age European contexts as well as the elaborate nature of these bronze vessels and their restricted distribution indicate that these vessels were insignia of power within communities, visually manifesting the exclusivity of the role of the host (*Dietler 1990; 2001; Arnold 1999*). If we consider feasts as venues for communal ritual, it becomes clear that the hosting of ritual feasts may have extended conceptions of the prestige and influence of the host into the sacred sphere, and anchored hierarchical structures outside the human realm (*Arnold 1999.81–84; Dietler 2001.71–72; Brück 2011.394–395*). In these contexts bird imagery was not epiphenomenal; rather, the cosmological and ritually laden associations of birds as cosmic voyagers, omnipresent watchers, and mediators between humans and the supernatural world were key (*Frie 2018*). The elaboration of vessels with bird imagery invoked the sacred associations of birds, and may have imbued these vessels with greater ritual efficacy.

Birds on insignia of power

There are three particular situlae from Dolenjska that provide additional insight into the role of bird imagery on ritually significant, prestigious artefacts: the Vače situla, and the situlae from Kapiteljska njiva and Magdalenska gora. These artefacts also demonstrate the existence of a broader corpus of avian ornamentation that has not survived in the archaeological record. Images of birds are used to embellish wagons and sceptres in scenes on these three situlae. Birds ornament wagons on two of them: bird protomes adorn the corners of a wagon on the

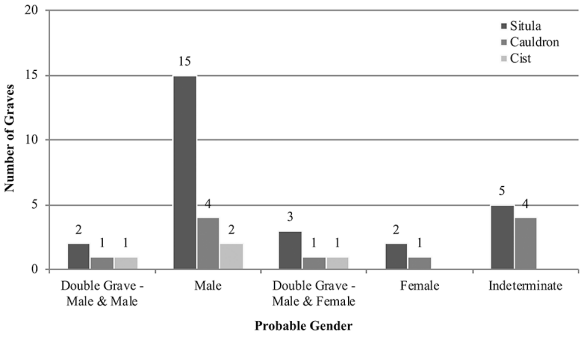

Fig. 5. Graves with bronze vessels depicting birds, divided according to the probable gender of the deceased.

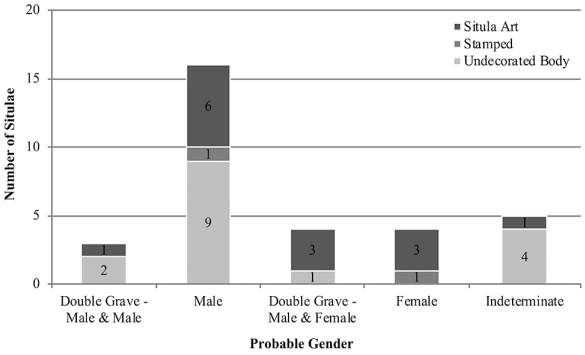

Fig. 6. Situlae with undecorated bodies and bird protome handles, situlae with stamped birds, and situlae decorated in the Situla Art style depicting birds, divided according to the probable gender of the deceased.

Vače situla, while the Kapiteljska njiva situla depicts a wagon with bird imagery carved or painted on the wagon box (Fig. 8). These images provide insight into other prehistoric animal representations that have not been preserved in the archaeological record, and allow us to speculate that not only were bronze vessels conspicuously ornamented with bird imagery, but wheeled vehicles probably were as well.

In addition to the evidence from Dolenjska, artefacts elaborated in the Situla Art style from the broader region indicate that avian imagery adorned other high status objects that have not survived in the archaeological record. The situla in Providence depicts a cauldron-stand elaborated with avian imagery (*Lucke, Frey 1962.Pls. 5, 7*). Birds are also painted or carved on the side of the musicians' couch on the Certosa situla (*Lucke, Frey 1962.Pl. 19*), while the Castelvetro lid depicts a nuptial bed and throne ornamented with birds (*Lucke, Frey 1962.Pls. 21–22*). Finally, the Moritzing '*vase*' and Sanzeno situla both have wagons elaborated with avian protomes (*Lucke, Frey 1962.Pls. 30, 67*), similar to the example from the Vače situla in Dolenjska (Fig. 8).

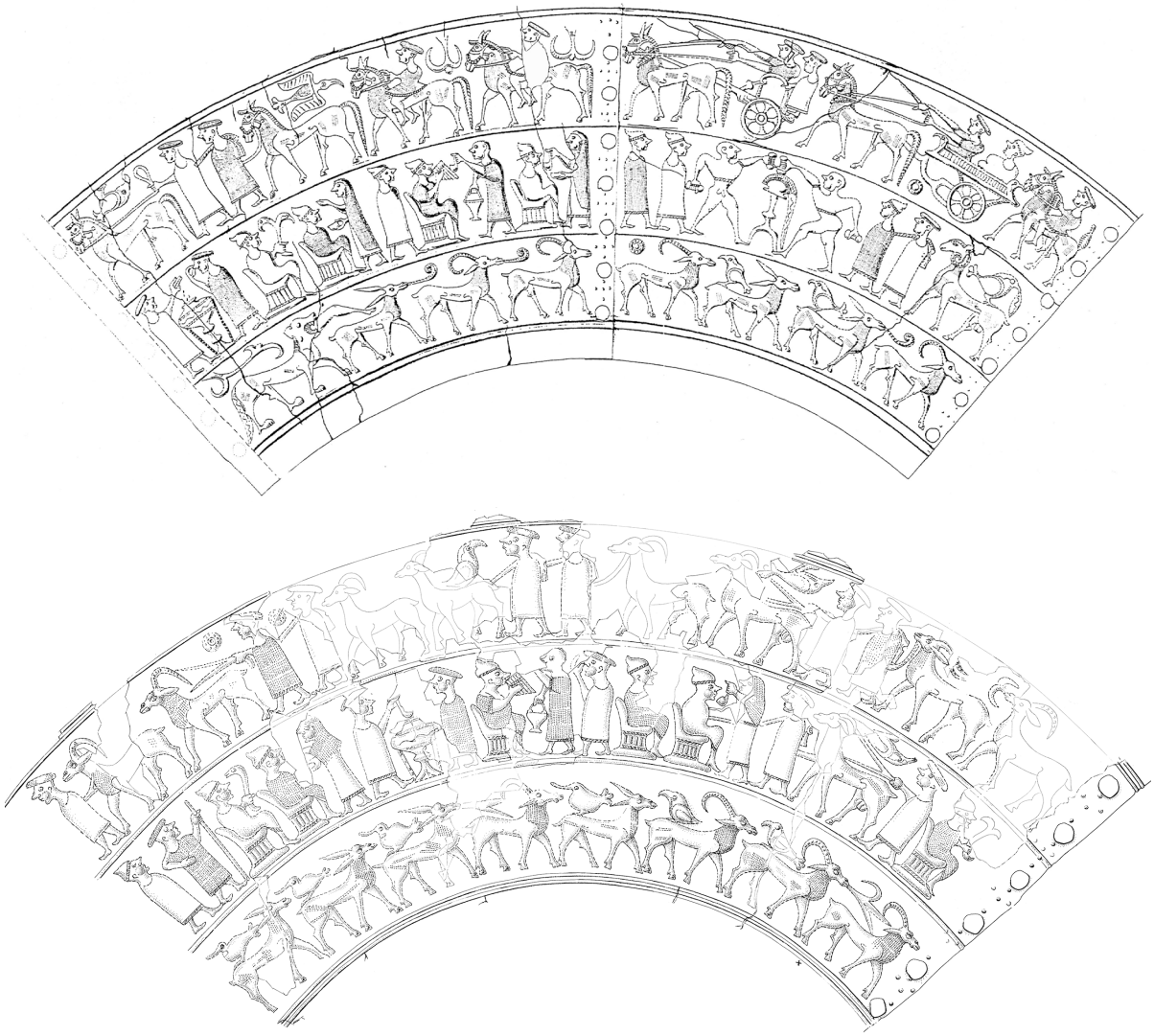

Fig. 7. Situlae depicting sceptres and wagons elaborated with bird imagery. Top: Situla from Grave 13/55 at Preloge near Magdalenska gora (after* Tecco Hvala *et al.* 2004.Appendix 5*; © Sneža Tecco Hvala). Bottom: Vače situla from Grave 1881/1 at Reber near Vače (after* Turk 2005.35, Fig. 52*; © National Museum of Slovenia, drawing by France Stare).

Wagons and chariots were bound up with cosmological beliefs, funerary activities, and status expression in other parts of Urnfield and Hallstatt Europe (*Pare 1989; 1992; Kmet'ová 2013*). In Western Hallstatt Europe and the Mediterranean, double sets of horse gear buried with deceased individuals have been interpreted as *pars pro toto* for a horse pair for a wagon or chariot. In certain cases, it is clear that wagons and chariots, or at least parts of them, were deposited in graves as well (*Pare 1992; Carter 1998; Kmet'ová 2013*). The focus on wagons and horses in iconography and burials has been associated with a proposed pan-Indo-European belief system, where preeminent deceased individuals were transported to the afterlife in a chariot or wagon pulled by horses, potentially as part of a social transition from elite to heroicised ancestor (*Pare 1989; 1992; Kuzmina 2006; Kmet'ová 2013.77–78*). This is considered closely related to the Bronze and Iron Age cosmology, where the sun was pulled across the sky in a horse-drawn wagon, and returned overnight via a boat drawn by water birds (*Kaul 1998; Armstrong Oma 2013; Bilić 2016*). Although wagons are not found in Dolenjska Hallstatt graves, their strong associations with high status individuals in other areas of Hallstatt Europe have been clearly demonstrated (*Pare 1992*). Dolenjska Hallstatt iconography supports similar associations, particularly the fact that the men riding in wagons in situla art scenes seem to be the same men who are enthroned and being served in other scenes (see Fig. 7). The depiction of birds on wheeled vehicles in these images further demonstrates the circulation of birds in the overlapping realms of ritual, hierarchy, and cosmology.

The situla from Preloge at Magdalenska gora and the Vače situla both depict enthroned men holding bird head sceptres (Fig. 7). Alexandrine Eibner (*1981; 2007; 2009*) has conducted several detailed studies of situla art, including the premier status symbols depicted and their correspondence to other finds from the archaeological record. She identifies thrones, stools, and sceptres as insignia of power with cross-cultural significance in the Iron Age (*Eibner 2007*). Although no bird head sceptres have been identified in the archaeological record, an elaborate throne similar to those depicted on the situlae from Vače and Magdalenska gora was found in Grave 89 at Verucchio (*von Eles 2002; Eibner 2007*), suggesting that these situlae depict real status symbols from this period. Moreover, although sceptres appear in many Situla Art scenes from Italy and Austria, thus far only these situlae from the Dolenjska Hallstatt region depict sceptres adorned with birds, potentially indicating that the association of birds with ritual or sacral authority was a local development (*Eibner 2007; 2009*). These enthroned males are the centres of much of the action depicted in these scenes, and yet they are aloof. They observe the serving of libations, music and dance, boxing competitions, and the presentation of animals for sacrifice, which raises the possibility that the men with sceptres may have been the hosts of the large communal feasts depicted on these vessels. If this is the case, bird images were not only used to elaborate the bronze vessels that played a prominent role in ritual feasts, but avian imagery also ornamented the sceptres that marked out the individuals presiding over them. The centrality of these men with sceptres and the depiction of sceptres in the broader south-eastern Alpine area indicate that these items served as insignia of power and perhaps even symbols of ritual authority (*Eibner 2007; 2009*).

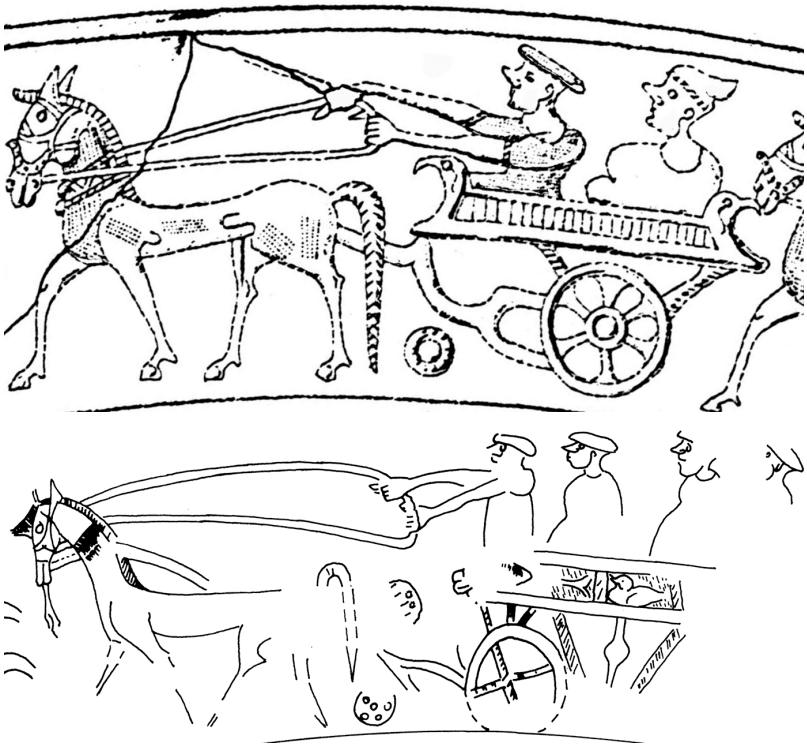

Fig. 8. Detail of wagons ornamented with avian imagery. Up: Vače situla from Grave 1881/1 at Reber near Vače (after* Turk 2005.35, Fig. 52*; © National Museum of Slovenia, drawing by France Stare). Bottom: Grave III/12 at Kapiteljska njiva near Novo mesto (after* Križ 1997.Appendix 3*; © Dolenjski muzej).

Other items described as sceptres have been identified in Early Iron Age graves, though their form is different: they are cylinders of sheet bronze with dangling triangular and zoomorphic pendants. These types of sceptres are particular to females in Dolenjska and Italy, and are not depicted in Situla Art imagery, though they are thought to be important ritual paraphernalia (*Križ* et al. *2009.123; Tecco Hvala 2012.334–341*). Interestingly, one of these bronze sceptres from an unknown context at Libna has avian imagery (Fig. 9) (*Guštin 1976.45, 113, Pl. 65*).[10] It has pendants in the shape of birds, an anthropomorphic figure, hand-shaped pendants, and triangular rattle plates. Some of the pendants are elaborated with concentric circle stamps, and the largest pendant combines anthropomorphic features with a spoked-wheel shape. It seems that in this particular case, cosmic symbolism, bird imagery, and ritual came together, and potentially indicates that such insignia of power were not solely restricted to men.

Birds are ubiquitous on items that were imbued with both status and ritual associations, but importantly, items that would have been highly visible during communal activities such as feasts, and that would have highlighted the distinction of the individuals

10 This object was not included in the formal study due to its unknown provenience and is not part of the quantitative analyses.

who possessed them. The appearance of birds on this triad of elite regalia – sceptres, bronze vessels, and wagons – indicates that birds may have been insignia of power that denoted the imbrication of worldly and sacral authority in the Dolenjska Hallstatt culture.

Conclusion

The co-occurrence of birds and sun symbols on Dolenjska Hallstatt artefacts indicates that local communities may have shared the European Bronze and Iron Age cosmology, where birds played a role in the sun's movement through the sky. However, though birds were the animals most strongly associated with sun symbols, they co-occur on less than 20% of artefacts with bird imagery assessed in this study, indicating that birds were likely multivalent symbols with broader significance in this region. The frequent appearance of avian imagery on bronze serving vessels referenced the role of birds as observers and possibly guardians in the liminal state induced by alcohol consumption, and it may be that the cosmological associations of birds and their exceptional natures made them the most appropriate animal to adorn these ritual vessels (*Becker 2018; Frie 2018*). These vessels were centrepieces of communal feasting activities that were ultimately deposited with certain individuals at their death, primarily men. The deposition of bronze serving vessels marked high status individuals. A key component of their status may have been the hosting of feasts, that were not only important communal ceremonies, but key moments for the presentation and consolidation of power both secular and ritual, if indeed they could be separated (*Teržan 1980; Dietler 1990; 2001.71–72; Arnold 1999.81–84; Brück 2011.394–395*). The ubiquity of bird imagery on such vessels indicates that birds were embedded not only in cosmological systems, but also had important associations with ritual and hierarchy. Avian imagery may have served as symbols of consecration, and the elaboration of these vessels with extraordinary and culturally significant creatures elevated them from objects of prestige to objects of ritual potency.

Bird imagery also ornamented wagons and sceptres, two other artefact categories with strong ties to hierarchy, ritual, and communal display. Wagons were associated with funerary rituals throughout the Hallstatt world, and it has been proposed that prominent dead were carried to the afterlife in these vehicles (*Pare 1989; 1992; Kuzmina 2006; Kmeťová 2013*). In addition, wagons were associated with the movement of the sun in many areas of Bronze and Iron Age Europe (*Kaul 1998; Bilić 2016*). Birds also adorn sceptres in two Situla Art scenes, and though no bird head sceptres have been recovered in the archaeological record, these scenes of enthroned men with sceptres observing feasts and other ritualised communal activities demonstrate that such sceptres were markers of distinction (*Eibner 2007; 2009*). The images of birds on bronze feasting vessels, sceptres, and wagons with important status, cosmological, and mortuary associations indicate that birds were deeply entangled in presentations of status, particularly those that blurred the lines between the secular and sacred realms.

Fig. 9. Sceptre with anthropomorphic, solar, and avian imagery. Libna, unknown provenience (© Universalmuseum Joanneum Graz, photo N. Lackner).

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Characteristics of Early Iron Age pottery from north-eastern Slovenia through the prism of ceramic technology and petrography

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ABSTRACT – *Pottery technology in the Early Iron Age remains understudied in Slovenian archaeology; especially in the use of description on a macroscopic level combined with the petrographic thin section analysis, taking in consideration also relevant stratigraphical information. In this study, we focus on the pottery technology of vessels from two recently excavated contemporaneous Early Iron Age sites in north-eastern Slovenia, Poštela near Maribor and Novine near Šentilj. We characterised the inclusions based on macroscopic observation on whole and reconstructed vessels. In addition, vessel typology, surface treatment, decoration techniques, and firing atmosphere were established. Based on these results, a petrographic analysis was conducted on pottery samples. At both sites, we looked at the different contexts, comparing pottery from settlements,* i.e. *hillforts, to pottery found in the adjacent cemeteries. The results show that potters from the two settlements produced similarly shaped vessels using different pottery recipes from locally available raw materials. The use of grog as a possible chronological marker in the Early Iron Age is also discussed.*

KEY WORDS – *pottery; technology; petrography; Early Iron Age; NE Slovenia; Poštela near Maribor; Novine near Šentilj*

Značilnosti starejšeželeznodobne lončenine v severovzhodni Sloveniji skozi prizmo keramične tehnologije in petrografije

IZVLEČEK – *Lončarska tehnologija starejše železne dobe ostaja v slovenski arheologiji slabše raziskana. To velja predvsem za uporabo makroskopskega opisa, združenega z dodatnimi petrografskimi preiskavami keramičnih zbruskov, ki upoštevajo tudi stratigrafske podatke najdb. V članku se osredotočamo na tehnologijo lončenih posod z dveh sodobno raziskanih starejšeželeznodobnih najdišč v severovzhodni Sloveniji, s Poštele pri Mariboru in z Novin pri Šentilju. Na zbiru celih in rekonstruiranih posod smo opisali sestavine lončarskih mas na makroskopskem nivoju. Poleg tega smo izdelali tipologijo posod, opisali obdelavo površine in izdelavo okrasa ter določili atmosfero žganja. Na podlagi teh rezultatov smo izbrali vzorce za petrografsko analizo. Značilnosti tehnologije izdelave posod smo na obeh najdiščih opazovali znotraj različnih arheoloških kontekstov, saj smo primerjali lončenino iz naselbin (gradišč) in tisto z bližnjih grobišč. Rezultati kažejo, da so lončarji iz obeh naselbin izdelovali podobne oblike posod, vendar so pri izdelavi uporabljali različne lončarske recepte iz lokalnih surovin. V članku opozorimo še na uporabo groga v lončarskih receptih kot morebitno kronološko občutljivo značilnost lončenine v starejši železni dobi.*

KLJUČNE BESEDE – *lončenina; tehnologija; petrografija; starejša železna doba; SV Slovenija; Poštela pri Mariboru; Novine pri Šentilju*

 DOI: 10.4312/dp.45.14

Introduction

Pottery represents a series of different physical properties of clay and additional raw materials that we observe with the aid of archaeometric analyses. But alongside the physical properties, ceramic vessels are products of a series of decisions made by potters in the past. These decisions and choices span from the procurement and preparation of raw materials, to tools, manufacturing techniques, sources of energy *etc*. These technological choices are related to the local environment and the availability of raw materials, as well as to potters' perception of the suitability of these materials, the politics of who controls these resources, the abilities and experience of potters, and cultural traditions (*Sillar, Tite 2000.7–9*). In all pottery analyses, we should strive to understand the environmental, technological, economic, social, political, and ideological contexts in which these products are embedded (*Stilborg 2001.401*). In particular, the choice of temper, which is by definition the substance added to clay by potters in order to modify its physical properties (*Rice 1987. 408–410*), can be besides the most obvious functional aspects also associated with social, political, or ideological aspects (*Stilborg 2001.398; Tite, Kilikoglou 2002.4; Tite* et al. *2001.321–322*). Pottery techniques are considered traditional inside their communities, and potters learn them from other potters in a form of apprenticeship, but the techniques used in one community present only some of all the possible technological solutions for making a clay vessel (*Sillar, Tite 2000.10*), and the unavailability of certain raw materials only rarely limited the manufacture of pottery (*van der Leeuw 1993.239*). Traditions can therefore be seen as the main unit of cultural evolution and change, and there is a correlation between culture and traditional activities, and as Elisabeth DeMarrais (*2004.13*) states, "*archaeology deals mostly with material traces of repeated activities*".

The technological choices of potters relate closely to the performance in manufacture and use in accordance with the intended function of the finished product. Potters control the shape and size of their products, the paste or pottery recipe, the surface treatment, as well as the firing conditions and techniques to create vessels that need to perform certain roles (*Skibo 2013*). Therefore, it is important to observe the paste's characteristics and other pottery manufacturing techniques on large sample assemblages to make better assessments of the intended role and function of vessels in a community. Although typology and chronology remain fundamental to pottery research, the analysis of pottery characteristics forms an important basis for our understanding of pottery production, as well as the social and physical environment of potters in the past.

Macroscopic analysis and descriptions of vessels remain the fastest method for processing large pottery assemblages, which is especially important in long-term projects, including excavations. It provides important fundamentals for further petrography sampling, as the results of thin section analysis can be extrapolated to the whole assemblage, which is virtually impossible if no data on macroscopic characteristics of pottery are provided (*Whitbread 2017*).

Ceramic petrography is an integral part of this analysis, especially for prehistoric pottery assemblages, as the observation, description, and interpretation of petrographic thin sections is central in understanding past technologies and production techniques (*Rice 1987; Whitbread 1995; Reedy 2008; Quinn 2015*). In petrography, we focus on pottery manufacture, such as collecting and preparing raw materials, the addition of temper, and the shaping, drying, and firing of vessels. This allows for a better understanding of how potters acted in the past, and what choices they made about pottery making. Furthermore, petrography and macroscopic descriptions of larger assemblages form the basis for understanding the operational sequence or the 'life cycle' of a vessel (*Lemmonier 1993*).

Our main focus in this study is pottery technology in the Early Iron Age, *i.e.* Hallstatt period (late 9th–mid. 6th century BC), specifically in the north-eastern region of Slovenia, which is an integral part of the broader Eastern Hallstatt circle and closely connected to the broader south-eastern Alpine and the north-western Pannonian regions. We analysed the composition of the ceramic material, as well as surface treatment, decoration, and firing techniques, and describe the pottery typology in the pottery assemblages from two Early Iron Age sites, Poštela near Maribor and Novine near Šentilj. The sites are similar in some ways: in the position of the settlement and presence of a flat cremation cemetery, as well as having barrow cemeteries outside the hillforts.

Within these complex sites, we also looked at the different contexts of sampled finds, comparing pottery from settlements to pottery from cemeteries outside the hillforts. Whole or reconstructed vessels were used as the main source of information for both sites, and were described firstly on a macrosco-

pic level. In the next step, thin sections of samples were prepared and analysed with an optical polarising microscope. As this is one of the first studies focusing on pottery technology for the Early Iron Age in Slovenia (*Žibrat Gašparič, Dolenec 2015*), especially using the combination of macroscopic and petrographic analysis, we will try to demonstrate the similarities and differences in pottery production and use between two contemporary sites, Poštela and Novine, first with an analysis within both individual sites and their various contexts, and then in comparison between them.

Archaeological background

Poštela is an Early Iron Age hillfort located above Maribor in north-eastern Slovenia that has been researched since the 19th century (*Teržan 1990.13, 59–78, 256–339; Teržan* et al. *2012; Mušič* et al. *2014.19*). In recent years, the hillfort was extensively researched in the course of interdisciplinary research projects of the Department of Archaeology at the University of Ljubljana. The projects included the interpretation of ALS data, geophysical research, geochemical mapping, as well as trial trenching and excavations (*Mušič* et al. *2014.42*).

The hillfort is located on the south-eastern ridge of the Pohorje Hills and covers approx. 6ha (Fig. 1). It is surrounded by a monumental rampart, while the interior has three smaller ramparts of a younger (post Early Iron Age) date and terraces (*Teržan* et al. *2012.26*). The settlement has a funerary area on the Habakuk plateau just below the hillfort, with a flat cremation cemetery, two groups of barrows (southern and northern group), and a so-called ritual ground located on the eastern edge of the southern barrow group. Individual barrows extend over the ridges to the south-east into the Drava River plain and towards the towns of Pivola and Spodnje Hoče near Maribor (*Mušič* et al. *2014.32–35, Fig. 16*).

In the present analysis, we included pottery from trenches excavated at the hillfort (trench 27), from the flat cremation cemetery (trenches 14 and 24), from the barrows (trenches 25 and 26), and from the ritual ground near the southern barrow group (trenches 1, 33 and 34), all of them located on the Habakuk plateau. The archaeological finds from the flat cremation graves and the earliest settlement layers date to the beginning of the Early Iron Age (Ha C0), whereas finds from the later settlement layers span to the developed Early Iron Age (Ha C1–C2/D1) and also to the Late Iron Age (Lt D). The finds from the so-called ritual ground and from the barrows seem to be dated only to the developed Early Iron Age (Ha C1–C2/D1).

The main trench excavated at the settlement (trench 27) shows two periods of occupation, the first form the Early Iron Age and the second from the Late Iron Age. The earlier can be further subdivide into three phases, representing different building activities or uses of the area (Fig. 2). The first phase is represented by two pits with a fireplace (phase Ia), which can be dated to the Ha C0. The following phase is characterised by extensive alteration of the excavated area by terracing (phase Ib). Later, a pit was dug through the accumulated layers (phase Ic), which held large amounts of pottery. Both of these phases are dated to the broader Ha C1–C2/D1 period, without a subdivision possibility in the present

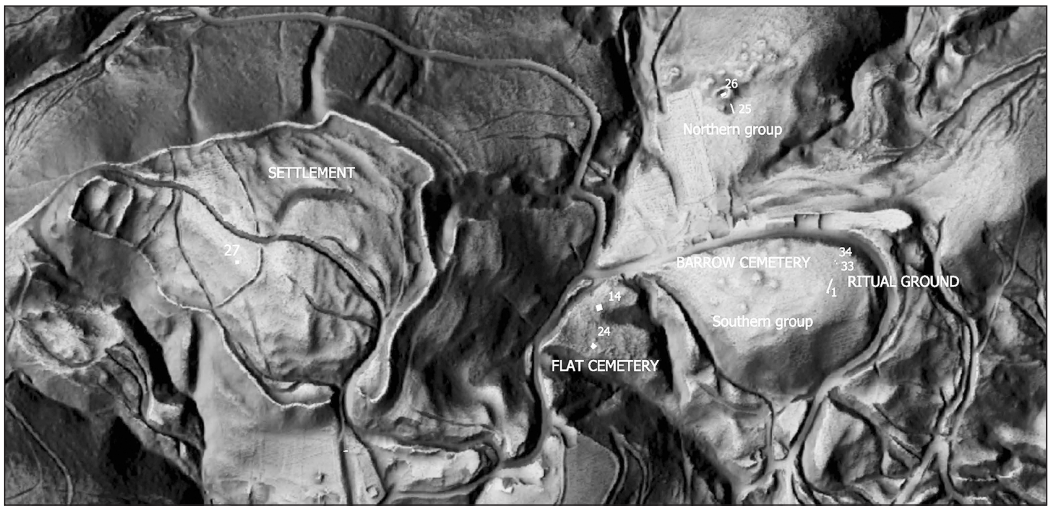

Fig. 1. Poštela on lidar-derived shaded DTM, with the position of the settlement, the so-called ritual ground, flat cremation and barrow cemetery and trial trenches.

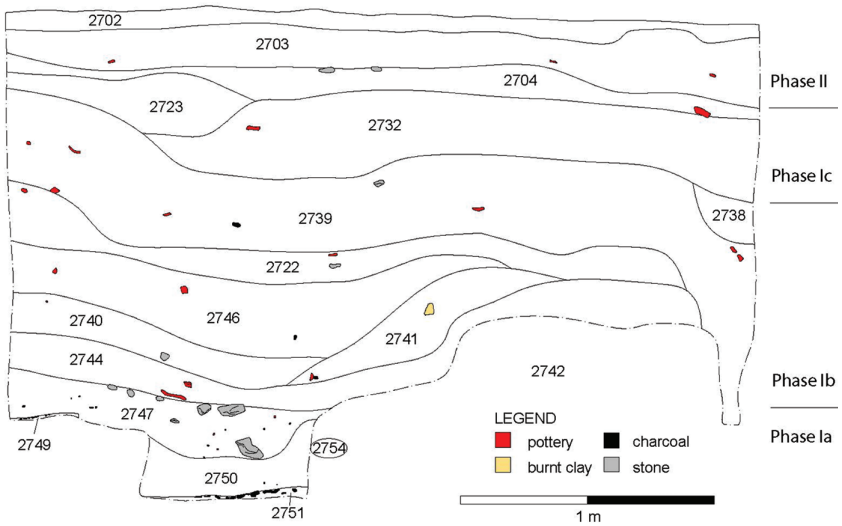

Fig. 2. Eastern cross-section of trench 27 at the Poštela hillfort showing the position of layers and interpreted periods/phases.

state of research. The second period, *i.e.* fourth building phase (phase II), dated to the Late Iron Age (Lt D), yielded a kiln with some additional contexts.

Novine (Ger. Bubenberg/Hoarachkogel) has a dominant position above the Mura valley (*Gaberz* et al. *2015.127*).[1] The hillfort, covering approx. 6ha, is situated on a small ridge on the right bank of the Mura River, and is divided by the modern Slovenian-Austrian state border (Fig. 3). The settlement is located on the northern part of the ridge and is fortified with ramparts on the western, southern and eastern side, whereas the northern part is protected by a precipice above the river. Intertwined holloways, *i.e.* ancient paths, lead from the hillfort to the south, passing a flat cremation cemetery and groups of barrows, but also additional elements of fortification. The complex ends to the south with the largest barrow on an elevated spur that overlooks the whole ridge (*Gaberz* et al. *2015.139*). In our analysis, we included pottery finds from the settlement (trenches 2 and 5), the flat cremation (trench 6) and the barrow cemetery (trench 1), as well as from the rampart shielding the central part of the cemetery (trench 3).

Most of the material comes from trench 5, which shows two different periods of occupation, the first form the Early Iron Age and the second from the Late Iron Age. The earlier can be further subdivide into four phases, representing different building activities or uses of the area (Fig. 4). The oldest phases are represented by two buildings (phases Ia and Ib), dated to the beginning of the Early Iron Age (Ha C0). They are followed by an occupational hiatus, marked by a levelling layer without building activities (phase Ic), which may, however, be merely a local phenomenon which cannot be extrapolated to the whole site. The fourth phase was marked by a stone pavement (Id) dating to the developed Early Iron Age (Ha C1–C2/D1). The youngest phase, dates already to the second occupational period (phase II) in the Late Iron Age (Lt D) (*Vinazza* et al. *2015.177–181, 183–184*).

Geological background

The Pohorje Hills, where Poštela is located, are part of Eastern Central Alps, and are composed of characteristic regionally metamorphosed rocks, with metamorphic rocks as the predominant type in the southeastern part. The central and western parts of Pohorje are composed mainly of igneous rocks (*Mioč, Žnidarčič 1989*). Poštela and its surroundings are built

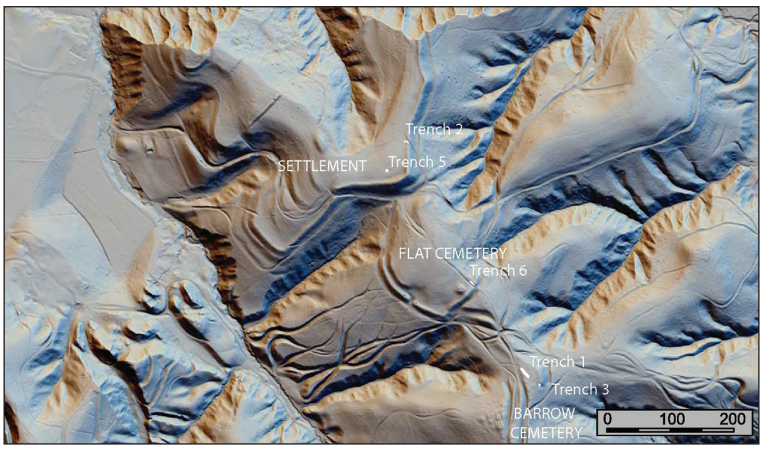

Fig. 3. Novine on lidar-derived shaded DTM, showing the position of the settlement, flat cremation and barrow cemetery, and trial trenches (modified after* Vinazza *et al.* 2015.sl. 1*).

1 The site recently came into focus, as it was one of the nodal locations for a bilateral Slovenian-Austrian project (*Črešnar, Mele 2015.9–10; Mušič* et al. *2014.41–42*).

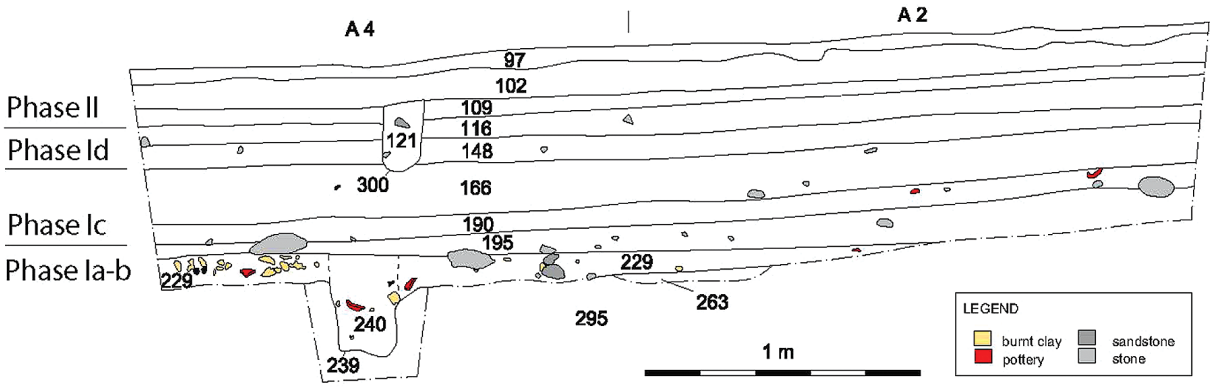

Fig. 4. Northern cross-section of trench 5 at Novine hillfort, showing the position of layers (after* Vinazza *et al.* 2015.sl. 37*).

on metamorphic rocks, such as muscovite-biotite gneiss, amphibolite, schist, and quartzite (Fig. 5). The gneiss often has lenses of brown to light grey and dark green amphibolite rock. The plains below the hillfort are composed of plio-quaternary sediments, with predominantly sand, sandy clays, and gravel. These sediments include grains of igneous, metamorphic, and sedimentary rocks and include heavy minerals (*e.g.*, garnet, rutile, epidote, zircon, zoisite, kyanite, and hornblende) (*Hinterlechner Ravnik 1971; 1973; 1974; Mioč, Žnidarčič 1989*).

Novine hillfort is located in the western part of the Slovenske gorice hills, which are characterised by sedimentary clastic Miocene rocks (Fig. 5). The surrounding hills are composed of sandstones and marls, with many microfossils, sands, and clay (*Rijavec 1976.56–58*). The gravel is composed of igneous, metamorphic, and sedimentary rocks with heavy minerals (*e.g.*, garnet, rutile, tourmaline, apatite). The sediments were deposited in marine basins, with the source material originating from the land masses of the Pohorje and Kozjak hills to the southwest and south of Novine, meaning that the igneous and metamorphic gravel found in the sandstones in Slovenske gorice came from parent rocks from Pohorje and Kozjak (*Mioč, Žnidarčič 1989*).

Analytical methods and sampling

For the present study, we analysed 832 ceramic vessels from Poštela and 405 vessels from Novine using macroscopic description and focusing on whole or reconstructed vessels that were excavated in different archaeological contexts. The Poštela samples come from the settlement, the flat cremation cemetery, the barrow cemetery and the ritual ground, all located on the Habakuk plateau below the hillfort (Fig. 1). We obtained the samples from Novine from inside the hillfort, and only a small number from graves, *i.e.* from the flat cremation and the barrow cemeteries (Fig. 3).

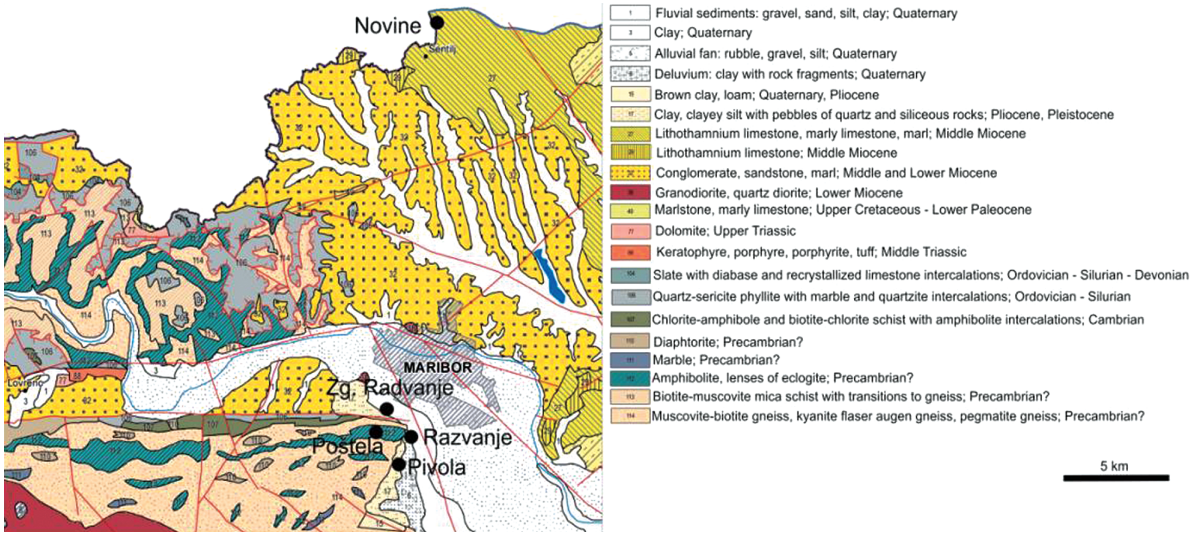

Fig. 5. The geological background of Poštela and Novine (adapted after* Buser 2009*).

Macroscopic description by means of a hand lens is still the most effective method for describing and analysing larger sets of samples. Macroscopic observation of pottery is relatively fast, offers adequate discrimination between vessels, can be done with minimal equipment, and forms the most suitable basis for petrographic sampling, as the acquired data can always be related back to the whole assemblage (*Whitbread 2017.217*). The main characteristics that we described on a macroscopic scale consist of the type of inclusions and their size, the size and shape of voids, forming techniques, surface treatment, decorating techniques and motifs, and the different firing techniques (*Horvat 1999; Rice 1987.113–310*). Using a hand lens and diluted hydrochloric acid, we determined the visible types of inclusions in a fresh cross-section of the pottery (approx. 1cm^2 surface), and we treat most as naturally occurring inclusions, with the exception of grog. We could identify additional inclusions as temper in petrographic analysis; therefore, we describe these results in the mineralogical/petrographic section of the paper.

In the following step, we chose samples for ceramic petrography analysis on the basis of the macroscopic results. Ceramic petrography was chosen, as it increases the identification of inclusions and allows for direct comparisons with the regional geology (*Rice 1987.415; Quinn 2015*). We sampled 23 vessels from Poštela and 15 vessels from Novine. We also collected locally available clays and sediments from the settlements and below the hillforts (Fig. 3). The clay samples were formed into 3 x 4cm tiles and fired in a modern kiln under oxidising conditions at 700 and 800°C and were also prepared as thin sections. The goal is to better understand potters' choices regarding the procurement of raw material in this region.

The selected samples were prepared as polished thin sections, 30µm thick, mounted on glass slides. These were then analysed under a polarising light microscope, Nicon Eclipse E600 POL, using standardised descriptions (*e.g., Whitbread 1995; Reedy 2008; Quinn 2015*). The thin sections were sorted into fabric groups based on the clay matrix and inclusions. On the basis of compositional, microstructural, and textural criteria, we identified the presence of specific techniques, such as the procurement of raw materials, the addition of temper, vessel forming, and the atmosphere and firing temperatures (*Reedy 2008. 146–148, 173–189; Whitbread 1986; 1995.393–394; Quinn 2015.83–93*).

Results

Poštela

Pottery typology and technology

During the 2012 to 2015 fieldwork at Poštela, more than 68 000 pottery sherds were recovered, and of these, 1689 could be reconstructed into 980 vessels. We analysed the technological characteristics of 832 whole and fragmented vessels from different contexts: the settlement (trench 27), the flat cremation cemetery (trenches 14, 24), the barrow cemetery (trenches 25, 26) and the so-called ritual ground (trenches 1, 33, 34, Figs. 1 and 2). Most of the material originates from the ritual ground, where a larger deposit of pottery alongside cremated animal bones was excavated. Other trenches were omitted due to their size (trenches less than 2m^2), the very small number of vessels (< 10), or mixed material with no clear stratigraphy. Accordingly, we analysed 173 vessels from the settlement, 554 vessels from the ritual ground, 55 vessels from the flat cemetery, and 50 vessels from the barrow cemetery.

We identified the following types of vessels at Poštela: bowls (conical, rounded, spherical, round-bellied), pots (oval, spherical, round-bellied), storage

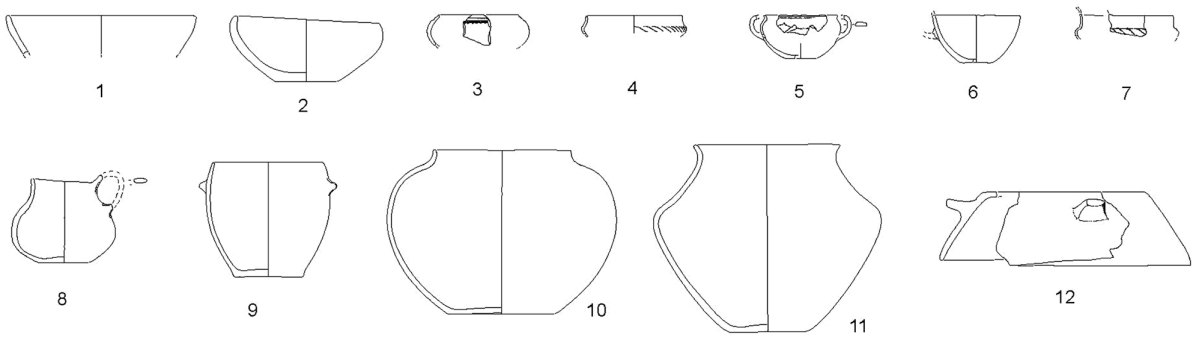

Fig. 6. Typical vessel types from Poštela. 1 conical bowl; 2 rounded bowl; 3 globular bowl; 4 round-bellied bowl; 5 globular cup; 6 semi-globular cup; 7 round-bellied cup; 8 jug; 9 oval pot; 10 globular pot; 11 round-bellied pot; 12 baking lid (scale 1 : 8; drawing by D. Oman).

jars, urns, lids (conical, shallow), backing lids (conical, rounded), jugs, cups (spherical, semi-spherical, round-bellied), small cups, and miniature vessels (round-bellied, biconical) (Figs. 6 and 7). Vessel types could be identified in 61% of the analysed material. The most common types are various bowls (60%), followed by pots (24%), while other types comprise less than 20% of the assemblage. Bowls are the most common type in the settlement, the ritual ground, and in the barrow, whereas pots predominate in the flat cremation graves.

The macroscopically determined inclusions are quartz, mica, organic matter, iron oxides, clay pellets, and grog in various combinations (Tab. 1). All of the samples contain quartz and mica inclusions; the main difference is in the presence of organic matter, iron oxides, clay pellets, and grog. Vessels with only quartz and mica inclusions predominate in the assemblage (20%), although vessels with additional organic matter and grog are also common (in approx. 15%). The majority of vessels from the settlement, the ritual ground, and the barrows contain only quartz and mica inclusions, whereas the vessels from the flat cremation cemetery have organic matter and grog added to the quartz and mica inclusions. Grog especially is more common in vessels from the flat cemetery than other locations (70% of vessels contain grog inclusions in contrast to the 30% to 45% of vessels excavated at the settlement, ritual ground, and the barrows) according to the results of the macroscopic description.

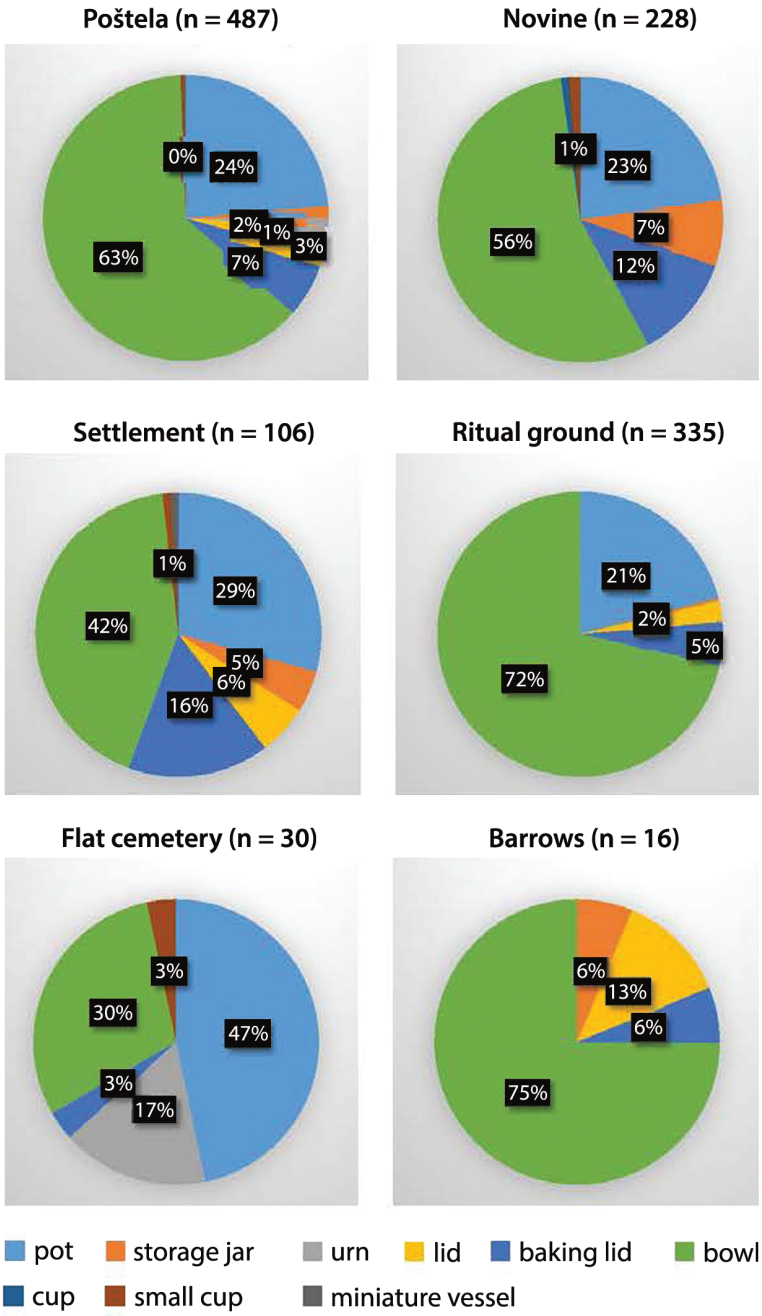

Fig. 7. Ratios of vessel types from Poštela in total and according to context, as well as from the Novine assemblage.

Most of the inclusions are in the medium sand size (0.26 to 0.5mm) in approx. 50% of the analysed vessels; some 30% of the vessels contain inclusions predominantly of coarse sand (0.5 to 1mm), 16% fine sand, and less than 1% in the fine gravel size (more than 1mm) (Fig. 8). The fine gravel inclusions were present only in vessels from the settlement and the ritual ground, whereas vessels from the flat cemetery and the barrows contain inclusions only in the sand size. Most of the shapes (*i.e.* pots, lids, baking lids, and bowls) contain inclusions in the medium sand size, although only baking lids contain inclusions in the fine gravel size. A third of the pots from the settlement and the ritual ground were made with inclusions in the coarse sand size, but only a fifth of pots from the flat cremation graves were made with such inclusions. Bowls are made mostly of medium sand size, although fine sand sized inclusions predominate in the bowls from the barrows.

Inclusions	Poštela (n = 832)	*settlement* (n = 173)	*flat cemetery* (n = 55)	*ritual ground* (n = 544)	*barrows* (n = 50)	Novine (n = 405)
Q, M	27,8%	38,2%	16,4%	23,1%	56,0%	4,5%
Q, M, Cp	0	0	0	0	0	14,2%
Q, M, Cp, G	0,2%	1,2%	0	0	0	17,0%
Q, M, G	16,5%	17,3%	30,9%	14,8%	16,0%	8,2%
Q, M, Io	5,9%	1,7%		8,3%	0	0,5%
Q, M, Io, Cp	0	0	0	0	0	0,7%
Q, M, Io, G	2,3%	2,3%	3,6%	2,3%	0	0,2%
Q, M, Om	16,8%	11,0%	12,7%	19,3%	14,0%	9,0%
Q, M, Om, Cp	0,1%	0,6%	0	0	0	7,7%
Q, M, Om, Cp, G	0,1%	0,6%	0	0	0	20,1%
Q, M, Om, G	15,9%	24,9%	34,5%	11,4%	14,0%	16,7%
Q, M, Om, Io	12,3%	2,3%	1,8%	17,5%	0	0,2%
Q, M, Om, Io, Cp	0	0	0	0	0	0,7%
Q, M, Om, Io, Cp, G	0	0	0	0	0	0,2%
Q, M, Om, Io, G	2,2%	0	0	3,2%	0	0

Tab. 1. Types of inclusions as observed by macroscopic analysis from Poštela, in total as well as from different contexts (settlement, flat cemetery, ritual ground, barrows), and from Novine (in total). The inclusions are abbreviated as: Q quartz, M mica, Cp clay pellets, G grog, Io iron oxides, Om organic matter.

Hand-forming techniques were used to form the vessels into various shapes from these clay pastes[2]. The surfaces were smoothed with various surface treatment techniques, the most common being smoothing, burnishing, and polishing. For smoothing, potters use soft tools (*e.g.*, cloth, leather) to smooth out any irregularities on the surface of the vessel after forming. In burnishing, the surface of the vessel is treated with a hard but smooth object such as a pebble or bone, which are easily recognisable by the streaky lustre and incomplete coverage of the surface. Polishing is executed on a dry surface, and gives the vessels a uniform lustre (*Rice 1987.124–140*). The surfaces of most of the vessels from Poštela were treated with smoothing and burnishing; only rarely was polishing used (on less than 5% of the analysed vessels).

Decoration of the vessels was not common. Most of the pottery assemblage has no decoration, and a mere 10% of the vessels from the flat cremation cemetery and up to 30% of the vessels from the settlement, barrows, and ritual ground were decorated. The decoration techniques identified in the Poštela assemblage are incisions (*e.g.*, incisions, grooved incisions, fluted incisions, and piercing), impressed decorations (*e.g.*, with fingertips, fingernails, awl, cord and stamp), applied decorations (*e.g.*, cordon, handmade appliqués, barbotine), and combinations of these techniques. The most common technique in the vessels from the settlement and the barrows are incisions (approx. 40 to 60%). Impressions predominate in the flat cremations cemetery vessels (approx. 60%), and most of the vessels from the ritual ground also have a combination of an applied cord with awl impressions (approx. 35%).

The motifs (Fig. 9) are mostly simple lines executed in different decoration techniques (incisions, impressions, appliques, or a combination of techniques) or circular ornaments (especially as appliqués). Less than 5% of the decorated vessels have other types of motifs: hatched triangles on vessels recovered

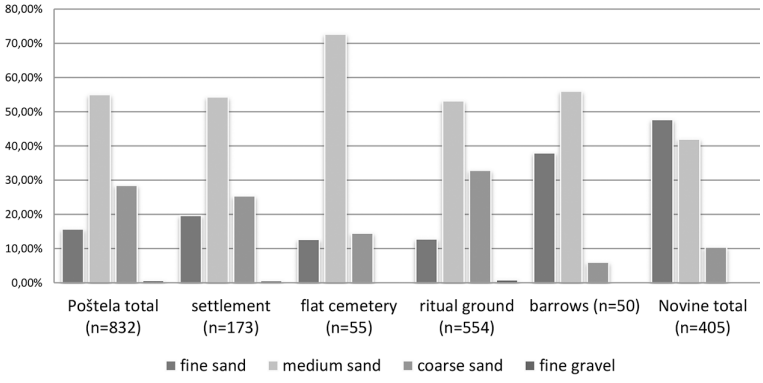

Fig. 8. Average grain sizes of inclusions in pottery from Poštela, in total and from different contexts, and Novine (in total) as observed on the macroscopic scale.

2 The results of this aspect of production will be published separately, as it is an extensive subject and is outside the scope of this paper.

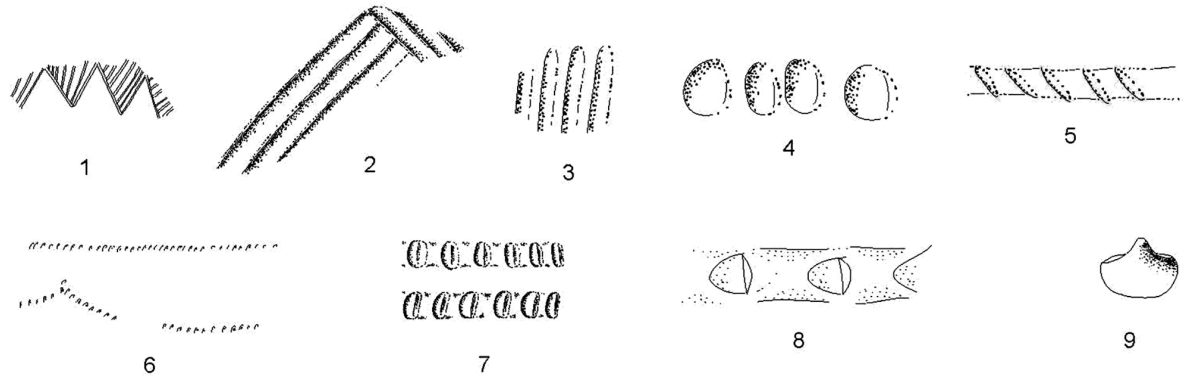

Fig. 9. Decoration techniques with different motifs at Poštela. 1 hatched incised triangles; 2 incised triangle; 3 incised lines; 4-6 impressed lines; 7-8 appliqué with impressions in a line; 9 simple appliqué.

from the settlement, the ritual ground and the barrows, zigzag motifs from the ritual ground and the settlement, concentric circles, and a rhomb motif arranged in a line.

An incomplete oxidising firing atmosphere predominates in the majority of prehistoric vessels fired in open fire pits, as the firing temperature and atmosphere were not easily controlled by potters (*Rice 1987.109*). Nevertheless, we know from other sites in the region that kilns were used for firing pottery at least from the Bronze Age (*Kossack 1995.Abb. 33; Črešnar 2006.115*). The use of both techniques can be assumed at Poštela (Tab. 2), where half of the vessels show traces of incomplete oxidation, while the remainder of the vessels bear traces of firing in a more controlled atmosphere, perhaps in a kiln. By looking at the contexts at Poštela, we could observe many differences in the firing atmospheres of the pottery (Tab. 2).

If we look more closely into the pottery assemblage from trench 27 at the Poštela hillfort, we can see that the excavations yielded a stratigraphy with occupation spanning from the beginning of the Early Iron Age until the Late Iron Age (Fig. 2). In the oldest phase (Ia), dating to the Ha C0 period, vessels were made both with and without grog inclusions in a similar ratio (51% *vs*. 49%). The inclusions are in the medium sand size in 60% of the vessels, and the vessels were fired in an incomplete oxidising and oxidising atmosphere in 35% and 25% of vessels, respectively. Firing with an oxidising atmosphere at the beginning and a reducing atmosphere at the end of firing (with a typical light coloured core and dark surface of vessels) was evidenced only in vessels from this phase. In terms of typology, the most common vessel types are bowls, pots, and baking lids, with occasional appearance of storage jars, lids, a small cup, and a miniature vessel. Almost half of the vessels were decorated with a combination of an appliqué with impressions, while the rest were decorated with incisions, impressions, and appliqués.

The inclusions in vessels from the second and third phase (Ib, Ic; Ha C1–C2/D1) consist predominantly of quartz and mica inclusions, whereas grog was identified in less than half of the samples (approx. 42%). The inclusions are in the medium sand size in some 40% of the vessels, and they were fired in an incomplete oxidising and reducing atmosphere at around 48% and 25%, respectively. Less than 10% of

Firing / atmosphere	**Poštela (n = 832)**	***settlement* (n = 173)**	***flat cemetery* (n = 55)**	***ritual ground* (n = 544)**	***barrows* (n = 50)**	**Novine (n = 405)**
oxidising	26.6%	16.8%	14.5%	32.1%	12.0%	21.2%
reducing	13.0%	20.8%	14.5%	8.1%	38.0%	23.0%
uncontrolled	8.8%	15.0%	7.3%	7.2%	6.0%	0
oxidising with reducing conditions at the end	1.3%	1.8%	0	1.4%	0	3.2%
reducing with oxidising conditions at the end	2.3%	0.6%	3.6%	2.3%	6.0%	11.1%
incomplete oxidising	48.0%	45.1%	60.0%	48.6%	38.0%	37.0%
series of alternating atmospheres	0.1%	0	0	0.2%	0	0.2%
overfired	0	0	0	0	0	4.2%

Tab. 2. Firing atmosphere of Poštela, in total and from different contexts, and Novine pottery (in total).

vessels from these phases were fired in a complete oxidising atmosphere. The other type of firing, exclusively identified in these phases, is firing in reducing conditions with an oxidising atmosphere at the end of the process (recognised by a typically dark-coloured core and light-coloured surface of vessels). These layers yielded bowls and pots as the most common types of vessels, with rare storage jars, lids, and cups; however no baking lids have been identified. Vessels were decorated with a wider variety of techniques, although more than half had incised decoration; other types of decoration are less frequent.

Ceramic petrography

For the petrographic analysis, we sampled 19 vessels from the Poštela settlement (9 samples from trench 27, one from trench 32), as well as from trenches below the hillfort: four samples from the ritual ground and five from the flat cremation cemetery (Tab. 3). The analysis revealed the presence of four main fabric groups (A, B, C, D) according to the presence of different inclusions, use of temper and composition of the clay matrix (Tab. 4; Figs. 10 and 11). All the fabrics are made of non-calcareous clay with aplastic and rare plastic inclusions, *i.e.* organic matter. The most common inclusions are monocrystalline quartz, mica (muscovite, biotite), metamorphic rock fragments (quartzite, amphibolite), opaques or 'amorphous' concentration features, and accessory minerals (epidote, clinozoisite, hornblende, plagioclase feldspars, rutile, and sphene) (more details in *Žibrat Gašparič, Dolenec in prep*). The pottery samples all show an optically active clay matrix in the petrographic analysis, which is indicative of lower firing temperatures (max. 800°C) for these vessels (*Grimshaw 1971.221–227; Cultrone* et al. *2001*).

Some of the samples contained temper intentionally added to the clay; metamorphic rocks (fabrics A, B1-2, C1-3, D1) were the most common, but other types of temper are also present, such as igneous rocks (fabric C3), grog (fabrics B2, D2), organic matter (fabrics B3, D3), and mica (fabric C1). Only two fabric sub-groups contained no temper added to the clay (fabrics B4, C4).

Fabric group A is an amphibolite tempered fabric determined by the size, sorting, and frequency of amphibolite, hornblende, and clionozoisite grains in the matrix. The fabric was found in an urn from the flat cremation cemetery on the Habakuk plateau dating to the Ha C0 period (Fig. 10.A1).

Sample No.	Vessel type	Trench	Context	Fabric	Description of fabric
149	cup	1	ritual ground (SU 1006)	C4	quartzite & hornblende fabric
449	urn	14	flat cremation cemetery (SU1605)	A1	amphibolite temper
453	small cup	14	flat cremation cemetery (grave N. 19)	B2	grog, quartzite & amphibolite temper
454	bowl	14	flat cremation cemetery (grave N. 19)	B3	organic, quartzite & amphibolite fabric
451	pot	24	flat cremation cemetery (grave N. 24)	D1	quartzite & garnet temper
452	bowl	24	flat cremation cemetery (grave N. 24)	B4	quartzite & amphibolite fabric
510	pot	27	settlement (SU 2725)	C2	quartzite temper
1023	pot	27	settlement (SU 2727)	D2	grog temper
808	bowl	27	settlement (SU 2739)	C2	quartzite temper
732	small cup	27	settlement (SU 2747)	D3	organic temper
738	pot	27	settlement (SU 2745)	C1	quartzite & mica temper
755	pot	27	settlement (SU 2745)	B2	grog, quartzite & amphibolite temper
788	bowl	27	settlement (SU 2745)	B2	grog, quartzite & amphibolite temper
733	lid	27	settlement (SU 2751)	B1	quartzite & amphibolite temper
745	pot	27	settlement (SU 2751)	C3	quartzite & granodiorite temper
659	bowl	32	settlement	B4	quartzite & amphibolite fabric
844	bowl	34	ritual ground (SU 3403)	B1	quartzite & amphibolite temper
866	bowl	34	ritual ground (SU 3403)	B1	quartzite & amphibolite temper
868a	decorated vessel	34	ritual ground (SU 3402)	B1	quartzite & amphibolite temper
Razvanje 1	clay, fired to 700°C		east of Poštela hillfort		
Razvanje 2	clay, fired to 700°C		east of Poštela hillfort		
Zg. Radvanje	clay, fired to 700°C		north of Poštela hillfort		

Tab. 3. List of petrography samples from Poštela.

Fabric	Description of fabric	Sample No.	quartz	mus-covite	bio-tite	hem. agreg.	quartzite	amphi-bolite	horn-blende	clino-zoisite	sphene	epi-dote	granodi-orite	gar-net	orga-nic	grog	other minerals (<2% total)
A1	amphibolite temper	449	25	20	5	15		1	20	10	5	5					chlorite, plagioclase, K-feldspars,rutile
B1	quartzite & amphibolite temper	733, 844, 866, 868a	30–35	30–40	10–15	2–5	<0.5	0.5–1	1–2	2–5	2–5	<0.5	<0.5	<0.5			chert, chlorite, plagioclase, rutile
B2	grog, quartzite & amphibolite temper	453, 755, 788	35–45	20–30	2–5	15	1–2	<0.5	1–2	2–5	0.5–1	0.5–1		<0.5	1–2	1–2	chlorite, plagioclase, rutile
B3	organic, quartzite & amphibolite fabric	454	35	35	1–2	2–5	<0.5	0.5–1	2–5	2–5	<0.5	<0.5			10		chlorite, plagioclase, rutile
B4	quartzite & amphibolite fabric	452, 659	35–40	35–40	5	15	0.5–1	<0.5	0.5–1	0.5–1	<0.5	0.5–1					chlorite, plagioclase, rutile
C1	quartzite & mica temper	738	35	25	20	10	2–5		0.5–1	0.5–1	<0.5	1–2					chlorite, rutile
C2	quartzite temper	510, 808	40–50	20–35	10	10	2–5		0.5–1	0.5–1	<0.5	0.5–1		1–2			chlorite, plagioclase, K-feldspars,rutile
C3	quartzite & granodiorite temper	745	40	20	15	15	1–2		0.5–1	<0.5	<0.5	<0.5	1–2				chert, plagioclase, K-feldspars,rutile
C4	quartzite & hornblende fabric	149	40	20	2–5	25	<0.5		0.5–1	1–2	<0.5	2–5					chlorite, K-feldspars, rutile
D1	quartzite temper & garnet inclusions	451	30	25		25	2–5					<0.5		10			chert, chlorite, rutile
D2	grog temper	1023	35	35	2–5	15	1–2			0.5–1		1–2				1–2	chert, chlorite, plagioclase, K-feldspars, rutile
D3	organic temper	732	50	25	2–5	5	1–2			0.5–1		1–2		<0.5	10		chlorite, plagioclase, rutile
clay	clay, fired at 700°C	Razvanje 1	35	20	15	10	<0.5	<0.5	2	0.5–1	<0.5	0.5–1		<0.5			plagioclase, rutile
clay	clay, fired at 700°C	Razvanje 2	40	20	15	5	<0.5	<0.5	5	<0.5	<0.5	1–2		<0.5			chlorite, plagioclase, rutile
clay	clay, fired at 700°C	Zg. Radvanje	35	20	15	5	<0.5	<0.5	10	<0.5	0.5–1	0.5–1		<0.5			chlorite, plagioclase, K feldspars, rutile, zircon

Tab. 4. The results of ceramic petrography of the Poštela pottery samples. Numbers are in %.

Fabric group B also contains metamorphic rocks as inclusions, but here quartzite is present in the clay alongside amphibolite. The various subgroups of this fabric include samples with quartzite and amphibolite added as temper (fabric B1), quartzite, amphibolite, and grog temper (fabric B2) or quartzite, amphibolite temper with added organic matter (fabric B3). Fabric B4 has only fine-grained quartzite and amphibolite fragments, which form part of the naturally occurring inclusions in the clay (Fig. 10.B1–B4). The different types of temper were identified on the basis of the size, sorting, and frequency of these grains in the clay matrix.

Fabric group C differs from the other samples, as the fabric has only quartzite inclusions, but no amphibolite. The subgroups differ according to the added temper, which is only quartzite temper (fabric C2), quartzite and muscovite and biotite mica temper (fabric C1), quartzite and igneous rocks temper (fabric C3), and fabric with only naturally occurring quartzite fragments (fabric C4) (Fig. 10.f; 10.C1–C4).

Fabric group D has only rare quartzite fragments, which occurs naturally, give their size, sorting, and frequency inside the matrix. The samples in this group contain quartzite temper and a higher frequency and size of garnet inclusions (fabric D1), grog temper (fabric D2), and organic temper (fabric D3) (Fig. 10.D1–D3).

The distribution of the fabric groups in the different contexts shows that samples from the settlement are more diverse in composition, as the majority of fab-

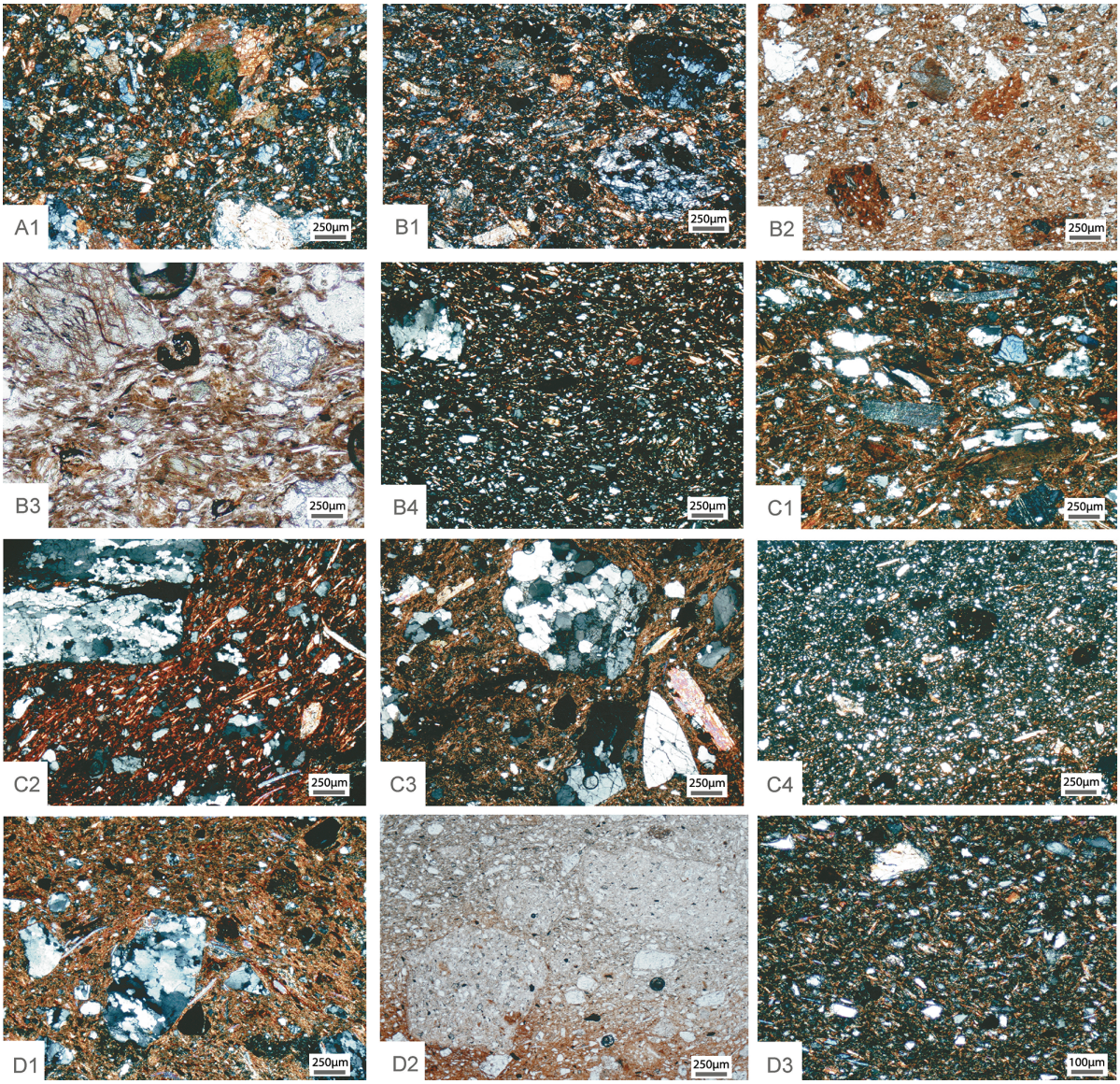

Fig. 10. Photomicrographs of the Poštela fabrics (A1 to D3). Photos B2, B3, D2 taken in parallel polars, all other photos taken under crossed polars.

ric groups and subgroups were identified here. That includes fabric groups B, C and D, whereas vessels with quartzite temper (fabric groups C1-C3) were identified in trench 27 exclusively. Fabric group B with added amphibolite and quartzite temper (fabric B1) and with added grog (fabric B2) was found only in the oldest Ha C0 phase, on the other hand groups C and D were found in all Early Iron Age occupation phases in this trench (Fig. 2).

In addition to the pottery samples, we obtained three locally available clays from the plains approx. 1.5km to the east (location Razvanje) and north of the Poštela hillfort (location Zgornje Radvanje) for a complementary provenance analysis (Tabs. 3 and 4). Here, regional clays are mostly secondary clays with an illite-chlorite composition and many other aplastic inclusions, depending on the local geology (*Rokavec 2014*). The three clay samples have a similar mineralogical composition, with quartz, muscovite and biotite mica, opaque minerals and clay pellets, as well as metamorphic rock inclusions (quartzite, amphibolite) and accessory minerals (plagioclase feldspars, hornblende, clinozoisite, sphene, epidote, rutile, and garnet) (for details see *Žibrat Gašparič, Dolenec in prep.*).

The two Razvanje clays are composed of a fine-grained non-calcareous reddish brown clay matrix with frequent (30%) aplastic inclusions in the clay matrix. The metamorphic (quartzite, amphibolite) rock fragments are sub-angular inclusions in fine to coarse sand size (0.05 to 1mm). The clay sample from Zg. Radvanje is composed of a fine-grained non-calcareous reddish-brown clay matrix, with abundant (40%) aplastic inclusions, such as quartzite and amphibolite; additionally, in comparison to the Razvanje clays, there was a higher content of hornblende, while clay pellets were absent.

The composition of the analysed clay samples is comparable to the pottery fabric groups B1–B4. The main difference in the composition is the presence of temper in the pottery fabrics. Fabric groups A1 and C1–C4 share some similarities with the local clays, but were obtained from a different source, since they contain different amounts of amphibolite and quartzite grains from the analysed clays (Tab. 4). Fabric groups D1–D3 have no amphibolite or hornblende inclusions; they could be made from raw materials not available at Poštela. The closest rocks with a similar composition can be found some kilometres south-west of the settlement, where the local geology shows significantly fewer amphibolite rocks than at the hillfort (*Mioč, Žnidarčič 1989*).

Novine

Pottery typology and technology

At Novine, more than 4500 sherds were recovered from all the trenches, of which 405 vessels were included in the analysis. As the excavated trenches were small, most of the samples come from trenches inside the hillfort (*i.e.* 399 vessels). The comparison between the settlement and the cemetery is therefore limited.

Vessel types could be identified in 228 of the samples (approx. 55% of all the analysed material), and include pots, storage jars, backing lids, bowls, cups, and small cups (Figs. 7 and 11). The most common types are bowls (approx. 55% of the types), which are divided into three groups (Fig. 11.1–5). Bowls are followed by pots, with 23%, which are divided into five groups (Fig. 11.10–14). Another fairly representative group, recognised in 12% of the assemblage, are backing lids (Fig. 11.9). Storage jars, cups and small cups comprise less than 10% of vessels (Fig. 11.6–8).

In the macroscopic analysis, we observed the following inclusions: quartz, mica, iron oxides, clay pellets, grog, organic matter, and graphite. Quartz, mica and grog are present in more than 60% of the samples. Other inclusions could be identified in various combinations (Tab. 1): additional organic matter and clay pellets in 20% of the samples, only organic matter or clay pellets in some 16% of the samples. Vessels without grog have quartz, mica and clay pellets as inclusions, and are present in 15%.

The inclusions are mostly in the fine sand size (up to 0.25mm) in around 47% of the vessels; approx. 42% contain inclusions in the medium sand size (0.26 to 0.5mm), and some 11% contain inclusions, mostly of coarse sand size (0.5 to 1mm) (Fig. 8). At Novine, only storage jars and baking lids contain inclusions, generally in the medium sand size, whereas pots and bowls are mostly made with inclusions of fine sand. Overall, the vessels at Novine have finer inclusions than the Poštela pottery.

The most common surface treatment of the Novine assemblage is smoothing, in more than 65% of the vessels, followed by burnishing in around 27%, and only some vessels were polished (about 4%).

Most vessels at Novine were undecorated; only some 14% had decoration. The most common techniques used are incisions (incisions, grooved and fluted incisions, and combed decorations), impressions (fingertip and fingernail impressions, awl impressions,

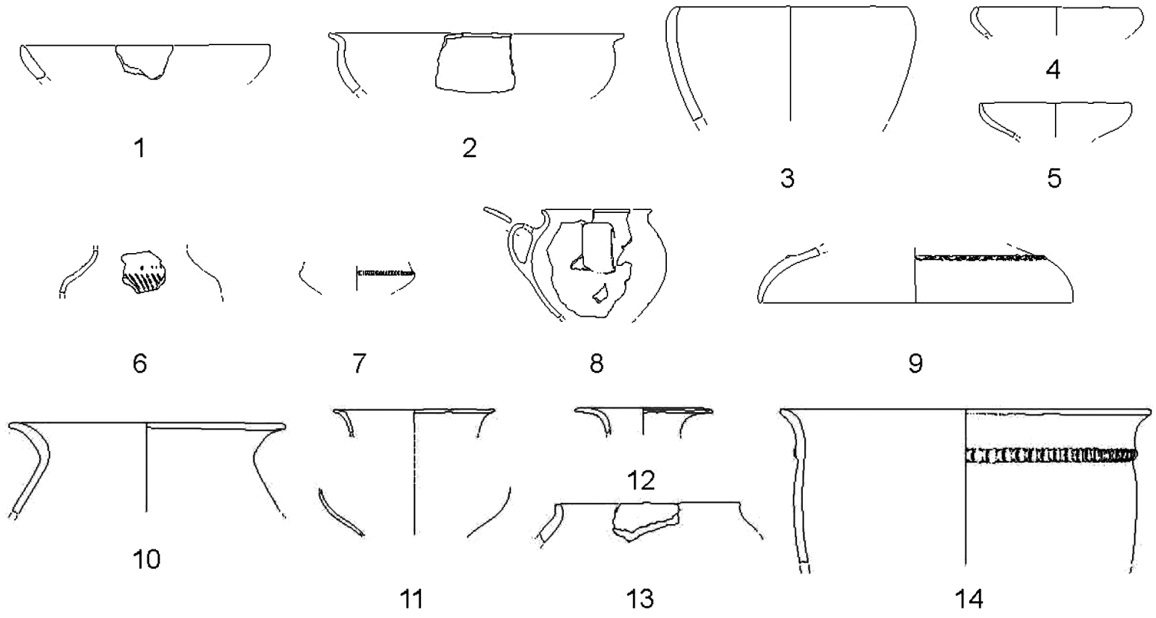

Fig. 11. Typical vessel types from Novine. 1 conical bowl; 2-5 rounded bowl; 6-8 cups; 9 backing lid; 10-11 round-bellied pot; 12 pot with high funnel-shaped neck; 13 globular pot; 14 oval pot (scale 1:8; drawing by D. Oman).

stamped, and roller-stamped decoration), applied decoration (a cordon, handmade appliqué, and a matrix-made relief), and a combination of impressions and applied decorations (the most common is an applied cord with awl impressions). Incised decorations were recognised in approx. 34% of the decorated samples, impressions in around 16%, and applied decorations in around 18% of the samples. The combination of appliqués with awl impressions could be seen in a third of the samples.

The most common motifs are simple horizontal, vertical, or oblique lines made with different techniques (incisions, impressions, appliqués, or a combination of these techniques). Other motifs are rare, and include perpendicular lines, a band of oblique lines, a band of (hatched) triangles, and semi-circles.

The firing techniques identified in the Novine assemblage show that most of the vessels (approx. 39%) were fired in incomplete oxidising conditions in an open fire (Tab. 2), and some 20% of the samples were fired either in a reducing or oxidising atmosphere. Other types of firing were less common. Some vessels (less than 4%) show signs of over-firing; these signs include some bloating, higher porosity and hardness.

The earliest phases at Novine date to the Ha C0 period, and vessels from these phases were mostly made with quartz, mica, organic matter, and grog inclusions. Vessels with grog from the earliest layers (phases Ia, Ib) comprise around 67% of the whole assemblage. The most common firing technique was in an incomplete oxidising atmosphere (in approx. 32%), but firing in an oxidising and reducing atmosphere inside a kiln is also common (approx. 25% for each). More than 10% of vessels were fired in an oxidising atmosphere at the beginning and a reducing atmosphere at the end of firing (with a typical light-coloured core and dark surface of vessels), which is a rare technique in the later phases. Typologically, most of the vessels are bowls and pots (approx. 30% each), but baking lids and storage jars are also common. The vessels were mostly decorated with a combination of an appliqué with impressions, although incisions and appliqués are also common (around 20% each).

The later occupational phases, dating to Ha C1–C2/D1, include vessels with predominantly quartz, mica, organic matter, clay pellets, and grog inclusions. Vessels with added grog predominate, but in a lower percentage than in the previous phases (only approx. 53%). The firing atmosphere was predominantly not completely oxidised (approx. 49% of vessels), although firing in oxidising and reducing conditions are also common (around 13% to 23%, respectively). The other common firing technique is in reducing conditions with an oxidising atmosphere at the end (recognised by the typical dark-coloured core and light-coloured surface of vessels) in some 12% of vessels. The order is the exact reverse of the firing atmosphere that occurred in the older phases. These pha-

ses have similar types of vessels, although different subtypes of bowls predominate in the assemblage, with approx. 72%. Only approx. 15% of vessels were pots, with the remainder being storage jars and baking lids. The decorations remain similar to the previous phases.

Pottery from both the Ha C0 and the Ha C1–C2/D1 phases was made mostly with the addition of grog temper, although the share of vessels with grog is lower in the later phases (around 53% to 67%, respectively). We could also observe differences in firing of vessels and the types, whereas the size of inclusions and decoration were not subject to change.

Ceramic petrography

The petrography of 14 pottery samples from Novine showed the presence of six fabrics that differ according to composition and temper (Tabs. 5, 6; Fig. 12). Most of the samples come from trench 5 from the settlement at Novine, and show many similarities in their composition. Two samples come from trench 3, excavated through the rampart at the central part of the cemetery, and one from trench 6 in the flat cremation cemetery in front of the settlement.

The pottery is made of non-calcareous clay with aplastic inclusions and rare organic inclusions. The most common aplastic inclusions are monocrystalline quartz, mica (muscovite, biotite), metamorphic rocks (quartzite), chert, opaques or 'amorphous' concentration features, argillaceous rock fragments and rare accessory minerals (plagioclase and K-feldspars, garnet). Generally, the samples have an optically active clay matrix in the petrographic analysis, which is indicative of lower firing temperatures (max. 800°C) for these vessels (*Grimshaw 1971.221–227; Cultrone* et al. *2001*). Only four samples show a darker clay micromass, with weak optical activity, which could point to a higher firing temperature for these samples, between 800 and 900°C (*Cultrone* et al. *2001.624–628*).

Most of the fabrics had temper added to the clay, such as grog (fabrics N3, N4, N5), rock fragments (fabrics N4, N5, N6), and organic matter or chaff (fabric N5). Fabrics with added grog are most common, and were recognised in 11 samples from Novine, whereas lithic temper (quartzite) is present in just four samples. Other fabrics with temper are represented by one sample each. Two fabrics have no added temper to the clay matrix, but are made from different clays: one is a clay matrix with rare quartz and mica inclusions (fabric N1), and the other has quartz, mica, metamorphic rocks, feldspars, and amphiboles as natural inclusions (fabric N2).

For the complementary provenance analysis (Tabs. 5 and 6), we sampled three locally available clays and sediments from Novine (No. 1004, 1005, 1006). The clays in this region are mostly secondary clays, with an illite-chlorite composition and aplastic inclusions, depending on the local geology (*Rokavec 2014*). The clay samples from Novine have a very similar composition; they are all of non-calcareous clay with predominantly quartz inclusions. The main difference between the samples is in their quartz grain size distribution (for details, see *Žibrat Gašparič,*

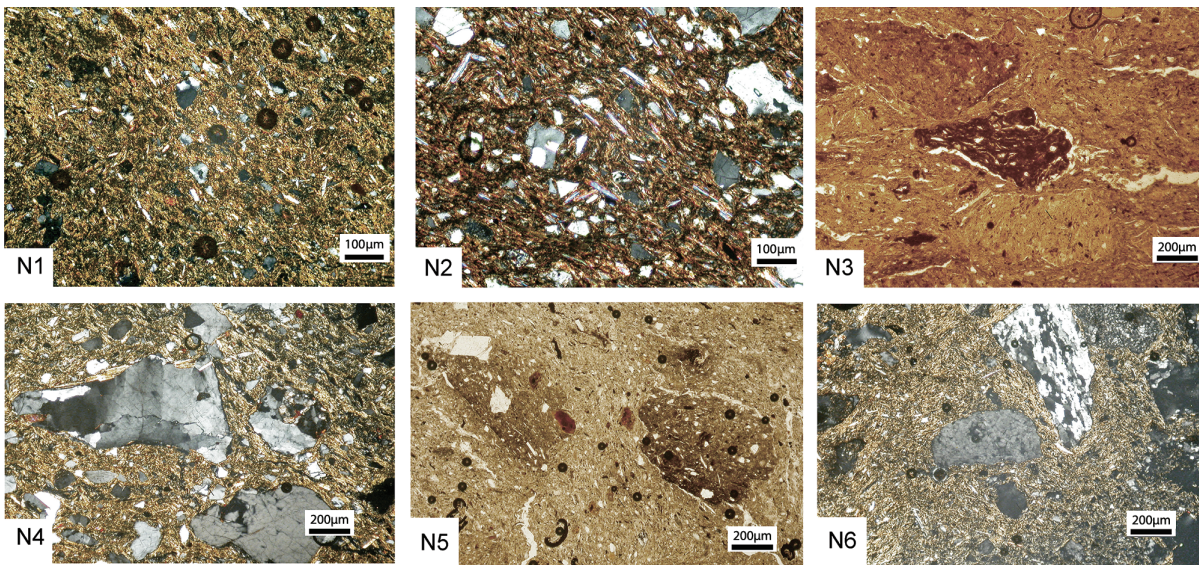

Fig. 12. Photomicrographs of the Novine fabrics (N1–N6). Photos N1, N2, N4, N6 taken under crossed polars, photos N3, N5 taken in parallel polars.

Dolenec 2015). All of the samples are light yellow-brown (Munsell 2.5YR 6/4), which turned into reddish yellow after firing (Munsell 5YR 6/6). The Novine clay samples 1004 and 1005 are fine-grained non-calcareous clays, and sample 1006 is coarse grained non-calcareous clay. The samples contain up to 30% aplastic inclusions, mostly monocrystalline quartz, muscovite and biotite mica, opaque minerals, and rare rock fragments (quartzite, chert) and other accessory minerals (feldspars, amphibolite, and garnets).

Discussion

Comparison of the macroscopic results

The macroscopic description of the Poštela and Novine samples showed significant variation in the composition of the ceramic paste between the two contemporary sites. At Poštela, vessels were made predominantly with quartz and mica inclusions, although vessels with additional organic matter and grog are also common. It is important to note that the vessels with grog temper come mostly from the flat cremation cemetery below the settlement, which is dated to the Ha C0 period. Vessels with added grog were also more common in the first occupation phase (Ia) as recognized in trench 27 in the settlement.

At Novine, two thirds of vessels were made with quartz, mica inclusions and grog temper, although clay pellets are also common inclusions in the pottery. Vessels with only quartz and mica inclusions are rare, comprising around 10% of the samples. Analysing further the samples from trench 5 from the Novine settlement, we can observe again that the samples from older stratigraphic layers (phases Ia and Ib) have mostly grog temper added to clay, whereas other types of temper occur in vessels from younger layers (*i.e.* phases Ic and Id, layers above stratigraphic unit 195; see *Vinazza* et al. *2015.180, Sl./Abb. 37, 38*).

An important difference between the two sites in their respective pottery production is therefore the use of grog as temper. At Novine, this is the most common temper in the clay paste and comprised approx. 60% of the samples, whereas at Poštela, less than 40% of the samples contain grog. Similarly to Poštela, the ratio of vessels with added grog at Novine is higher in the earlier occupation phases, and drops in the subsequent phases (67.5% compared to 53.5% of vessels with grog in trench 5). The results from trench 27 at Poštela and trench 5 at Novine are evidence of a more distinctive preference for the use of grog temper in the oldest occupation layers (Ha C0). Therefore, it seems likely that these technological changes can also be related to chronological phases.

Grog is fired ceramic material intentionally crushed and added to clay during the pottery manufacturing process and is a common type of inclusion in prehistoric pottery. Grog is a suitable tempering material, since its physical properties (such as coefficient of expansion) are similar to those of clay (*Rye 1976. 115; Rice 1987.229; Reedy 2008.146*), and it was commonly used in the Late Bronze Age and Early Iron Age, as was demonstrated by macroscopic observation at other contemporary sites in north-eastern Slovenia (*Črešnar 2010.10–11; Mele 2009*) and

Sample N.	Vessel type	Trench	Context	Fabric	Description of fabric
NOV14	storage jar	5	settlement (SU 215)	N3	grog temper
NOV39	storage jar	5	settlement (SU 229)	N3	grog temper
NOV45	baking lid	5	settlement (SU 289)	N3	grog temper
NOV58	baking lid	5	settlement (SU 195)	N1	chert fabric
NOV118	storage jar	5	settlement (SU 229)	N3	grog temper
NOV123	storage jar	5	settlement (SU 229)	N3	grog temper
NOV195	bowl	5	settlement (SU 223)	N5	grog, organic matter and rock temper
NOV232	decorated vessel	5	settlement (SU 158)	N4	grog and rock temper
NOV240	storage jar	5	settlement (SU 220)	N3	grog temper
NOV248	decorated vessel	6	settlement (SU 138)	N3	grog temper
NOV339	bowl	5	settlement (SU 195)	N3	grog temper
NOV347	bowl	5	settlement (SU 102)	N2	quartzite fabric
NOV362	pot	5	settlement (SU195)	N4	grog and rock temper
NOV417	decorated vessel	3	settlement (SU 80)	N6	rock temper
1004	clay, fired to 800°C	3	cemetery (SU 118)		
1005	clay, fired to 800°C	5	settlement (SU 258)		
1006	clay, fired to 800°C	5	settlement (SU 294)		

Tab. 5. List of petrography samples from Novine.

Fabric	Description of fabric	Sample No.	quartz	musco-vite	bio-tite	opaq. min.	quartzite	amphi-bolite	horn-blende	clinozoi-site	grano-diorite	organic	grog	other minerals (<2%)
N1	chert fabric	NOV58	40	40	5	5								chert, garnet
N2	quartzite fabric	NOV347	45	45		5	<1%		<1%			<1%		plagioclase, K-feldspars
N3	grog temper	NOV14, NOV39, NOV45, NOV118, NOV123, NOV240, NOV248, NOV339	30–45	30–40	5	10–20	<1%		<1%			<1%	3–5	chert, garnet, plagioclase, K-feldspars
N4	grog and rock temper	NOV232, NOV 362	50	30	2–5	5–10	<1%	<1%		<1%	<1%		1	chert, garnet, plagioclase, K-feldspars
N5	grog, organic matter and rock temper	NOV195	35	25	0,5	10	<1%					10	1	chert, garnet, plagioclase, K-feldspars
N6	rock temper	NOV417	40	50	1	5	1				1	1		chert, garnet, plagioclase, K-feldspars
	fired clay samples	1004, 1005, 1006	50–55	20–25	5–10	15–20	<1%	<1%						chert, plagioclase, garnet

Tab. 6. The results of ceramic petrography of the Novine pottery samples. Numbers are in %.

Austria (*Hellerschmid 2006.112–113; Sauer 2006*). In addition to its physical properties, grog can be regarded as a symbolic improvement of clay, as seen in some ethnoarchaeological examples (*Quinn, Burton 2009.288; Gosselain, Livingstone Smith 2005. 41*).

At Poštela, the most common surface treatment of the vessels include smoothing and burnishing, with polishing present in less than 5%. In the settlement, the ritual ground, and in the barrows, different types of bowls predominate in the assemblages; on the other hand, pots are the predominant type of vessels in the flat cremation cemetery. At Novine, smoothing of vessels surfaces is more common than burnishing, whereas polishing can be considered a rare surface treatment technique.

Most of the vessels were fired in an incomplete or complete oxidising atmosphere; at Poštela in more than 70% and at Novine in around 60% of samples (Tab. 2). A reducing atmosphere was used in less than 15% at Poštela, and some 25% of vessels at Novine. The combination of a reducing atmosphere with an oxidising atmosphere at the end of firing is at Novine also more common than at Poštela (10% compared to 2% of samples). As it can be concluded after the petrographic analysis, the vessels at Poštela and Novine were fired in similar temperature ranges (at max. 800°C). We conclude that firing was done in open fire pits, as well as in a more controlled atmosphere, perhaps inside a structure, *i.e.* a pottery kiln.

Although there are many differences in clay paste selection and preparation, in surface treatment, and firing of vessels between Poštela and Novine, the forms of vessels show many parallels. Similarly shaped bowls and pots are the most common types at both sites, followed by baking lids, lids, cups, and small cups (Fig. 7). Although the forms are comparable, vessels of the same type were made from different fabrics. For example, pots are made with fabrics without grog temper at Poštela, but more than 70% of Novine pots contain grog temper. The same holds for bowls and cups. Only baking lids were predominantly made with grog temper at both Poštela and Novine.

Besides pottery forms, it is also the decoration techniques that show many similarities. The most common techniques are incisions, followed by impressions and appliqués in combination with impressions. The motifs are mostly simple horizontal, ver-

tical, or oblique lines made in different techniques, with rare motifs occurring at each of the sites.

The petrography of Poštela and Novine samples

The petrography of pottery samples from Poštela shows a variety of fabrics that were made with different types of locally available raw materials. Most (*i.e.* 67%) of the analysed vessels contain crushed metamorphic rocks of local origin added as temper. Other types of temper were added rarely, and include igneous rocks, mica, garnet and organic matter. At Poštela, crushed pottery or grog added as temper was recognised in around 20% of the petrographic samples, although a higher share (about 35%) was observed during the macroscopic analysis. None of the other samples contained temper added to the clay.

Rock temper is commonly added to clay to improve the workability of the raw material when forming vessels (*Rye 1981; Reedy 2008.133–141*). This type of temper was commonly used by Bronze and Iron Age potters at sites in western Hungary and Austria (*Gherdan* et al. *2002; Sauer 2006*). The most common temper at Poštela – quartzite – is a metamorphic silicate rock found locally (*Hinterlechner Ravnik 1971*), which includes several accessory minerals that were also found in the pottery samples (mica, feldspars, opaques, garnet). The natural bedrock at Poštela (*Hinterlechner Ravnik 1971*) is amphibolite, a metamorphic rock that is easily recognisable by its dark green colour. Amphibolite is composed mostly of hornblende, but also includes other minerals (*i.e.* quartz, feldspars, epidote, clinozoisite, sphene). All these minerals were identified in the pottery samples from Poštela.

Two samples from the oldest layer at the Poštela hillfort (from trench 27, samples 733, 745) contained igneous rock inclusions (granodiorite), which were part of the raw material or even added as temper additionally to the metamorphic rock grains. Granodiorite is common in the central Pohorje massif, and can be found about 10km west of Poštela; it is composed mostly of feldspars, quartz and biotite mica, with other accessory minerals (*Mioč, Žnidarčič 1989; Zupančič 1994/1995*).

Most of the petrography samples come from the settlement, and only a smaller amount from the flat cremation cemetery and the ritual ground. Nevertheless, some differences in the fabrics from the different contexts can be seen. At the flat cemetery, the vessels were quite diverse and only two fabrics (B2, B4) were also found in other analysed Poštela contexts. Here we identified a vessel with amphibolite temper (fabric A1), quartzite and amphibolite temper with grog (fabric B2), quartzite and amphibolite temper with organic matter (fabric B3), and a vessel with no temper and only naturally occurring quartzite and amphibolite inclusions (fabric B4), as well as a vessel with quartzite and garnet inclusions (fabric D1). The samples from the ritual ground, on the other hand, are similarly made and belong mostly to one fabric with added quartzite and amphibolite temper (fabric B1), while one sample was made without temper (fabric C4) and was not found in any other context. Due to the large amount of pottery excavated from this context and based on the results of the macroscopic description, we expected greater diversity in these samples, but as only four samples were analysed from this context, it will be necessary to include more samples from the ritual ground for future petrographic analysis. All the other samples come from trenches inside the hillfort, where the pottery was made from a variety of fabrics (groups B, C, and D). The vessels of fabrics groups C and D were appearing predominantly in the settlement and were not identified in the flat cremation cemetery or the ritual ground. Based on the results of the macroscopic and petrographic analyses, we presume that the Poštela potters made vessels that were intended for different uses (funerary, ritual, or domestic) from different fabrics.

If we compare the petrography results with the macroscopic description, we can observe that the main groups of inclusions display greater diversity when viewed under the microscope, which is to be expected, as petrography gives a more detailed insight into the mineralogical composition of the fabrics. However, we could ascertain that the recognition of grog inclusions in macroscopic analysis was not correct in one third of the samples, as fragments of iron-rich pellets and amorphous concentration features as well as rock fragments were mistakenly interpreted as grog in the fabrics. As the recognition of grog is sometimes difficult even in thin section (*Whitbread 1986*), this result is not surprising, but does indicate that the amount of pottery with grog temper could be lower than estimated in the macroscopic analysis. This will have to be studied in more detail with new petrographic samples.

At Novine, pottery was made predominantly with grog temper, found in more than 60% of the samples in the petrographic as well as in the macroscopic analysis. The samples from trench 5 at the settle-

ment show that fabric N3 with grog was found only in the earlier phases (Ia and Ib), whereas other types of temper can be found also in the later phases (Ic and Id). Metamorphic rocks and organic matter were rarely added to the clay, and just two samples were without added temper (fabrics N1, N2). Rock temper was identified in less than a third of the samples from Novine, and in most samples was added alongside grog (fabrics N4, N5); only one fabric had rock temper exclusively (fabric N4). The most common rock found in the samples is quartzite, a metamorphic silicate rock that forms lenses inside other types of rocks (phyllite, schist, amphibolite, and gneiss) on the Pohorje Massif and the Kobansko area some 10 to 15km to the south and south-east of Novine, although larger pebbles of quartzite could also be procured by prehistoric potters from the alluvial deposits below the settlement (*Mioč 1978; 1983; Mioč, Žnidarčič 1989*).

Uniquely to Novine, one fabric showed the presence of charred organic remains that were identified as chaff under the polarising microscope (Fig. 12.N5). Chaff is husks of cereals and other seeds that are separated from grains by threshing, and is often mixed with clay in pottery preparation (*e.g., Mariotti Lippi, Gonnelli, Pallecchi 2011; Kreiter* et al. *2013*) as this increases the plasticity and dry strength of sandy clays (*Rice 1987.78*). This was common practice at least from the Neolithic period (also in Slovenia, see *Tolar, Velušček 2016*), and its use could also be confirmed for the Early Iron Age at Novine. Chaff temper is related to seasonality in pottery production, as chaff as an agricultural waste product occurs at the end of harvesting (*Rye 1981*). Thus with the use of chaff we can directly relate pottery production to agricultural activities, which has a temporal character and is a seasonal activity, much like pottery production that often happens in the drier parts of the year (*Arnold 1985.77*). We understand the use of chaff as a part of material culture and an active part in the structuring of social actions incorporated in pottery. The connection manifests itself in the way that pottery is used for the storage, preparation, and consumption of agricultural products, as much as how agricultural by-products are connected to the raw material of the vessels (*Kreiter* et al. *2013. 139*).

The grain size of the inclusions is also different at the two sites (Fig. 8). At Poštela, the grain size distribution shows that the mean value of the inclusions is mostly between 0.25 to 0.5mm, with a third of the samples containing inclusions between 0.5 to 2mm. On the other hand, at Novine most of the samples containing inclusions in sizes less than 0.25mm. These differences in grain size can also be observed in the clay samples, as the clays from Razvanje and Zg. Radvanje contain inclusions between 0.05 and 1mm, whereas the clays from Novine contain inclusions up to 0.6mm in size. The differences in the size distribution of inclusions in the clays can be attributed to the local geology, whereas the differences in the size of inclusions in pottery is also connected to the use of temper.

Although the forms and decoration of these Early Iron Age vessels from both sites are similar, we could observe important differences in the pottery composition and firing. The analyses of local clays show a strong correlation between the locally available raw materials and the ceramic fabrics. We conclude that Early Iron Age potters from Poštela and Novine used local raw materials to produce comparable vessels intended for similar purposes. The differences in the procurement of raw materials and paste preparation are therefore more connected to the availability of clays and temper than to the desired physical properties of the finished vessels.

Conclusions

The results of the analysis show that potters from the contemporaneous sites of Poštela and Novine made similarly shaped vessels with similar decorations, using different pottery recipes with locally available raw materials. At Novine, grog was the main temper used, in addition to a fine-grained clay paste, and at Poštela metamorphic rocks (mostly amphibolite and quartzite), rocks forming the bedrock at the sites, were used as temper, as well as forming a large part of natural inclusions in the clay paste.

The use of grog, as identified on the macroscopic level, can be connected to the oldest occupation phases, as vessels with grog predominate in both the Poštela and Novine settlement assemblages in the Ha C0 period. This is supported by the results of petrographic analysis, which show a shift towards added rock temper in the later phases, *i.e.* Ha C1–C2/ D1.

The differences in pottery composition can be associated with the naturally available raw materials, as metamorphic rocks are readily available at Poštela, but rare in the Novine area, where limestone and sandstone predominate in the geological structure. On the other hand, differences in the use of temper can also be linked to different choices and pottery

traditions inside these communities. This can be especially demonstrated with the addition of grog, as the practice of adding old ceramics to new clay paste can be associated with change and the past (*Quinn, Burton 2009.288; Gosselain, Livingstone Smith 2005.41*).

We also established that there are certain differences in pottery technology according to the context of the vessel placement at Poštela: the settlement, flat cremation cemetery, barrow cemetery or the so-called ritual ground. The results indicate that vessels placed inside the flat cremation graves were made differently from vessels discarded inside the settlement. This is less surprising, as the use of pottery inside the settlement and in the graves is linked to different functions – this is also demonstrated by the predominance of vessels made for cooking or storage inside the settlements (pots, lids, baking lids, storage jars) and the lack of these inside the graves (especially the lack of lids and baking lids). Additionally, vessels discarded at the so-called ritual ground have many similarities to vessels from the settlement, and less with pottery from the graves, as cooking vessels are also very common in this context. On the other hand, bowls are the most prevalent type of vessel found in the ritual ground, their number far exceeding the number of bowls in other contexts. Bowls, from small to large forms, are open-shaped vessels that are usually used in the serving and consumption of food, and can be linked to feasts and communal activities (*e.g., Arthur 2002; Hayden 1996; Mlekuž* et al. *2013*).

Petrographic analysis shows that the Poštela pottery was made with a variety of fabrics and contained mostly added rock temper. These results were compared to locally available clays below the Poštela hillfort, which showed that Early Iron Age potters used local clays and other types of raw materials for temper, although not always from the same source. At Novine, the petrography showed that the most common fabrics had grog or crushed old pottery added as temper. Other inclusions added as temper included rock fragments (mostly quartzite) and chaff. Again, locally available clays were used, but the provenance of the rock temper is not yet clear; it could have come from the alluvial deposits below Novine or from geological regions nearby, the Kobansko and Pohorje Hills to the southeast of the site.

The comparison of the results of the Poštela and Novine samples show that the Early Iron Age pottery in north-eastern Slovenia was made using similar forming and firing techniques, but made with different fabrics and different tempers, using mostly locally available raw materials. This confirms that potters were connected to their environment in their production, and that potters had different views when selecting the most suitable material for making pottery.

The present work is the first step in comparing Early Iron Age sites and their pottery production in the region. However, the work is being extended to broader regional and transregional levels, as well as over multiple chronological phases. In this way, more in-depth knowledge about technological changes and other decision-making factors about pottery in the Early Iron Age will be produced.

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