Metallurgy during the Chalcolithic and the Beginning of the Early Bronze Age in Western Anatolia

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Abstract: The archaeometallurgical and archaeological research carried out in southeastern Europe, the Aegean and Anatolia has provided a general insight into cultural interactions that occurred during the 4th millennium BC. For example, metal objects that were found in the rich graves of Novosvobodnaja, Majkop or Arslantepe provide evidence that various metals such as gold, silver, lead and arsenical copper were already available in Anatolia and the Caucasus in the 4th (and early 3rd) millennium BC; heavy shaft hole axes and other implements occurred in the Balkans during that period as well. To date only a few settlements have been found along the west Anatolian coastline which yielded evidence confirming the production or melting of metal in the 4th and early 3rd millennia BC. Çukuriçi Höyük as one of these few examples provides evidence for intensive metalworking, e.g. the production of arsenical copper during EBA 1. Moreover, the production of a silver-copper alloy suggests that the metallurgists at Çukuriçi Höyük had the knowledge of particular smelting and alloying techniques, which attests to a wide-ranging social and technological network at the beginning of the 3rd millennium BC. This well-developed system of metalworking is rooted in the Late Chalcolithic period, as indicated by lead isotope analyses carried out on objects found at Çukuriçi Höyük. Furthermore, archaeological objects as well as analytical results obtained from finds unearthed in the regions under study indicates a 'connection' with the Balkans, as shown by two recently found 'ring idols' near Izmir.

Keywords: Turkey, western Anatolia, Chalcolithic, Early Bronze Age 1, development of metallurgy, arsenical copper, copper processing, bronze, precious metals, 'ring idols', Archaeometallurgy

The 4th millennium BC has been described as an era of transition, which was characterised by many socio-economic changes. Various important phenomena can be observed against this background: the invention and utilisation of the plough, the wheel and the wagon, metallurgy, the domestication of the horse and the occurrence of new types of weapons, for example the shaft-hole axe or swords.[2] These observations allow the conclusion that wide-ranging systems of communication already existed during this time. Rich grave offerings dating from the 4th and early 3rd millennia BC (e.g. Majkop, Novosvobodnaja, Arslantepe, Alacahöyük)[3] yield evidence pointing to an advanced society with a stratified structure. Various metals such as gold,[4] silver,[5] lead[6] and copper[7] were available and placed within elaborately furnished graves of an élite segment of society.

In the late 4th millennium and the first half of the 3rd millennium BC important changes in metalworking technology took place in Anatolia and Greece.[8] Several sites in Turkey have revealed

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2 Benecke 1994, 455–466; Maran 2004; Hansen 2009, 29–30,36 fig. 35; Burmeister 2010, 223; Courcier 2010, 88–89, figs. 10 –11; Hansen 2011; Hansen, this volume 243–260.

3 Hančar 1937; Koşay 1944; Frangipane – Palmieri 1983; Hauptmann et al. 1999; Frangipane et al. 2001; Govedarica 2002; Hansen 2009, 29–30,36, fig. 35.

4 Zimmermann 2005, 191, 195–197, fig. 1.

5 Hess et al. 1998, 64; Pernicka et al. 1998, 123; Prag 1978, 39; Hauptmann – Pernicka 2004; Papadopoulos 2008.

6 Hess et al. 1998, 59; Pernicka et al. 1990, 58.

7 Zwicker 1980 ; Pernicka 1987; Pernicka et al. 1984; Lutz et al. 1991; Schmitt-Strecker et al. 1992; Begemann et al. 1994; Pernicka 1995; Hess et al. 1997; Özbal et al. 1999; Yalçin 2000 ; Hauptmann et al. 2002; Pernicka et al. 2003; Thornton et al. 2009; Meliksetyan – Pernicka 2010.

8 Day – Doonan 2007; Tzachili 2008.

Fig. 1 The metallurgical ensemble, found at Çukuriçi Höyük comprises numerous crucibles, moulds, blow pipes, tools, semi-finished as well as finished products dating to the Late Chalcolithic period and EBA 1 (photo: N. Gail/OAI).

fragments of metalworking. Finds from Arslantepe, Çamlıbel Tarlası, Murgul and Norşuntepe[9] are particularly impressive. Only a few settlements along the Western Anatolian coast yield definite evidence attesting to the processing of metal (especially copper) during the Late Chalcolithic and Early Bronze Age. Considering the question of early copper working in western Anatolia the results from the Çukuriçi Höyük offer new insight and new data for this discussion.

Metalworking at the Çukuriçi Höyük

At the Çukuriçi Höyük the remains of a major metalworking workshop, dating to the Late Chalcolithic and EBA 1, were found. Metal objects, as well as metallurgical ceramics, were recovered throughout the entire tell. In a multi-phase building complex, within the former centre of the tell, two different kinds of furnaces and fireplaces were uncovered.[10] The excavation revealed oval or 'horseshoe' shaped constructions, which were abutting the wall. Furthermore, round bowl-shaped fireplaces situated in the centre of the room were excavated. Numerous crucible fragments were found (Fig. 1), as known from other Early Bronze Age sites. Additionally, many blow pipes, as well as copper prills and semi-finished products came to light. Of particular interest, among the finds, was a mould for casting flat axes and a block anvil[11] for forging metal by shaping bars into finished objects. Four moulds for rod ingots in different sizes[12] show, that metal was collected

[9] Zwicker 1980, 17; Lutz et al. 1991; Hess et al. 1997, 75; Hauptmann et al. 1999; Schoop 2011.
[10] Horejs et al. 2010, 10, figs. 2.17; 8.
[11] Horejs et al. 2010, 15–16, figs. 4–7; Mehofer, in preparation.
[12] Horejs 2009, 363, fig. 6; Horejs et al. 2010, 15, fig. 4; Mehofer, in preparation.

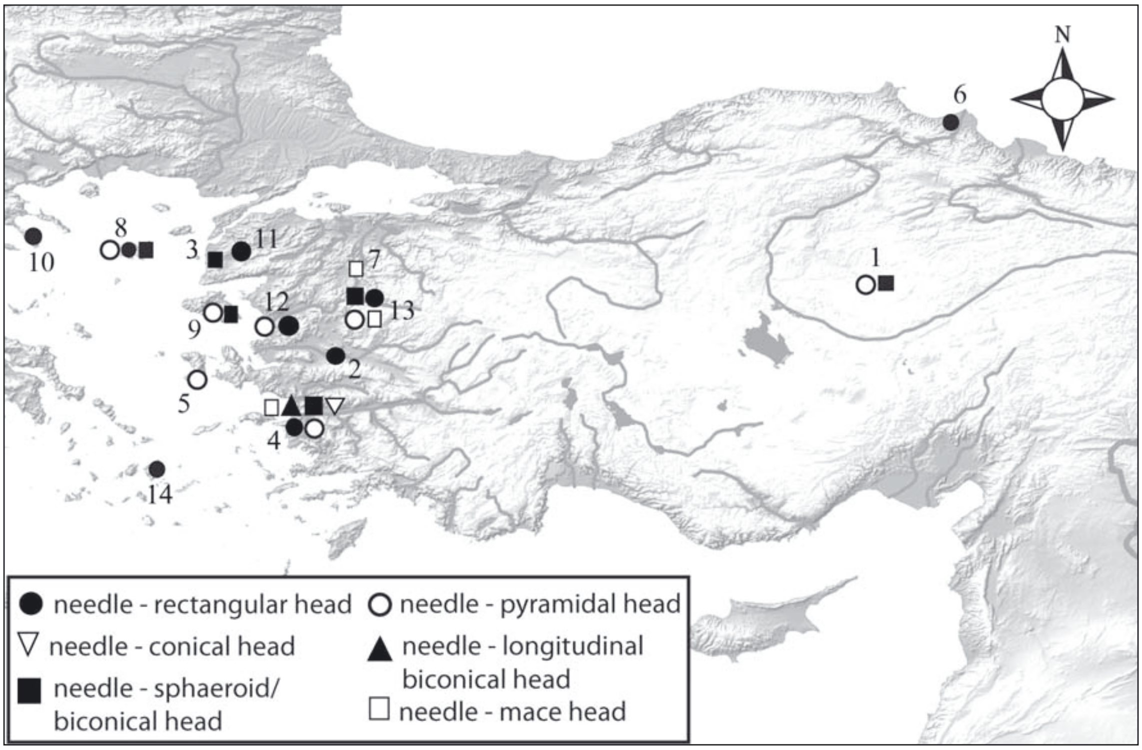

Fig. 2 The map shows sites where needles of similar type like the Cukurci Höyük examples were found. 1. Alishar Höyük; 2. Ovabayındır; 3. Besiktepe; 4. Çukuriçi Höyük; 5. Emporio; 6. İkiztepe; 7. Babaköy; 8. Poliochni; 9. Thermi; 10. Torone; 11. Troia; 12. Yeni Yeldegirmentepe; 13. Yortan (© M. Mehofer, VIAS).

and casted into different standard sizes at the tell.[13] These facts indicate that metal was not only produced for domestic use but also for trading. Lead and other metals were present as well as different tools including several chisels[14] attesting to the presence of specialised crafts. Another highlight worth pointing out are the various weapons, which were excavated over the past two years. Four daggers, two flat axes and an arrowhead found in EBA 1 contexts, indicate a stratified society (Fig. 1). Furthermore, a great amount of pins and needles came to light – up to 27 exemplars which can be subdivided into different types (Fig. 2). They can be compared to needles from other western Anatolian sites such as Babaköy, Demircihöyük, Troy I, Poliochni, Thermi, Yeni Yeldeğirmentepe or Yortan[15] but some of them are still unique, for example, a needle with a conical head and a decorated shaft (Figs. 1 and 2). An evaluation of their earliest appearance shows that almost all of these types can first be found in western Anatolia. A needle with a rectangular head from the Aegean island of Naxos[16] constitutes the only older exception.

The spectrum of finds does not only comprise a large number of arsenical copper artefacts (130 objects so far) but also includes precious metals, Bronze objects,[17] and an artefact made of a specific silver-copper alloy of c. 49% silver and c. 49% copper.[18] In his studies on 'elite' graves and precious weapons made of gold and silver, Svend Hansen demonstrates that it is possible to reconstruct a wide-ranging communication network[19] which stretched from the Balkans to Meso-

[13] Mehofer, in preparation.
[14] Meißeltyp 7b nach Müller-Karpe 1994,165, pl. 69.1–9.
[15] Maran 1998; Kouka 2002; Mehofer, in preparation.
[16] Zachos 2007, 177, 184, fig. 11.2k.; Zachos 2010
[17] Mehofer, in preparation.
[18] Horejs 2009; Horejs et al. 2010, 16, 21, fig. 6.2, tab. 1; Horejs – Mehofer, in print.
[19] Primas 1988; Born – Hansen 2001, 52, fig. 45; Hauptmann et al. 2002; Hauptmann – Pernicka 2004.

potamia[20] at the beginning of the 3rd millennium BC. With regard to the observable distribution of this specific silver-copper alloy, the find from the Çukuriçi Höyük fills the gap[21] between the Balkan region and Eastern Turkey. As such, the small fragment has the same lead isotope ratios as other metal artefacts found on the tell. Hence, it is reasonable to believe that it was produced on the site. It also proves that the metallurgists at Çukuriçi Höyük were aware of these wide-ranging exchange and communication systems.

Archaeometallurgical Analysis

The excavation revealed not only a very rich metallurgical assemblage, but also a small number of slag fragments and smelting debris. Many of these remnants were found in an Early Bronze Age 1 workshop area (rooms 1 and 2).[22] Although these fragments seemed inconspicuous they have a unique appearance, e.g. they are heavier than the vitrified crucibles and brown in colour. Comparative pieces are known from Liman Tepe and Bakla Tepe and were also recovered from Çamlıbel Tarlası, Norşuntepe and other sites.[23] Cross-sections of these objects were produced to analyse them with an optical microscope and a scanning electron microscope.[24] The analyses of a piece of smelting debris,[25] found in layer SE 368 of workshop area 1, made it possible to recognise that the sample can be divided into three sections. In the first section, copper, arsenic, iron and sulphur were present, in the second section copper was the dominant element, and in the third section arsenic had a higher concentration than copper or sulphur. The micrograph (Fig. 3A) shows that copper(iron)sulphides in globular form (Tab. 1) are present which can be identified as 'Kupferstein = matte'.

		O	S	Fe	Cu	As	Σ
07/368/6/501	sulphidic inclusions, spot analyses	n.d.	22.3	0.3	76.1	1.3	100
07/368/6/501	sulphidic inclusions, spot analyses	n.d.	21.8	1.8	74.8	1.6	100
07/368/6/501	sulphidic inclusions, area analyses	4.9	19.8	4.7	71.3	4.2	100
07/368/6/501	iron arsenides, spot analyses	n.d.	0.5	41.3	1.2	57	100
07/368/6/501	iron arsenides, spot analyses	2.4	0.6	42.4	0.7	56.3	100
07/368/6/501	iron arsenides, spot analyses	n.d.	0.4	40.3	1.2	58.1	100

Tab. 1 Spot- and area analyses (SEM-EDS) of sulphidic inclusions and iron arsenides in sample no. 07/368/6/501 (cat.no. 220), measurements in mass%, n.d. = not detected, normalised to 100%.

In the right part of the micrograph, white dendritic inclusions were visible, which turned out to be iron arsenide (mainly as FeAs – Tab. 1) or so-called 'speiss'. They were embedded in a matrix in which arsenic and iron are the dominant elements (Fig. 3A).

20 Objects made of such an alloy are known from Bosnia, Koumasa on Crete, Arslantepe and Uruk-Warka (Mesopotamia). Gale et. al 1985, 372, tab. 1; Müller-Karpe 1989, 182, fig. 4 ; Born – Hansen 2001; Horejs et al. 2010, 27–28.

21 Horejs et al. 2010, 23, fig. 10.

22 Mehofer, in preparation.

23 Zwicker 1980, 17; Yalçin 2000; Kaptan 2008, 246, 250, figs. 5–8; Rehren – Radivojevic 2010, 208, fig. 63a.

24 Optical microscope: Olympus BX 51; SEM–EDS: Zeiss EVO 60 XVP with an EDS system produced by Oxford Instruments (INCA 400). Accelerating voltage: 20 kV, working distance of 9.5mm, beam current 100µA, dead time between 30 and 40%. The stability of the beam current was verified by cyclical measurements of a cobalt standard. All results were normalized to 100% and are given as mass percentage.

25 Find no. 07/368/6/501 = cat. no. 220, Mehofer, in preparation.

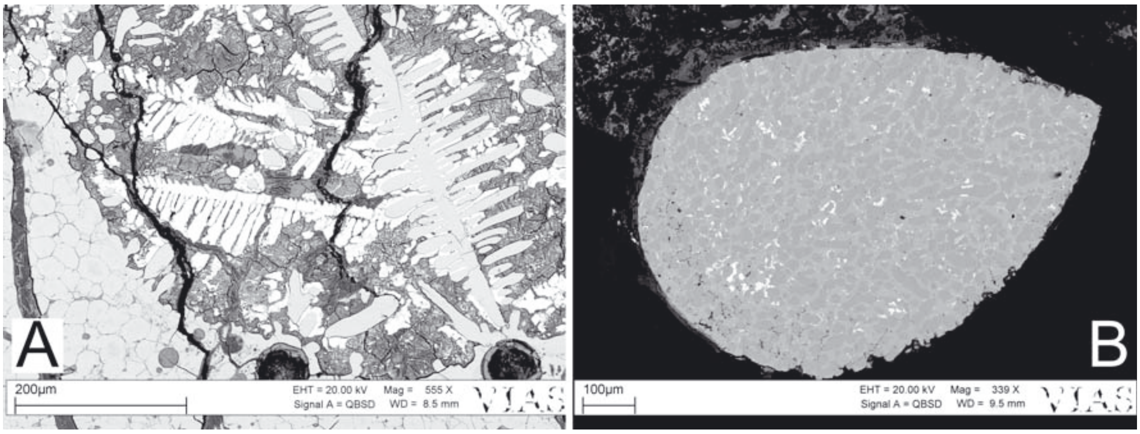

Fig. 3 A. The microstructure of the smelting debris is composed of different phases, in the left section copper sulphides (grey) are visible, meanwhile iron arsenides (white) in dendritic form can be observed in the right section, they are embedded in matrix dominated by iron, arsenic and other elements. B. The SEM-picture shows a cross-section of a crucible. The found copper prills have a very high arsenic content up to 20%. Dark grey= copper with low arsenic concentration; light grey= copper with high arsenic concentration; white=lead inclusions (© M. Mehofer, VIAS).

Crucible fragments

A cross-section of one of the excavated crucible fragments helped to complete the *chaîne opératoire* as it provided further useful hints. It contains copper sulphides with a varying, but generally low iron concentration.[26] These inclusions can also be observed in the metal objects[27] indicating to the additional presence of sulphur during the smelting process (beside carbonatic copper ores).

In the vitrified inner layers of some crucibles, several copper prills with a very high arsenic content (as γ-Cu_3As) of up to 18–20% were found (Fig. 3B) which might be relicts of an incomplete smelting process.

Production of arsenical copper

The analyses illustrate that copper sulphides and iron arsenides were present in the smelting debris and in the vitrified sections of the crucibles. These results correspond very well with the results from the metal artefacts, where arsenical copper with sulphidic inclusions are detected.

During the last years there have been intensive discussions on the various ways to produce arsenical copper, which is the dominant sort of copper during the 4th and 3rd millennia BC. Various scholars have argued for different methods.[28] In the following they will be summarised briefly. The first possibility would be that a mixture of copper ores with arsenic-bearing minerals (intentional or unintentional) was smelted in a crucible. This particular smelting process, the so-called 'co-smelting', produces arsenical copper in a single step. It is postulated for the Late Chalcolithic/Early Bronze Age sites of Tappeh Silak and other sites in Iran, as well as for the sites of e.g. İkiztepe or Murgul, Turkey.[29] Archaeometric research recently carried out on slags from Arisman, western Iran point to another possibility. These analyses provide evidence that 'speiss', an

[26] Mehofer, in preparation.
[27] Mehofer, in preparation.
[28] E g. Heskel 1983; Rostoker et al. 1989; Lechtman – Klein 1999; Hauptmann et al. 2003, 211; Pigott 2008; Thornton et al. 2009, 314; Pernicka et. al. 2011; Rehren et al. 2012; see also Pernicka, this volume 447–462.
[29] Other sites with approx. contemporaneous dating and comparable finds are Arisman (Iran); Phaskalio Kavos (Cyclades); Poros Katsambas (Crete); Shar-i Sokhta (Iran); Teppeh Hissar (Iran); Lutz et al. 1991; Hauptmann et al. 2003, 211; Birtacha –Georgakopoulou 2007, 379–403;Thornton et al. 2009, 309–210; Rehren et al. 2012.

arsenic-bearing smelting product, was produced in a separate smelting process.[30] In a final step, this arsenic-rich speiss was then melted together with copper or copper ore in order to produce arsenical copper.

The detection of copper(iron)sulphides and iron arsenides in separate zones, in the aforementioned smelting debris (Tab. 1) may also suggest different interpretations. It is possible that during a 'co-smelting' process[31] the smelting conditions in the crucible were not suitable for oxidising the sulphur; therefore, copper sulphides and other phases were formed. A second explanation might be that the used copper (ore)[32] or the separately produced speiss (deriving from an arsenopyritic ore) still contained a small amount of sulphur,[33] which then formed the copper sulphides during the smelting process. Both scenarios would end in the observed smelting debris, but as the archaeometallurgical analyses are still in progress no definitive assignments[34] can be made. Nevertheless, we can state that arsenical copper was produced at the site[35] itself during the EBA 1.

Early Metalworking in Western Anatolia

It seems quite reasonable that the well-developed system of metalworking described above (including all stages of production) must be rooted in the 4th millennium BC (or even earlier). The mapping of metal artefacts dating before 4000 BC revealed that it is still difficult to find early evidence for metalworking in western Anatolia (e.g. by crucible finds) as pointed out by Ernst Chernykh[36] in a recent article on radiocarbon chronology and metallurgical provinces. In central and eastern Anatolia, we already have evidence for metalworking and processing dating to c. 5000 BC and before. These include copper beads from Aşıklı Höyük (PPNB), Çayönü Tepesi (PPNB), Nevali Çori (PPNB), Çatal Höyük (layer IV-IX), a hammered mace head from Çan Hasan 2b, a casted chisel and a flat axe found in layer XVI of Mersin-Yumuktepe, slag fragments found in Tepecik and Tülintepe (Altınova), as well as a copper ingot found in Değirmentepe.[37]

A closer look at the western Anatolian finds made it possible to identify several sites, where metal or metalworking took place before the middle of the 4th millennium BC (Figs. 4–5). The oldest metal artefacts from the western Anatolian region came from Haçilar (layer Ia–IIa ~ 6000 BC).[38] There, two copper beads from an unknown production place (concerning the provenance of the metal) were found. Subsequent metal objects and a crucible fragment from Orman Fidanlığı (layer VII)[39] are dated to the advanced respectively late 5th millennium BC. Furthermore, one can mention a fragmented metal ring[40] found in Emporio on Chios (layer IX–VIII). Interestingly, the excavator of Emporio, Sinclair Hood, believes that this object was part of a ring idol.

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30 Thornton et al. 2009, 311, 313, tab. 1 ; Pernicka et al. 2011; Rehren et al. 2012.

31 Lechtman – Klein 1999; Pernicka et al. 2011; Rehren et al. 2012; Horejs – Mehofer, in print.

32 Usually it is believed that the copper ore was collected from or near the surface, e.g. from the gossan of a sulphidic ore body. There the carbonatic copper ores are dominant but some sulphidic ores can still be present in this section.

33 Pernicka et al. 2011; Rehren et al. 2012.

34 Mehofer, in preparation.

35 Geological mapping of the surrounding hilly landscape of the Çukuriçi Höyük allowed us to observe various metallic mineral deposits such as lead-, silver-, gold- and arsenic bearing ores. This suggests that some of the metals used were present in the wider neighbourhood of the site. Further research to confirm, whether the ore deposits were in fact exploited and mined will be carried out in the future in co-operation with Danilo Wolf and Gregor Borg, University Halle. Kaptan 2008, 249, fig. 2; Lengeranlı 2008, 366, fig. 1; Wolf et al. 2012.

36 Chernykh et al. 2002; Chernykh 2011, 156, fig. 6.

37 Yalçin 2000, 17, 19, 22, fig. 1, tab. 2; see also Pernicka, this volume 447–462.

38 Yalçin 2000, 19, tab. 2.

39 Ay-Efe 2001, 139, 157, pl. 3d–e; Zimmermann 2011, 300; Zimmermann 2005.

40 Hood 1982, 657, 661, 664, fig. 295.17.

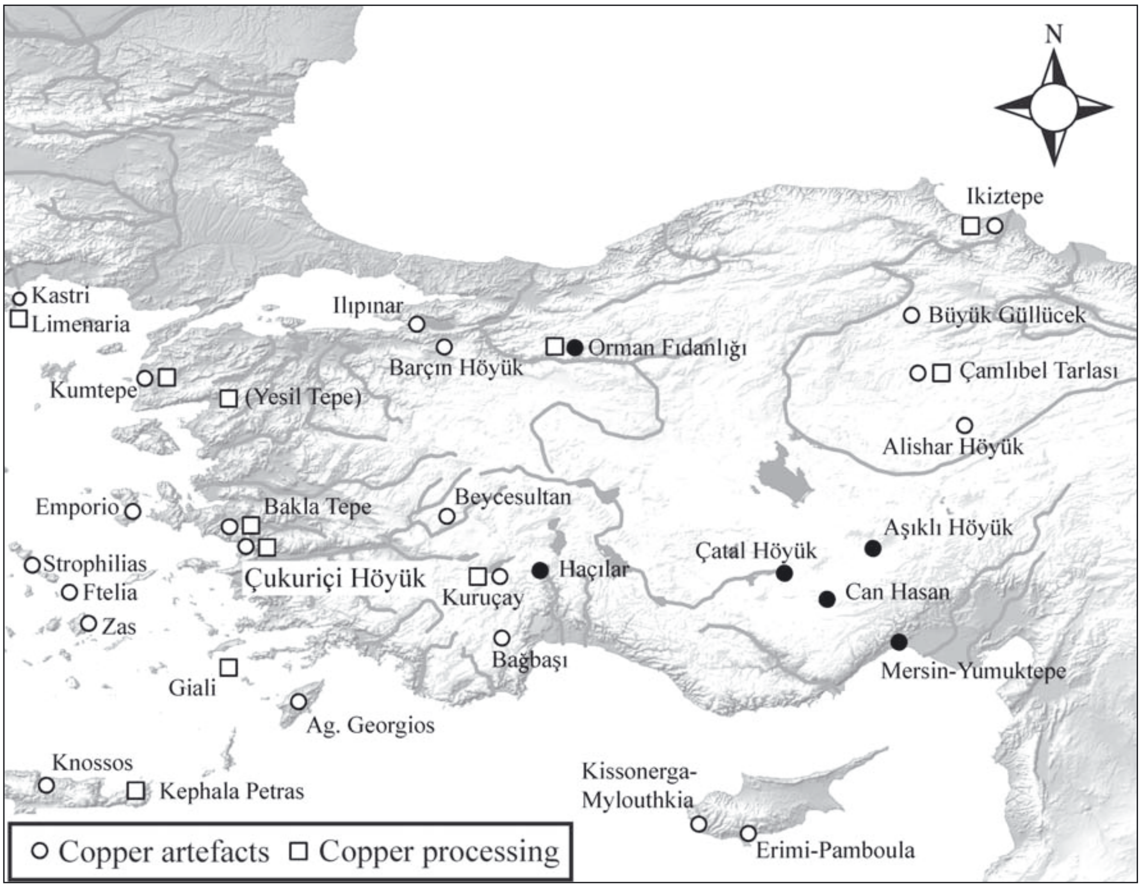

Fig. 4 Sites with copper finds or evidence for copper working dating to the 5th and 4th millennia BC in the Aegean and Turkey. The full dots mark sites, where metal or metalworking is known before the middle of the 5th millennium BC ( ) = dating or provenance unsecure (after Alram-Stern 1996; Sampson 2002; Zachos 2007; Zimmermann 2011) (© M. Mehofer, VIAS).

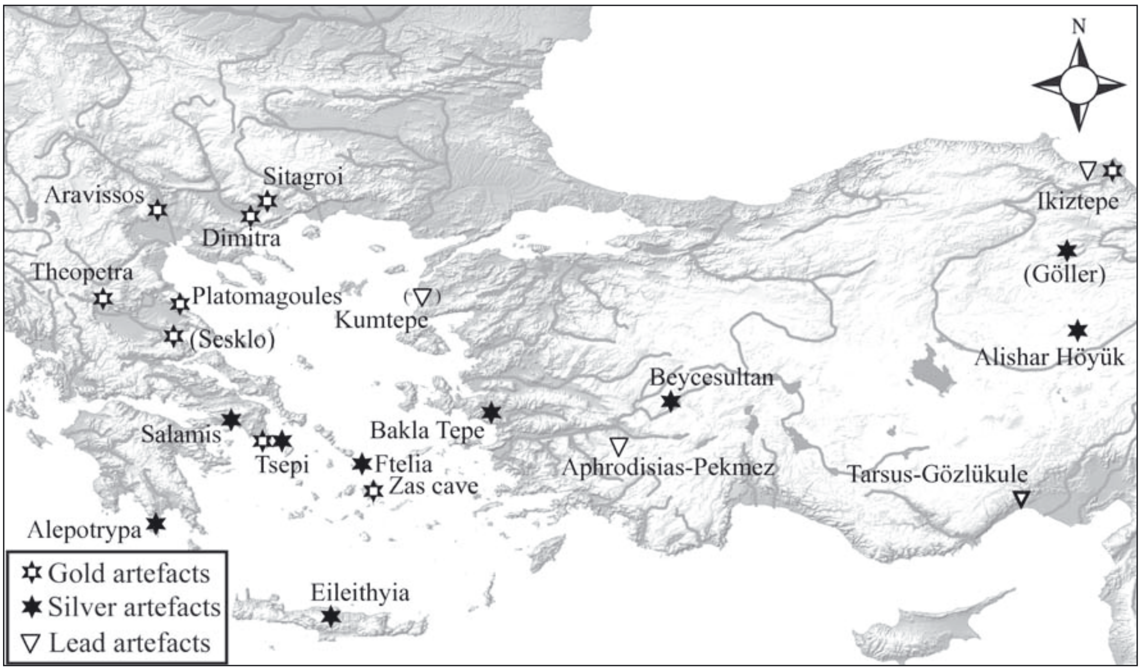

Fig. 5 The map show sites where objects made of gold, silver or lead were found in the regions under study. ( ) = dating or provenance unsecure (after Demakopoulou 1998; Zachos 2007; Pantelidou Gofa 2008; Zimmermann 2011) (© M. Mehofer, VIAS).

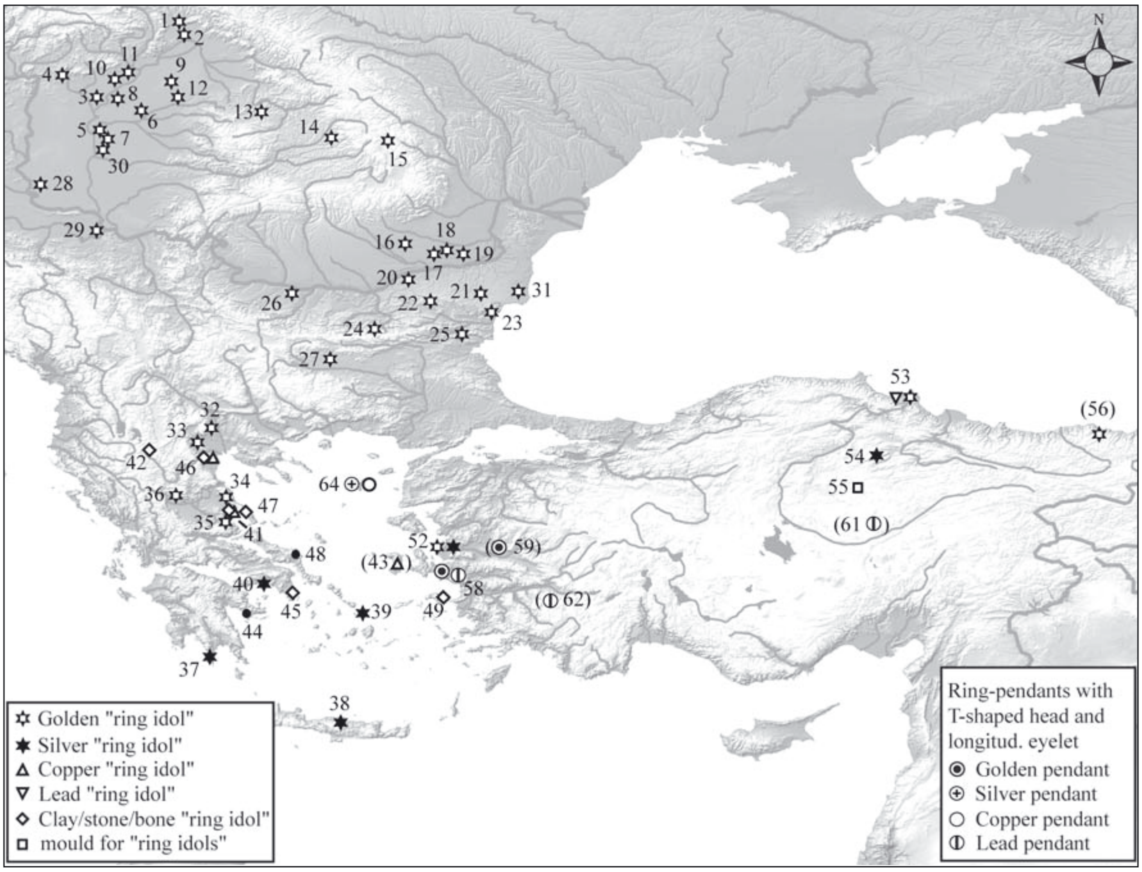

Fig. 6 Sites where 'ring idols' (Appendix, List 1), ring-pendants with T-shaped head and longitudinally orientated eyelets (Appendix, List 2), pottery fragments with 'ring idol' decoration or corresponding features (rock carvings) were found on the Balkans, Greece and Turkey. 1. Tibava; 2. Vel´ké Raškovce; 3. Jászladány; 4. Hatvan-Újtelep; 5. Pusztaistvánháza; 6. Magyarhomorg-Kónyadomb; 7. Magyartés; 8. Tiszaszőlős; 9. Hencida; 10. Tiszavalk-Tétes; 11. Tiszavalk-Kenderföld; 12. Oradea; 13. Moigrad; 14. Targu Mureş; 15. Traian; 16. Vidra; 17. Sultana; 18. Gumeniţa; 19. Vărăşti; 20. Ruse; 21. Dălgopol; 22. Radingrad; 23. Varna; 24. Chatnica; 25. Sava; 26. Sofronievo; 27. vicinity of Pazardžik; 28. Vajska; 29. Progar; 30. Hódmezővasárhely-Kishomok; 31. Durankulak; 32. Aravissos; 33. Palimbela - Kolindrou; 34. Platomagoules; 35. Sesklo; 36. Theopetra cave; 37. Alepotrypa cave; 38. Eileithyia; 39. Ftelia; 40. 'Euripides' cave near Salamis; 41. Dimini; 42. Dispilio, Kastri; 43. Emporio, Chios; 44. Franchthi cave, pottery fragments.; 45. Kitsos cave; 46. Makrygialos; 47. Pevkakia; 48. Strophilas on Andros rock carvings; 49. Tigani, Samos; 50. – 51. no find place (see Appendix, List 1); 52. Ege Gübre; 53. İkiztepe; 54. Göller; 55. Çamlıbel Tarlası; 56. vicinity of Trabzon; List 1; 57. no findplace (see Appendix, List 1), 58. Bakla Tepe; 59. vicinity of Sardis; 60. no findplace (see Appendix, List 1), 61. Alishar; 62. Aphrodisias-Pekmez, 63. see Appendix, List 1; 64. Poliochni. ( ) = dating, findplace or interpretation as 'ring idol/pendant' unsecure, 'ring idols/pendants' whose findplaces are not reconstructable are not displayed on the map. For the exact find contexts of the Greek examples see Appendix, List 1 (after Demakopoulou 1998; Maran 2000; Hansen 2007; Lichter 2006; Zachos 2007; Zimmermann 2007) (© M. Mehofer, VIAS).

The weapons found in the Chalcolithic cemetery of Ilıpınar (Phase IV)[41] form impressive evidence for metalworking during the first half of the 4th millennium BC. As a second important northwestern Anatolian site we can mention Barçin Höyuk, where a flat axe was found in Chalcolithic layers[42] yielding a radiocarbon date of c. 3800 BC. A slightly older date has been suggested for the finds from Aphrodisias Pekmez,[43] but its archaeological context is not secure and has to be discussed. The artefacts and crucibles from Beycesultan (level XXXIV) and Kuruçay (layer 6A, 6, 4)[44] can be

41 Roodenberg 2008, 327, 329, figs. 8.5–7; 10.6–7; 12.6–8.
42 This artefact is not made of locally available ores as will be shown below; Gerritsen 2010, 198, 224, fig 12.
43 Schoop 2005, 157–159; Zimmermann 2011, 302.
44 Lloyd-Mellart 1962, 19, 21, 112; Duru 1994; Duru 1996, 56, 125, pls. 159–161; Zimmermann 2011, 300–301.

seen as further evidence for the presence and knowlege of metalworking since the middle of the 4th millennium BC. Two very interesting pieces came from Ege Gübre, a site in the Izmir region. There, a golden and a silver 'ring idol'[45] were found in Chalcolithic contexts. The golden one is dated by ^{14}C analyses to the first half of the 4th millennium BC (cf. below). Finally, the excavations in Bağbaşı, Bakla Tepe, Liman Tepe, Çukuriçi Höyük, Yeşiltepe (with unsecured find context) revealed blow pipes, crucible fragments, furnace remains, slags and metal artefacts.[46] They all date to the second half of the 4th millennium BC and can be seen as evidence for metalworking in western Anatolia.

'Ring-Shaped Idols'

It is more than worth pointing out the two aforementioned 'ring idols' which were excavated in Ege Gübre by Haluk Sağlamtimur. The golden 'ring idol' was found in a deposit which formed part of Ege Gübre level II. The ^{14}C dates of this level give two dates between 4040–3950 BC and 3780–3640 BC.[47] The silver 'ring idol' was found in grave 4 which dates to the Chalcolithic period.[48] As they can be parallelised with examples which were found on the Balkans, they are the first 'ring idols' in 'classic ring-shaped style' which were found at the west Anatolian coastline dating before 3500 BC (cf. Appendix, List 1).

Generally, golden 'ring idols' can be found in the Balkans, in Greece, along the Turkish Black Sea coast and at the west Anatolian coastline (Fig. 6).[49] Unfortunately, many of these 'ring idols' come from unconfirmed find contexts (especially in Greece, see Appendix). Therefore their archaeological interpretation must be done with great caution.[50] One can observe that the 'ring idols' found in southern Greece were made of silver instead of gold, which hints to the early processing of silver in this region.[51] It should be mentioned that there are also certain examples which were made of clay, stone and/or bone; see the examples found at the Pevkakia Magoula, Dimini and from Makrygialos (Appendix, List 1).[52] Furthermore, there might be artefacts of this type which are not yet published or lacking a clear interpretation as 'ring idols'. For example, we can list the aforementioned ring fragment found in Emporio (Chios).[53] One can also find these symbols as part of rock carvings (Strophilas on Andros)[54] or as decorative items on pottery, e.g. from Dimini, Kastro Tigani, the Franchthi Cave[55] and one pottery fragment from Selsko.[56]

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45 Sağlamtimur 2007; Sağlamtimur 2011; Sağlamtimur – Ozan 2012, 228, fig. 6A; Keskin 2011, 199, 210, 221, no. 7, fig. 1, no. 7.

46 Erkanal 2008, 168; Kaptan 2008; Keskin 2011a,145; Zimmermann 2011, 302, note 38; Mehofer, in preparation.

47 Sağlamtimur – Ozan 2012, 240.

48 Sağlamtimur 2007; Keskin 2011, 199, 210, 221, no 7, fig. 1, no. 7; Sağlamtimur – Ozan 2012, 228, fig. 6A.

49 Bigli 1984, 70, 95, 265–266, fig. 18; Bigli 1990, 161, 218, 427, figs. 19; Parzinger 1993; Rudolph et al. 1995, 284, fig. 175; Alram-Stern 1996; Papathanasopoulos 1996, 336, fig. 290; Demakopoulou 1998, 62–67, nos. 56–74; Maran 2000, 185–188; Lichter 2006, 528–529; Hansen 2007, 282–287; Pappa 2007, 263, fig. 17; Zachos 2007; Zimmermann 2007, 27, fig. 1; Zachos 2010.

50 E.g. some time ago a huge amount of golden ring idols was confiscated by the Greek police from antiques smugglers; Maran 2000, 181, note 15; Zachos 2007.

51 Cf. the results from the rescue excavations in Merenda, Koropi, Lambrika and Laurion; Maran 2000, 185; see also Alram-Stern, this volume 305–328.

52 It would be interesting to know if some of these stone artefacts as those found in the layers Makrygialos really can be classified as ring pendants as described by Demakopoulou. Schliemann 1881, 479, fig. 157; Weißhaar 1982, 321, note 17; Felsch 1988, 116, note 516; Weißhaar 1989, 51, pl. 8.8; Hourmouziades 1996, 45, I4b; Demakopoulou 1998, 67, figs. 72–73; Pappa et. al. 1998, 67; Maran 2000, 185–192.

53 Hood 1982, 657, 661, fig. 295.17.

54 Televantou 2008, 49, figs. 6, 10; Nazou 2010, 9.

55 Höckmann 1969, 9. 12 fig. 2, pl. 1.6; Felsch 1988, 116, pl. 47.8; Demakopoulou 1998, 68, figs. 75–76; Vitelli 1999, fig. 64; Maran 2000, 161, note 60; Skafida 2008, 520, 530, figs. 7–9.

56 Tsountas 1908, 219, t. 21.2; Demakopoulou 1998, 68, no. 76; Skafida 2008, 521.

The fact that the 'ring idols' found in the vicinity of İkiztepe can be correlated with the exemplars found in the Balkans suggests a connection between these regions. The extent to which this exchange was operated is still not fully established or understood as recently pointed out by C. Lichter and T. Zimmermann.[57] Fortunately, a recent excavation in Çamlıbel Tarlası[58] revealed a mould for casting 'ring idols'. U. Schoop dates the site between the early to the middle of the 4th millennium BC, which fits with the assumption that the 'ring idols' were no longer used after the middle of the 4th millennium BC.[59] This mould was used for casting 'ring idols' while most of the known examples are made of sheet metal.[60] It can be used to produce an idol with a T-shaped head and a single hole in the head whereas many of the exemplars found on the Balkans and in Greece have flat rectangular heads with one or two holes. The best parallel form of the casted 'idol' is found in İkiztepe,[61] but this idol seems to be made of sheet metal and not casted.

As described by J. Maran in an article on the Aegean Chalcolithic period,[62] ring pendants known from the western Anatolian coastline no longer exhibit the typical form of the 'ring idols'. The upper part of these ring pendants, found in Early Bronze Age 1 contexts or even later, is remodelled in order to fix the pendant, for example, as part of a bracelet.[63] They have a longitudinally orientated eyelet and a more or less T-shaped head. However, the basic form is still connected to its Balkan ancestor (Appendix, List 2). These western Anatolian 'derivatives'[64] were not only made of different metals like copper, silver and lead; they were also casted instead of being cut out of hammered sheet metal. These specific technological features can be assumed for two silver and copper pendants from Poliochni (phase 'rosso'),[65] three from Bakla Tepe, one exemplar from Sardis (without context).[66]

The archaeological interpretation of all these western Anatolian 'derivates' is still under discussion as they generally date after 3000 BC. This is more than 500 years after the assumed end of use of the 'Balkan style' metallic 'ring idols'.[67] In this context the two aforementioned 'ring idols' from Ege Gübre are of particular interest. They provide evidence that during the 4th millennium BC and before, this specific form was not only known in the Balkans, in Greece and in Northern Turkey but also in western Anatolia and might have influenced the development of these later dated 'derivates'. Moreover one can mention that all the 'ring idols' found in Greece which come from regular excavations were found in caves or settlement contexts (and not in graves) whereas some of the well stratified 'ring idols' and pendants found in Turkey derive from grave and settlement contexts (see Appendix, Lists 1–2).

Provenance Studies and Lead Isotope Analyses

The evidence for extractive metallurgy (e.g. crucibles, blow pipes, slags) in western Anatolia is still limited. However, the archaeometallurgical analyses helped us to get a deeper insight. First off, all the

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57 Lichter 2006, 527–529; Hansen 2007, 284, fig. 175; Zimmermann 2007, 27, fig. 1.
58 Schoop 2011, 59, fig. 9.
59 Maran 2000, 185; Lichter 2006, 529.
60 E.g. Maran 2000, 185–188; Lichter 2006, 528–529; Hansen 2007, 282–287; Kaltsas 2007, 39–41; Zimmermann 2007, 28–29, figs. 2–33.
61 Zimmermann 2007, 28, fig. 3.2.
62 Maran 2000, 188.
63 Cf. the reconstruction published in Keskin 2011a, 280, cat. no. 164.
64 Zimmermann 2011, 302.
65 Bernabó-Brea 1964, 663, 170, 3, pl. 177.25, 28; Maran 2000, 188.
66 Six pendants found at Crete possibly also form part of this specific group; they were found at the cemeteries of Livari Skiadi (EM IB–EM IIA) and Ayios Onoufrios; Evans 1895, 111, figs. 95–96; Maran 2000, 188; Zimmermann 2007, fig. 1; Erkanal 2008, 173, fig. 6; Keskin 2011a, 148, 280, cat. nos. 163–164; 281, cat. no. 165; Papadatos – Sofianou, in print.
67 Maran 2000, 185; Lichter 2006; Zimmermann 2007; Reinholdt 2008, 30–33; Zimmermann 2008, 473.

material from Çukuriçi Höyük repeatedly yields very interesting results.[68] The EBA 1 matte-speiss fragment and the metals mentioned above have lead isotope ratios, which plot within the same narrow range (Fig. 7). As the matte-speiss fragment is interpreted as debris of the production process of arsenical copper, it can be stated that arsenical copper and the metal artefacts were produced on the tell.[69] Furthermore, it is very interesting that the Late Chalcolithic objects also fall within this isotopic group. This allows drawing the conclusion, that during the LC and EBA 1 the metallurgists had access to the same mining area(s), probably in the wider region of the site itself. It is highly important to note that two of the LC metal objects, made of arsenical copper, have almost the same lead isotope ratios meaning that both were made of the same copper metal. These two pieces – a small awl and a small metal bar – were found in the same small trench together with vitrified clay (the possible remains of a furnace), accordingly, it is obvious that they were produced on the tell.[70] Therefore, we can state that the working of arsenical copper already began during the LC period at the tell.

Subsequently, the Çukuriçi Höyük data was combined with those from other sites in Anatolia and Greece (Fig. 8). The diagram shows that there is no correlation with the great ore deposits of Laurion in Attica and on Cyprus.[71] The copper mines in Middle and Eastern Turkey,[72] which provided copper for Hassek Höyük, Arlsantepe or Norşuntepe,[73] can generally be excluded due to their different lead isotope ratios and trace element contents. The data indicates a partial overlap with the lead isotope data gathered from ore deposits found in northwestern Anatolia,[74] but they do not correspond very well. Nevertheless, it seems reasonable to localise the mined ore deposits used to produce the Çukuriçi Höyük metals to somewhere in western Anatolia.[75]

The metal artefacts found in the Chalcolithic cemetery of Ilıpınar (Phase IV)[76] provide further useful hints concerning the provenance of the earliest metal used. For comparative purposes, available dates for artefacts found in northern Greece were included in the lead isotope diagrams. Z. Stos-Gale describes that some of the Late Chalcolitic metals from Sitagroi III have the same lead isotope ratios as some Bulgarian ore deposits[77] (Fig. 9) – the Rhodope Mountains and the Burgas Region. Meanwhile, others are isotopically consistent with ores from the Taurus Mountains, the Cyclades and Lavrion.[78] These observations are also important for the interpretation of some northwest-Anatolian artefacts. The most interesting fact is that nearby all of the analysed objects from Ilıpınar

68 The analyses were carried out at the Curt-Engelhorn Centre for Archaeometry in Mannheim.

69 Mehofer, in preparation.

70 Mehofer, in preparation.

71 The ore deposits of Laurion are particularly interesting due to lead and silver production that took place there (this is also mentioned for other deposits in the Aegean). Researchers have repeatedly suggested that they were also used for copper mining. Concerning the discussion of the copper mining potential in Lavrion see e.g. Gale et al. 1985; Pernicka 1987, 671, 702; Stos-Gale 1992, 165; Pernicka 1995; Gale et al. 2004; Muhly 2005.

72 The ore deposits of Alihoca, Bakir Daği, Derealan-Bakır Çay, Ergani Maden, Eseli Maden, Gümüş, Gümüşhane-Hazıne Mağara, Helva Maden, Işık Dağ-Maden Boğazı, Karadağ, Karoli, Keban-Fırat Batı 1, Keban-Bamaş, Keban-Kalhane, Keban-Keban Dere, Keban-Sirt, Kedak, Kısabekır, Kürtün Çayirçukur, Küre, Mamlis, Menteşe, Siirt-Madenköy, Sizma-Bakırlık, Ortabaraka, Piraziz-Madenköy, Pirajman, Tekmezar, Tirebolu-Haşit Köprüibaşi, Yakadere-Tepeyurt Kıltençik Dere, Zankar. Seeliger et al. 1985, 641, tab. 1.

73 Seeliger et al. 1985, 642, tab. 2; Schmitt-Strecker et al. 1992, 112, tab. 2; Hauptmann et al. 2002, 49, 56, 62, tabs. 6, 9.

74 This comprises the ore deposits of Avcilar, Balya, Camyurt, Doğancılar, Gümüşköy Kozcağiz, Serçeören Köy and Tahtaköprü. Begemann et al. 2003, 193, tab. 4.

75 Mehofer 2011, 51.

76 Begemann et al. 1994, 204, 213, tab. 2.

77 A similar provenance is discussed for some artefacts found in EBA II–III contexts in Kanlıgeçit near Kırklareli. Pernicka et al. 1997, 117, 135, 147, 158–159, 161–168, tabs. 5–6; A1–A5; Stos-Gale 2003, 328; Yalçin 2012, 187.

78 Further Greek artefacts with an early dating fall in line with the previously described observations. Two objects from Dimini are said to be made of metal from the Black Sea region and the Taurus Mountains while the objects found in Ftelia (Mykonos), in the Cyclopa cave on Giali, in the Tharounia Cave (Euboea) and Kephala-Kea have been associated with ore deposits at Kythnos, Siphnos, Seriphos, Lavrion and the Taurus mountains. McGeehan-Liritzis – Gale 1988; Stos-Gale 2003, 328, tab. 8.3.2–3.

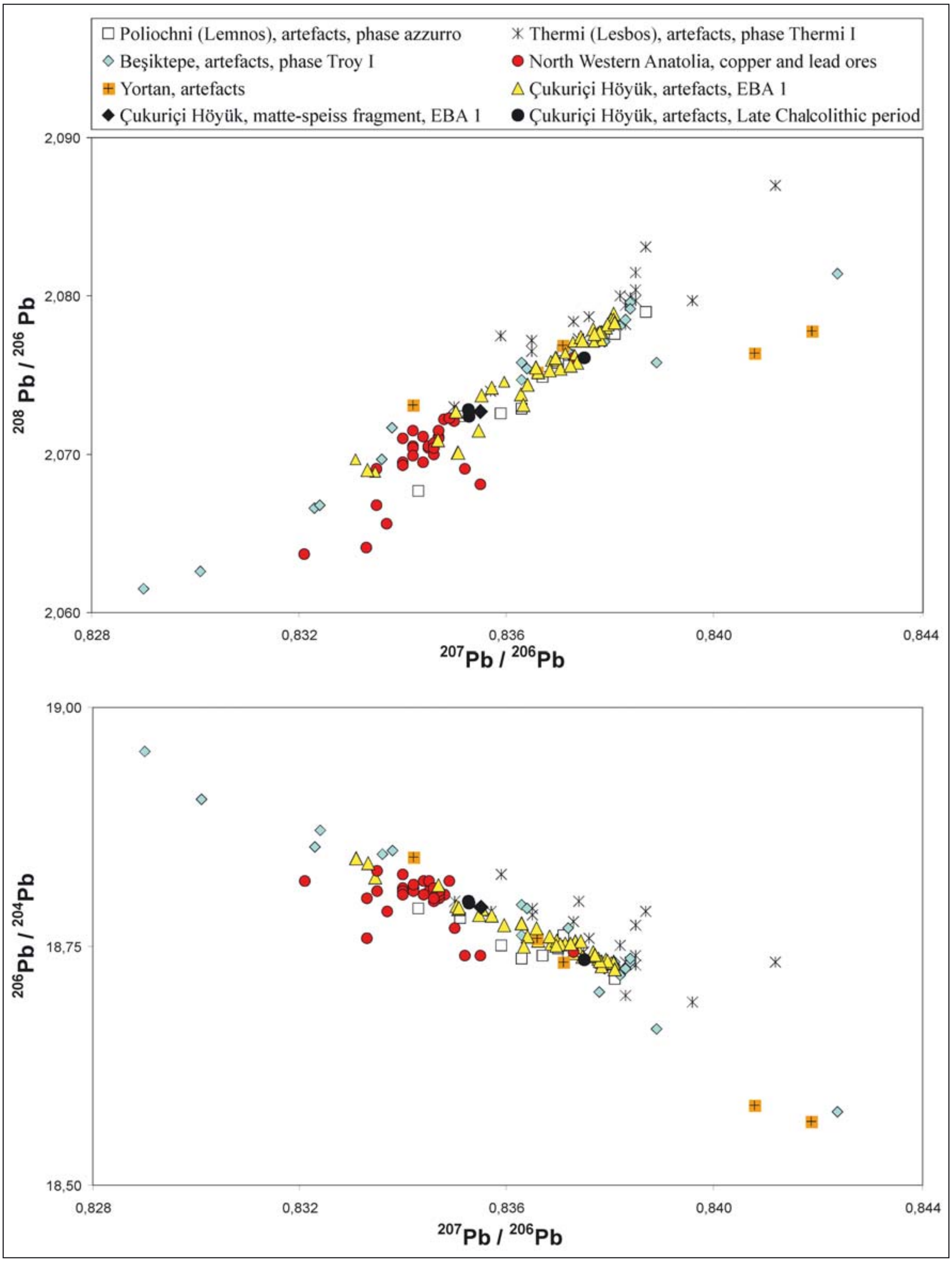

Fig. 7 In the diagram the lead isotope ratios of Çukuriçi Höyük objects dating to Late Chalcolithic period (black circles) are combined with those dating to the EBA 1 (yellow triangles). It can be observed that they plot within the same narrow range which hints to the conclusion that the copper used came from the same mining areas. It further illustrates that the objects found at the Çukuriçi Höyük coincide with objects found at Beşiktepe (blue diamonds) as well as objects found in Poliochni and Thermi (black stars and open squares); (for data see Fig. 8) (© M. Mehofer, VIAS).

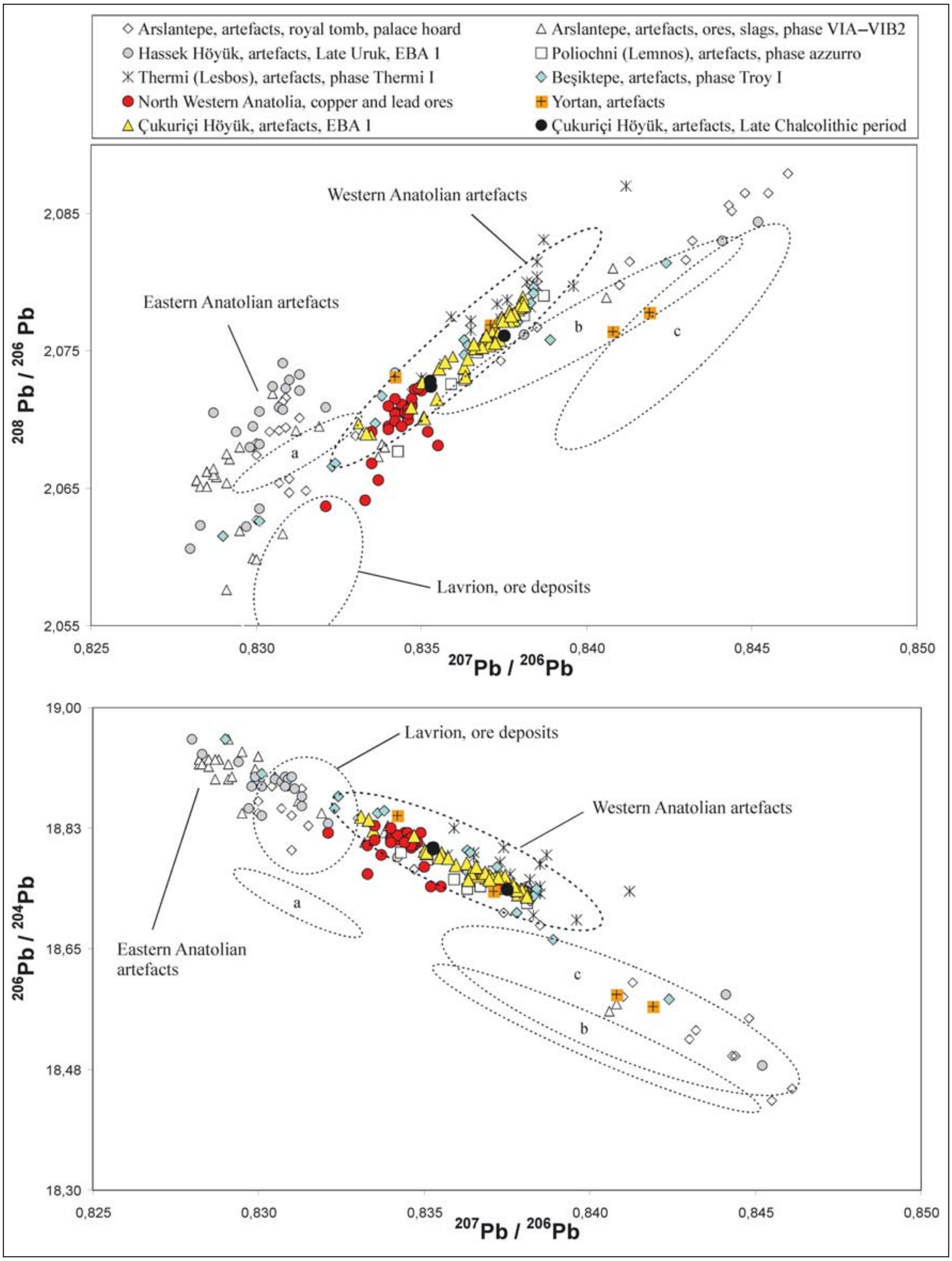

Fig. 8 The diagram presents the lead isotope ratios of the objects dating to the EBA 1, compared to published lead isotope ratios of copper and lead ores from Cyprus and Lavrion (outlined by ellipses). It suggests a partial overlap with northwestern Anatolian ore deposits (red dots) meanwhile they do not coincide with Middle and East Anatolian objects (open diamonds and triangles, grey dots), a, b, c, ... Cyprus, ore deposits, (Data: Pernicka 1984, 579, tab. 4; Gale et al. 1985, 157, 161, 167; tabs. 3, 5, 6; Seeliger et al. 1985, 641, tab. 1; Pernicka et al. 1990, 269, tab. 4; Schmitt-Strecker et al. 1992, 112, tab. 2; Stos-Gale 1992, 174, tab. 1; Begemann et al. 1994, 214, tab. 3; Hauptmann et al. 2002, 49, tab. 6; Begemann et al. 2003, 193, tab. 4) (© M. Mehofer, VIAS).

have the same lead isotope ratios and trace element contents like the later dated objects found in Poliochni, Thermi, Beşiktepe or the Çukuriçi Höyük. The finds from these sites are also made of arsenical copper and were produced from locally available ores and metals.[79] Only two of the metal finds from Ilıpınar – a dagger and a knife[80] – do not fall in line with this observation,[81] therefore, these artefacts or at least their metal must be an import to the region. Their lead isotope ratios plot in a range where we can observe not only some eastern Anatolian ores and artefacts but we can also find a concentration of Late and Final Chalcolithic Bulgarian objects and ores. Their analytical results would, therefore, allow for two interpretations. One the one hand, it is possible that the metal or the artefacts were produced in eastern Anatolia. One the other hand, these results would at least allow for the possibility that the metal for these daggers could have come from an ore source which has to be located in the Balkans.[82] Quite rightly, Begemann and his co-authors point to the fact that comparable Balkanic artefacts and ores, as well as the northwestern Anatolian ores, have a lower arsenic concentration[83] than the Ilıpınar objects making it difficult to link them together. This problem might be solved in the future as new research revealed that the arsenic was probably intentionally added as alloying element.[84] If this specific technique was already known in the 4th millennium BC in the regions under study, then this must be in the focus of future research.

Coming back to the discussion on the provenance of the early copper artefacts it is worth pointing out a flat axe found in Barcın Höyük, which can be parallelised with the axes from Kuruçay. Like some of the Ilıpınar finds, it also has a different trace element content and lead isotope ratios.[85] This would mean that it was not produced with 'west-Anatolian' ores and, therefore, it (or its metal) is an import to this region. The provenance of the metal itself to date is unknown. Finally, if the assumption that nearly all objects from Ilıpınar were produced from western Anatolian ores holds true, then we can postulate that extractive metallurgy was already known since the second quatre of the 4th millennium BC[86] or even before in the region under study.

Conclusions

The connection and influence of the Balkans (and Balkan metallurgy) on Greece and the northern Aegean regions has a long history[87] within the scientific literature (cf. the ring pendants).

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79 Horejs–Mehofer, in print.

80 These early daggers from Ilıpınar have blades with lentoid or rhombic cross sections and a triangular hilt plate. Comparable pieces, in size and shape, are known from Beycesultan (Level XVIII), İkiztepe or Çamlıbel Tarlası Phase (phase VI) meanwhile daggers with triangular shaped blades are known from various Greek sites like Alepotrypa or Aghia Marina; Stronach 1962, 281–282, fig. F.8.1; Zachos 2007, 177–179, fig. 11.6a–d, f–g; Schoop 2011, 62, fig. 14.

81 These are the objects Ilıp 88/38 (HDM 1388) found in grave UP (V-13 076) and Ilıp 88/40 (HDM 1393) found in grave UA (V-13 1 2 010); Begemann et al. 1994, 213–214, tabs. 2–3.

82 Within a recent article on early metal daggers Thomas Zimmermann postulated that certain typological forms (type Bodrogkeresztùr, Type Usatovo I-3, type Cucuteni Ost, Type Nerušaj) found in the Balkans might have influenced the development of metal daggers in northwestern Anatolia and Ilıpınar. This would fit to the previously described observations which are based on the analytical results. However, it has to be pointed out that daggers made of obsidian or flint are long known in Turkey as demonstrated by the famous flint daggers found in Çatal Höyük, which date to the 7th millennium BC. These and other stone daggers could also have served as models for the later metal daggers. Zimmermann 2006, 254–255, figs. 4–5; Zimmermann 2008.

83 Begemann et al 1994, 208.

84 Thornton et al. 2009, 311, 313, tab. 1; Pernicka et al. 2011; Rehren et al. 2012; see also Pernicka, this volume 447–462.

85 The nickel, silver and antimony contents are lower than those of the west Anatolian finds; meanwhile the arsenic content reaches 3.58%, which falls in line with the northwestern Anatolian artefacts. Gerritsen et al. 2010, 209, 212, tabs. 1–2.

86 Begemann et al. 1994, 204.

87 Renfrew – Slater 2003, 316; Hansen 2007; see also Alram-Stern, this volume 305–328.

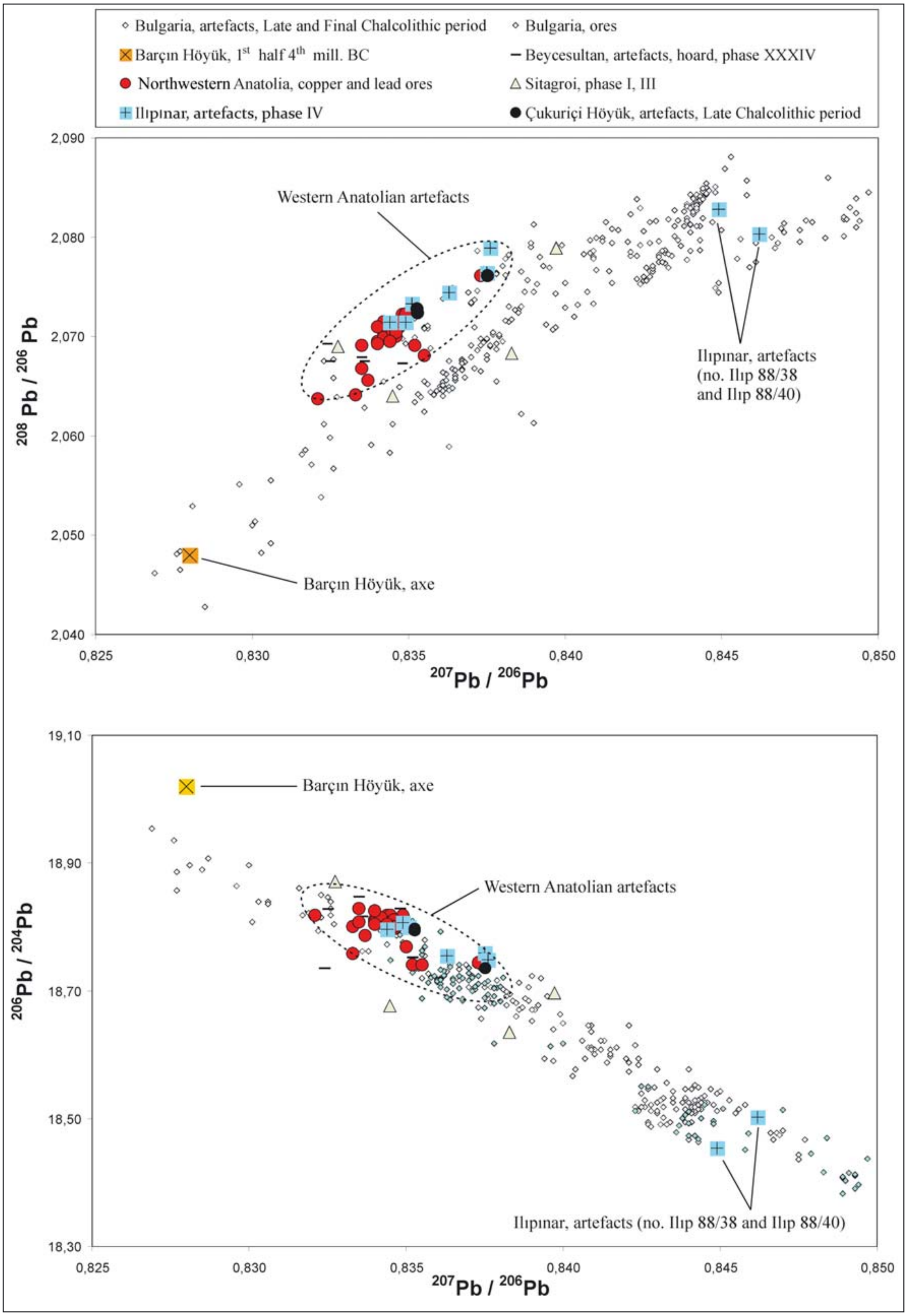

Fig. 9 In the diagram the analytical data of artefacts from the 4th and 5th millennia BC are combined. It can be observed, that two of the Ilıpınar objects (Phase IV) and an axe found in Barcın Höyük have lead isotope ratios which are not consistent with those of northwestern Anatolian ores or artefacts (Begemann et al. 1994, 214, tab. 3; Pernicka et al. 1997; Begemann et al. 2003, 193, tab. 4; Gerritsen et al. 2011, 212, tab. 2) (© M. Mehofer, VIAS).

These relations should be discussed for northwestern Anatolia. Having these possible Balkanic relations in mind it would be more than interesting to analyse the finds with early dates from Orman Fidanlığı and Haçilar to get information on the origin of the copper used on these sites.

If we summarise the described observations, it can be stated that it is not possible to find clear evidence for extractive metallurgy before 4500 BC in western Anatolia, which dates much earlier than the Balkan metallurgy. The crucible from Orman Fidanlığı[88] seems to be the oldest evidence for metalworking by pyrotechnical processes in western Anatolia. For the time span of 4000–3500 BC, we can mention the axe from Barcın Höyük, an import to the region, and objects from Ilıpınar, where most of the finds already have a 'local' lead isotope signature, which would make them the oldest artefacts produced of local ores. The subsequent finds would be the artefacts and crucibles from Beycesultan and Kuruçay. Finally, from the middle of the 4th millennium BC onwards metalworking reaches the West Anatolian coastline and is also observed in Greece and the Aegean.[89] With the beginning of the 3rd millennium BC, evidence for extractive metallurgy becomes denser in Anatolia and in the neighbouring regions.

These observations show that from a metallurgical point of view it is still difficult to close the gap between Europe and western Anatolia. Especially, for the period before 3500 BC or even 4000 BC, the archaeological and analytical evidence for the smelting of copper ores in western Turkey is limited. On the one hand, this may be caused by the state of research in the area under study; on the other hand, other explanations[90] are also possible. However, with the beginning of the 3rd millennium BC the exchange of new metal technologies between Europe and Anatolia seems to be established. This is demonstrated by specific silver-copper alloys or the spread of the new copper-tin alloy – the bronze.[91] Finally, we are still in need of well stratified sites with metallurgical remains and especially of more analytical data since these are a powerful research tools to make such correlations visible.

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88 To date, the artefacts of Orman Fidanlığı are not analysed; therefore, no statements concerning the provenance of the metal used could be made.

89 Parzinger 1993, pls. 227–230; Alram-Stern 1996, 181; Zachos 2007; Todaro – Di Tonto 2008, 183; see also Alram-Stern, this volume 305–328.

90 Renfrew 1969; see Pernicka, this volume 447–462.

91 Pernicka et al. 2003, 168, fig. 15.

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Appendix

List 1: Sites with 'Ring Idols' and Ring Pendants on the Balkans, in Turkey and Greece

Carparthian Basin and the Balkans

1. Tibava; 2. Vel´ké Raškovce; 3. Jászladány; 4. Hatvan-Újtelep; 5. Pusztaistvánháza; 6. Magyarhomorg-Kónyadomb; 7. Magyartés; 8. Tiszaszőlős; 9. Hencida; 10. Tiszavalk-Tétes; 11. Tiszavalk-Kenderföld; 12. Oradea; 13. Moigrad; 14. Targu Mureş; 15. Traian; 16. Vidra; 17. Sultana; 18. Gumeniţa; 19. Vărăşti; 20. Ruse; 21. Dălgopol; 22. Radingrad; 23. Varna; 24. Chatnica; 25. Sava; 26. Sofronievo; 27. Surroundings of Pazardžik; 28. Vajska; 29. Progar; 30. Hódmezővásárhely-Kishomok; 31. Durankulak (after Hansen 2007, 284, fig. 175, 504–515).

Mainlaind Greece and the Aegean

Golden 'Ring Idols'

32. Aravissos, Pella: 1 golden 'ring idol', 2 golden artefacts, without context (Demakopoulou 1998, 62, nos. 58–60; Zachos 2007, 174).

33. Paliambela, Pieria: 1 fragmented golden 'ring idol', found in settlement layers, dating: Late Neolithic period (Greek chronological system) (Kotsakis – Halstead 2002, 414, fig. 11).

34. Platomagoules, Magnesia: 1 golden 'ring idol', without context (Demakopoulou 1998, 62, no. 56 ; Zachos 2007, 174).

35. Sesklo, Magnesia: 1 golden 'ring idol' (now lost), 1 pottery fragment decorated with painted 'ring idol' motives (Tsountas 1908, 219, tab. 21/2; Demakopoulou 1998, 68, no. 76; Zachos 2007, 171; Skafida 2008, 521).

36. Theopetra Cave, Kalambaka: 1 golden 'ring idol', comes from an excavation, but not securely stratified (Demakopoulou 1998, 62, no. 57; Zachos 2007, 174).

Silver 'Ring Idols'

37. Alepotrypa cave, Mani: 1 silver 'ring idol', (together with 9 silver artefacts, 1 necklace), no context published (Demakopoulou 1998, 65, nos. 64–66).

38. Eileithyia cave, Aminissos, Crete: 1 silver 'ring idol' (Demakopoulou 1998, 64, no. 63).

39. Ftelia, Mykonos: 1 silver 'ring idol' (Sampson 2002, 124).

40. 'Euripides' Cave near Salamis, Attica: 1 silver 'ring idol', 1 silver ring, without context (Demakopoulou 1998, 64, no. 62; Zachos 2007, 174).

Other Finds (Copper, Clay, Stone, Decoration)

41. Dimini, Magnesia: 1 copper pendant, 3 'ring idols' made of stone, 3 pieces of painted pottery with 'ring idol' motives (Demakopoulou 1998, 66, nos. 67–89, 68, no 75; Zachos 2007, 172; Skafida 2008, 529, figs. 7/530; 8–9).

42. Dispilio, Kastoria: 1 'ring idol' made of stone (Demakopoulou 1998, 67, no. 74).

43. Emporio, Chios: 1 fragmented copper ring interpreted as 'ring idol' (?), found in the settlement (layer IX–VIII) (Hood 1982, 657, 661, fig. 295/17).

44. Franchthi Cave: pottery fragment with painted ‘ring idol’ motives (Vitelli 1999, fig. 64).

45. Kitsos cave, Attica: 1 ‘ring idol’ made of stone (Demakopoulou 1998, 67, no. 71).

46. Makrygialos, Pieria: 1 fragmented copper pendant (settlement context: Makrygialos II), 2 further stone artefacts interpreted as ‘ring idols’, settlement finds (Demakopoulou 1998, 67, nos. 72–73; Pappa 2007, 263, fig. 17).

47. Pevkakia, Magnesia: 1 ‘ring idol’ made of clay, settlement context (Demakopoulou 1998, 66, no. 70).

48. Strophilas, Andros: rock carvings with ‘ring idol’ motives (Televantou 2008, 49, fig. 6, 10; Nazou 2010, 9).

49: Tigani, Samos: 1 pottery fragment with plastic ‘ring idol’ decoration (Felsch 1988, Taf. 47.8)

Unknown Provenance

50. Collected near Ptolemaida: 1 golden ‘ring idol’. Reinholdt lists this object as surface find, to date it was only mentioned in the local newspaper (Reinholdt 2008, 31, note 104).

51. Convolute of 55 golden artefacts with 32 golden ‘ring idols’, without context (Demakopoulou 1998, 51–62, nos. 3–55; Zachos 2007, 174).

Turkey

Gold, Silver and Lead ‘Ring Idols’

52. Ege Gübre: 1 golden ‘ring idol’ was found in a deposit in Ege Gübre level II, 1 silver ‘ring idol’ was found in grave 4 at this site, dating: The golden ‘ring idol’ was excavated within a deposit of Level II of Ege Gübre. The ^{14}C analyses give two dates for this Chalcolithic level, in particular 4040–3950 BC and 3780–3640 BC. Grave 4 also dates to the Chalcolithic period (courtesy of Haluk Saglamtimur, Ege University Izmir; Keskin 2011, 199, 210, no. 7; 221, fig. 1, no.7; Sağlamtimur – Ozan 2012, 228, fig. 6A, 240).

53. İkiztepe: 2 golden ‘ring idols’ (1 without head, 1 with T-shaped head), 1 lead ‘ring idol’ with T-shaped head, found in graves, dating under discussion (Chalcolithic period) (Bigli 1984, 265, fig. 18; Bigli 1990, 161, 427, fig. 19; Zimmermann 2007, 28, fig. 3.1–3).

54. Göller near Oymaagaç (context unsecure): 1 silver ‘ring idol’ (Lichter 2006, 528; Zimmermann 2007, 29, figs. 4, 1).

Other Finds (e.g. Mould or from Unknown Context)

55. Çamlıbel Tarlası: 1 mould for ring pendant with T-shaped head found in a settlement, dating: early to the middle of the 4th millennium BC (Schoop 2011, 59, fig. 9).

56. ‘group of jewellery no. 1’, unknown provenance, (Turkey?), said to come from the region of Trabzon, no context: 12 golden ‘ring idols’, jewellery, carnelian bracelets (Rudolph 1995, 27, fig. 30.1, E; Lichter 2006, 528; Zimmermann 2007, 28, figs. 3, 4–6).

57. Turkey, no context: 1 golden ‘ring idol’, formerly said to be found in Kalınkaya (Lichter 2006, 528; Zimmermann 2007, 28).

List 2: Ring-Pendants with T-Shaped Head and Longitudinally Orientated Eyelet

Turkey

Golden Ring Pendants

58. Bakla Tepe, Turkey: 1 golden pendant with T-shaped head and longitudinally orientated eyelet, 2 lead pendants with T-shaped perforated head and longitudinally orientated eyelet, found in graves, dating: EBA 1–2 (Erkanal 2008, 173, fig. 6; Keskin 2011, 148, 280–281, no. 163–165).

Other Finds (e.g. Context Unknown or Interpretation as Part of this Group Insecure)

59. vicinity of Sardis: 1 golden pendant with T-shaped perforated head and longitudinally orientated eyelet, no context (Zimmermann 2007, 29, fig. 4.2).

60. 'group of jewellery no. 2', unknown provenance (Turkey or Mesopotamia?), 4 golden ring pendants with T-shaped head and longitudinally orientated eyelet, bracelets, ear-rings, precious stones etc. (Rudolph 1995, 35, 42, 43, fig. 2, I).

61. Alishar, 1 ring pendant with T-shaped head made of lead, found in a grave, dating 'Copper age' (von der Osten 1937, fig. 197, c753).

62. Aphrodisias-Pekmez: 1 lead pendant without T-shaped head, interpretation as part of the 'ring pendant/idol' group questionable, found in a settlement area, new research dates the find to the end of the 5th millenium BC (Reinholdt 2008, 131, fig. 17.10; Keskin 2011, 221 fig. 1.8; Zimmermann 2011, 301, fig. 2.9).

63. 1 vessel with plastic 'ring pendant' decoration, private collection, no context (Höckmann 1984, 133, fig. 7.3; Keskin 2011, 210, no. 23).

Greece

Silver and Copper Ring Pendants

64. Poliochni, Lemnos: 2 ring pendants with longitudinally orientated eyelet found in the settlement, 1 made of silver, 1 made of copper, dating: phase 'rosso' (Bernabó-Brea 1964, 663, pls. 170.3; 177.25, 28; Maran 2000, 188).