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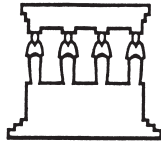


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MEDITERRANEAN

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Revisiting Late Bronze Age oxhide ingots: Meanings, questions and perspectives

Serena Sabatini

The so called oxhide ingots from the Late Bronze Age are an intriguing class of objects from the Mediterranean. Their amazing number, spread, distribution and puzzling characteristics have long attracted scholars' attention. They provide a glimpse into the extraordinary complexity of the Mediterranean world during the 2nd half of the 2nd millennium BC as they were subjected to practices of production, exchange, transformation and use spreading from the Levantine coast to Sardinia. The Turkish shipwrecks from Uluburun and Cape Gelidonya leave no doubt about their use as means of transportation of copper and tin, but can we consider them to just be ingots? A review of their distribution pattern paired up with critical attention to the chronology of the phenomenon invites a reflection on the meaning of these objects.

Introduction

Oxhide ingots are well known in archaeological literature. They were used throughout the 2nd half of the 2nd millennium BC over a vast area stretching from Southern France and Sardinia to the west, Mesopotamia and Egypt to the east and extending as far north as Scandinavia (Fig. 1). This paper aims to provide a renewed overview of the known finds, in particular their chronology, while attempting to offer 'food for thought' to a long and lively debate.

Oxhide ingots were potentially not contemporaneously in use throughout their distribution area; analysis of the existing evidence offers a valuable insight into the process of the emergence, development and transformation of this class of material. The **ingots inhabited the Mediterranean for about six centuries;** while their significance as metal ingots (a means of transportation of copper or tin) might be considered unaltered throughout the whole period, considerable historical and political changes took place during their period of use. The fact that they were parts of different cargoes, like those on the Uluburun and Cape Gelidonya ships, shows how this class of material could be adapted to a variety of trade systems. Their origin, role and significance are matters of debate; it is clear, however, that oxhide ingots were accepted in geographically and culturally



Fig. 1: *Distribution map of the oxhide ingots. Black squares: find spots of full sized and miniature oxhide ingots. Grey squares: find spots of oxhide ingot images. Images have been reproduced in several different ways such as on rock panels from Sweden, ceramics from Sardinia, various artefacts from Cyprus and paintings/reliefs in Egypt.*

separated environments. In other words they seem to be a prominent expression of networking and connectivity between people from different cultural and economic backgrounds. Their characteristics give additional potential to the possibility that they were a sort of brand commodity.

A few notes about oxhide ingots

It is not the aim of this paper to thoroughly discuss the class of material itself. Oxhide ingots can be described as copper and tin ingots in the form of rectangular slabs featuring more or less elongated corners which form a handle of sorts (Fig. 2a). The resemblance to the shape of a stretched ox-hide has led to their most commonly used name; however, it is generally acknowledged that their shape was

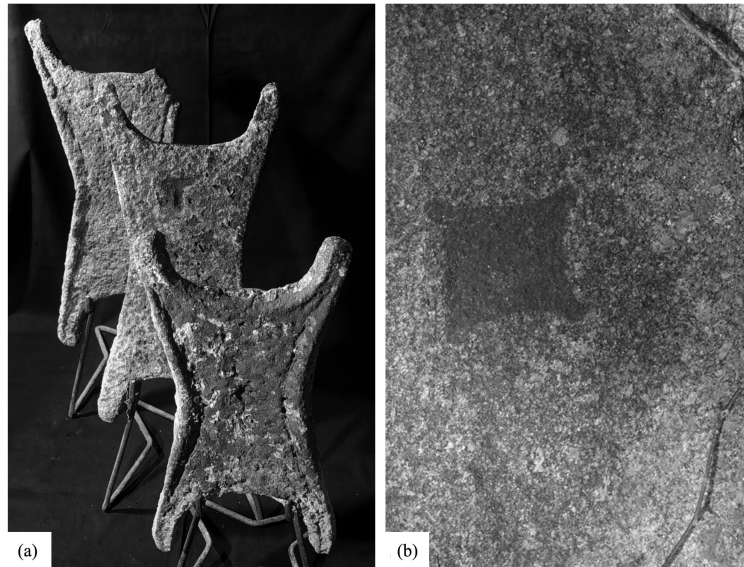


Fig. 2 A: Oxhide ingots from cape Gelidonya (courtesy of the Institute of Nautical Archaeology). B: The oxhide ingot carved on the rock panel Kville 156:1, Torsbo, Bohuslän, Sweden (photo A. Mederos, courtesy of Prof. J. Ling, Gothenburg University).

instead determined by the need to carry them easily.¹ Copper oxhide ingots weigh between *c.* 20 kg and *c.* 40 kg. A large number of them have a weight of around 29/30 kg which has led to the suggestion that one oxhide ingot might have been the equivalent of the Aegean talent weight unit.² Although debated, the association between any such ingots and a talent unit appears possible when considering that they may have been the object of a double counting.³ Quick loading and unloading procedures could have been carried out by counting each piece as a talent, while their real weights would have been used for the final transaction/payment.

Early studies have also attempted to classify and provide chronological records with regards to shape variations within the class;⁴ however, archaeological evidence shows that different types/shapes were used contemporarily. Only the first Buchholz's type (Bass type 1a and 1b), which features less protruding handles, appears to have an archaic character within the whole class.

1. E.g. Bass 1967, 69; Jones 2007, 85; Kassianidou 2012, 12.

2. E.g. Jones 2007, 84; Kassianidou 2012, 12; Muhly 2009, 18; Parise 1986, 308.

3. E.g. Parise 1968, 128; Zaccagnini 1986; Pulak 1988, 8.

4. Bass 1967; Buchholz 1959.

Oxhide ingots are indeed archaeologically documented in several forms. They are initially described as copper and tin ingots. Secondly they were also manufactured in miniature forms.⁵ Thirdly they are known from representations on paintings and reliefs in Egypt, on bronze stands and cultic statuettes from Cyprus and rock art in Scandinavia.⁶ Other oxhide representations, although some are highly questionable, have been recognized on cylinder seals, Linear B tablets and ceramics.⁷ This manifold evidence communicates the complex narratives of this long lived class of material. In this work, attention will primarily be paid to the oxhide ingots in strict relation to the geographical and chronological information they provide as an understanding of the whole phenomenon.⁸

Distribution and chronology of the finds

Useful and detailed reviews/catalogues of the known finds have been published in earlier and more recent times with accurate lists of previous references;⁹ these will generally not be repeated here. The main aim of this paper is to provide renewed insights into the whole phenomenon using a chronological perspective. In doing so items which can be accurately dated will primarily be taken into consideration. They offer a picture of the phenomenon's movement in space, which is worth extra attention. The large number of finds which cannot be precisely dated will also be considered as it provides an insight into the scale and significance of this class of material and the network patterns through which it circulated.

The proposed chronological journey is divided in three main periods (*c.* 1600-1400 BC; *c.* 1400-1200 BC; *c.* 1200-1000 BC). This simple model is based on several relevant observable changes regarding production, trade and the use of oxhide ingots. At the end of the 15th and the beginning of the 14th

5. E.g. Giunlia-Mair *et al.* 2011; Hadijsavvas 2011.

6. See respectively Papasavvas 2009 and Ling and Stos-Gale 2015.

7. E.g. Bass 1967; Knapp 1986; Manunza and DeFrassu 2009; Papasavvas 2009.

8. Both full size and miniature ingots will be taken into consideration. It is worth highlighting, however, that a considerable number of oxhide ingots have been found in a fragmentary state. There is no possibility in this article to propose a thorough study of such evidence. Nonetheless it seems that while fragments of various shape and size can be connected to metalworking activities, quarters or halves of oxhide ingots are generally related to cultic contexts (cf. Caloi 2006).

9. Bass 1967; Bucholz 1959, 1988; Doncheva 2012; Gale 1991; Jones 2007; Kassianidou 2009; Kassianidou and Papasavvas, eds., 2012; Liard 2010; Lo Schiavo *et al.*, eds., 2005; Lo Schiavo *et al.*, eds., 2009.



Fig. 3: *Distribution map of the oxhide ingots dated to the 16th and 15th century BC.*

century BC, as discussed below, the sources of copper, which were previously from multiple locations, shrank to being almost exclusively from the Cypriot lead isotopic field, in particular to the ore of Apliki in the Solea mining district.¹⁰ Subsequently, at the passage between the end of the 13th and the beginning of the 12th century BC, datable evidence from Cyprus becomes less consistent while the oxhide ingot distribution appears slightly more significant in the Central Western Mediterranean. It therefore appears, particularly according to the scope of this paper, appropriate to propose such a temporal division for a fruitful discussion.

c. 1600-1400 BC

The earliest oxhide ingots are mainly found in the eastern part of the Mediterranean region including the island of Crete (Fig. 3). Evidence from this early stage already shows the multifaceted presence of such ingots both

10. E.g. Kassianidou 2013.

in their full form as well as miniaturized. Their representations in Egyptian tomb paintings from the 15th century onwards,¹¹ along with recently discovered evidence from Scandinavia, suggests that oxhide ingots were already part of a wide metal supply distribution network.

Aegean and Crete

The oldest full size copper oxhide ingots which have been securely dated by their archaeological contexts are found on the island of Crete; an island which lacks its own copper ores.¹² The finds from the sites of Chania, Gournia, Haghia Triada, Mochlos, Tylissos and Zakros can be dated to the Late Minoan (LM) IB (c. 1500-1450 BC), if not even earlier to the end of the LM IA.¹³ They come from a complex set of contexts of both utilitarian and non-utilitarian nature.¹⁴

The oldest Cretan ingots are probably the most interesting as far as their provenance is concerned. Several of the early ingots (from Chania, Gournia Mochlos and Zakros) appear to have been produced with copper from Cypriot ores including Apliki.¹⁵ For the significant remaining number of ingots it has not been possible to identify the source of their copper, yet they seemingly must come from at least two different non Cypriot copper ores.¹⁶ Still unknown sources, somewhere beyond Mesopotamia, have recently been suggested,

11. It ought to be mentioned that it has been attempted (Nibbi 1987) to emphasize a series of representations of oxhide ingots on Egyptian Middle Kingdom sarcophagi (dated between approximately 2000 and 1600 BC). These images appear next to the term NMS which connects them to practices of wrapping. Largely due to chronological discrepancies these representations are generally not considered as images of oxhide ingots. Their recurrent association with specific elongated objects, arrows and bows (see Nibbi 1987) also suggests that they are not oxhide ingots. Nevertheless the similarity of the shape is striking. Given that there are currently no clues regarding the origin of the oxhide ingots, these representations together with Nibbi's (1987, 85-86) suggestion that oxhide-shaped ingots were in use during the Middle Kingdom for the transportation of salt, might actually warrant further investigation.

12. E.g. Liard 2010, 49; Stos 2011.

13. E.g. Liard 2010; Soles 2004.

14. The terms utilitarian and non-utilitarian contexts are used several times in this paper. With such definitions it is intended to roughly distinguish between contexts connected to metallurgical activity/workshops and thus containing material that was most likely waiting to be used (utilitarian) and contexts where material was probably deposited for ritual purposes (non-utilitarian) and not to be melted or further used later on. See also Liard 2010, 61, pl. 2; Lo Schiavo *et al.* 2013; Soles 2004.

15. Gale 2011; Liard 2010; Stos 2009, 173.

16. Liard 2010; Stos 2009; Stos-Gale 2011.

possibly in the area controlled by the powerful Mitanni Kingdom between the 15th and the 13th century BC. They surely suggest, however, that the production of oxhide ingots involved articulated systems of international copper supply, at least during the 15th century BC.¹⁷

Early oxhide ingots have been found in the Aegean, in particular at **Ayia Irini on the island of Keos** (from a context – House A - where metallurgical activity was taking place), and outside the coast of **Kyme on Euboea**.¹⁸ They have been dated to the Late Helladic (LH) I and II (c. 1500-1400 BC); however Kyme's pieces were not from a completely reliable context as far as chronology is concerned.¹⁹ Opposed to the Cretan oxhide ingots they appear to have been produced with metal from the Cypriot source of Apliki.²⁰

At least one of the small ingot fragments found in a hoard in the West House at **Kastri on Kythera**, has tentatively been proposed as a possible part of an oxhide ingot.²¹ The find dates to around the transition between the LMIA and LMIB period.

Egypt

A large amount of evidence comes from Egypt. The earliest **representations of oxhide ingots in Egypt are generally in the form of paintings which have been found on the walls of several Theban tombs as well as in reliefs carved onto Karnak temples**. The chronology of the former corresponds relatively well to the reign of Hatshepsut and Thutmose III (c. 1479-1400 BC), while the Karnak reliefs are dated to the reign of Amenhotep II and Thutmose IV (c. 1400-1390 BC).²² Such representations are clear evidence of the ubiquity of using oxhide ingots in Egypt. They also speak in favour of the character of 'gifts' to the Pharaohs from foreign kingdoms. They appear as valuable goods to the Egyptians, suggesting that the Egyptians were most likely not casting the ingots themselves.²³ In the case of the Theban tomb of Rekhmire, dated to the time of

17. Stos-Gale 2011.

18. Cummer and Schofield 1984; Mangou and Ioannou 2000; Jones 2007, 419.

19. Stos-Gale *et al.* 1997, 112.

20. Gale 2011; Stos Gale *et al.* 1997.

21. Broodbank *et al.* 2007.

22. The chronology given in parenthesis in the text is taken from Hornung *et al.* 2006, 490-495. Such information is partly different from that given by Bass (1967, 62). He placed the reign of Hatshepsut and/or Thutmose III between 1490 and 1436 BC. Bass (1967, 65) also places Amenotep's reign between 1436 and 1411 followed by Thutmose IV between 1411 and 1397.

23. Stos 2011.

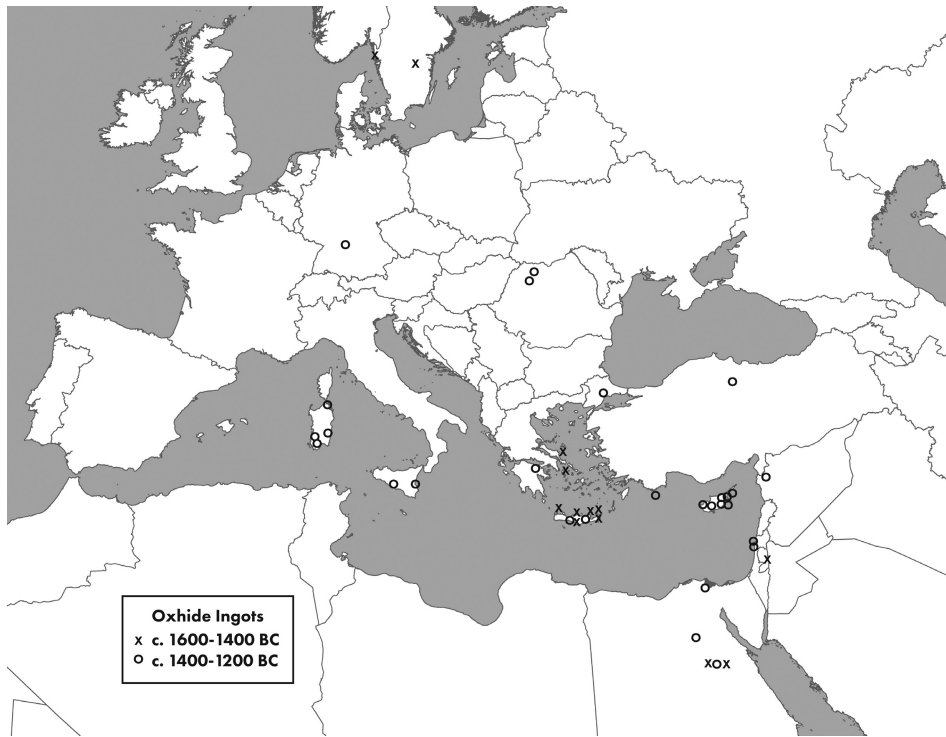


Fig. 4: *Distribution map of the oxhide ingots dated to the 14th and 13th century BC.*

Thutmose III – Amenhotep II, Shelley Wachsmann observed that the oxhide ingots clearly seemed to have been brought by the Aegeans.²⁴ In the tomb of Amenemopet, which dates to the reign of Thutmose IV, the bearers appear to be hybrids, in the sense that they are depicted with features which partly belong to the iconography of the Aegean people and partly to that of the Syrians. Oxhide ingot bearers are identified as Syrians in all the other Theban tombs.²⁵

Levant

The oldest oxhide ingot currently known is half of a miniature sized example excavated at the beginning of the 20th century from the **West Bank site of Tell**

24. Wachsmann 1987, 50. It might be worth to recall here that one interesting detail from Rekhmire's tomb which matches the archaeological record is that the Aegean bearers carry several luxurious goods including an elephant tusk. Oxhide ingots, precious goods and elephant tusks have actually been found in association in a deposit from Zakros on Crete (Platon 1985; Liard 2010), dated to the final LM IA-LM IB.

25. Wachsmann 1987: 50.

Beit Mirsim. From the excavation report it appears to have been recovered from a workshop area of the so called stratum D which is dated to the 16th century BC.²⁶ If the reliability of the stratigraphy could be proven this miniature oxhide ingot would not only confirm the early emergence of this class of material, but also, due to its miniature shape and treatment (only half was found so it was probably cut into two parts), it infers that they held multiple meanings even at an early stage of their use and production.²⁷

Northern Europe

Very recent and intriguing discoveries on rock art panels from Western Sweden imply an even larger vision of metal trade and networking patterns.²⁸ In particular the representation of a Buchholz type 1 oxhide ingot on the **rock carving Kville 156:1, Torsbo in Northern Bohuslän (Fig. 2b)**, datable by association with the nearby carved boats to the 16th century BC shed light on the possible width of networking patterns which already existed during the 16th century BC.²⁹ Another conceivable representation appears **‘on board’ a ship (Fig. 4) carved on a panel from Östra Eneby 1:1.**³⁰ The ship, which is dated between 1500 and 1300 BC³¹, seems to have a stern-mounted steering oar, which is rather unknown in Swedish rock art,³² while, interestingly, it is reminiscent of Mediterranean boat

26. Albright 1938, 54, pl. 41:13 and 58-60. However it has to be kept in mind that Albright's methods and influence have been questioned (e.g. Dessel and Joffe 2000).

27. The debate about the use and meaning of the miniature oxhide ingots is open. A recent contribution (see e.g. Giumlia-Mair *et al.* 2011 with previous bibliography) showed among other things that there is no need to cut them in order to melt them. Therefore it is suggested that there was some sort of ritual act behind such a practice. It is also suggested that, at least in terms of the finds from Cyprus, they were not used as weights.

28. The urge for collaboration between European and Mediterranean studies for better understanding and contextualisation of several phenomena has been rising in recent years (e.g. Alberti and Sabatini 2012; Maran and Stokhammer, eds., 2012; Wilkinson *et al.*, eds., 2011). An enlightening example is the conference ‘Italy, Mediterranean and Europe in the Bronze Age’ which took place in Göteborg, April 2013, where scholars of both the Mediterranean and European Bronze Age were invited. It is thanks to this mixed scholarship that, during the conference excursion, the importance of the Kville oxhide ingot (Fig. 2b) became evident.

29. Ling and Stos-Gale 2015.

30. Ling and Stos-Gale 2015.

31. Given its chronology between 1500 and 1300 BC, the panel could also be the evidence of contacts taking place not at this early stage, but during next period (1400-1200 BC).

32. E.g. Kaul 1998; Ling 2008.

representations.³³ Additional potential representations of oxhide ingots, dated between 1600-1100, have also been detected on other rock art panels from different parts of Sweden.³⁴

1600-1400 BC: Comments

A few brief comments should be made about this initial phase. In the first place it is interesting to stress the peculiarity of the Cretan oxhide ingots. They not only show the existence of a system of copper supply using manifold sources, but they also provide evidence of early use of Cypriot copper. Some of the Cretan oxhide ingots were made of metal matching the Cypriot ore of Apliki, whose copper had apparently been used for the manufacture of a large majority of copper oxhide ingots from the 14th century BC onwards.³⁵ This evidence, which seems difficult to question from the scientific point of view, has been challenged.³⁶ Kassianidou questions the feasibility of such evidence from a practical point of view, however, knowing very little about the political organisation of Bronze Age Cyprus it seems difficult to propose alternative interpretations. Muhly observed that although oxhide ingots generally seem to bear an Apliki signature and were a means of transportation of copper, which in turn must have been used to cast bronze objects, none of the analysed Mediterranean bronze objects seem to match Apliki signature. Where is the gap? Are bronze objects always the result of mixed copper sources? Indeed the fragmentary conditions of many of the oxhide ingots which were found in contexts where metallurgical activities were obviously taking place, along with the general presence of other material which was to be melted, seems to support the idea that casting was seldom carried out exclusively using ingots. In this respect it has been argued that given the necessity of mixing copper with tin in order to get bronze, the small amount of lead which is contained in pure copper oxhide ingots is changed during bronze production and thus the Cypriot origin of the copper basically becomes impossible to detect unless it is on Cyprus itself.³⁷ However recent analyses of Scandinavian metal artefacts have given the possibility to confirm the validity of lead isotope analysis (LIA) for the identification of the copper ores used in the manufacture of bronze objects.³⁸

33. Wachsmann 1998 and 2013.

34. Ling and Stos-Gale 2015.

35. E.g. Gale 2011; Stos Gale *et al.* 1997, see also the considerations of Hauptmann 2009.

36. Kassianidou 2009, 63-4; Muhly 2009, 29-30.

37. Begemann *et al.* 2001.

38. See Ling *et al.* 2014, 117-118.

The second comment regards the Egyptian representations. Shelley Wachsmann illustrated how in most of the cases, oxhide ingots were brought to Egypt by the Syrians.³⁹ However he also admits that Egyptian paintings or reliefs are not photographs of real events. The rules that the artists were expected to follow and the circumstances in which they were working might have biased reality to an extent which is difficult to establish. Did the Theban tomb painters know about production and exchange practices which were primarily managed by Syrian merchants or were the Syrians just managing traffic with Egypt? Archaeological evidence from Crete, Keos and Kyme suggests that the Aegeans and Minoans were involved in practices of exchange and use of oxhide ingots. Could it be that the Egyptians, being more acquainted with Syrian merchants than Aegean people preferred to represent the former? In my opinion it is highly significant that Rekhmire's tomb - which shows the most detailed images of oxhide ingots and metalworking - is also the only one which undoubtedly shows the Aegeans as oxhide ingot bearers. Could it be that particular realism was applied to Rekhmire's tomb paintings? If so, why is that? Might these particularly accurate tomb paintings tell us more than the others do? Alternatively is Egyptian evidence just witnessing a various degree of care brought about by the complex management of copper trade during the 16th and the 15th century BC? According to a recent study,⁴⁰ our understanding of the representations of Aegean/Minoan people in Theban tombs has generally been biased by a sort of orientalist approach to the issue. It is instead proposed that Aegean/Syrian hybrids are not the outcome of ignorance or inaccuracy but are instead due to the way Egyptians perceived those people. Both texts and pictures suggest that they were considered to have belonged to a similar cultural sphere. In other words they were both regarded as people from Asia (or the 'north') and therefore liable to be hybridized with each other.

Egyptian paintings showing a silver or grey coloured oxhide ingot side by side with red ingots (copper ingots) also offer early evidence for the use of those ingots as a means of transportation of metal other than copper. George Bass proposed that the bluish oxhide ingots were made of lead or tin.⁴¹ Later finds, particularly those from the Uluburun shipwreck, confirmed that tin oxhide ingots were actually manufactured and shipped together with the copper ones.⁴² A practice that probably continued until at least the beginning of the 12th

39. Wachsmann 1987.

40. Matič 2012.

41. Bass 1967, 62-67.

42. E.g. Pulak 1997, 239.

century BC since, despite its poor conditions on the sea bed, the tin discovered on the Cape Gelidonya shipwreck was probably also cast into oxhide ingots.⁴³

The most striking evidence as far as this early period is concerned is the recently discovered images from Scandinavian rock art. We probably should not assume that the presence corresponds with a full acquaintance to the underlying networks that this class of material represented in the Mediterranean, however, we cannot deny it either. From about 1600 BC in southern Scandinavian, we not only see an increased use and production of metal objects, but also of contact with the rest of the continent.⁴⁴ In addition, recent studies on the copper provenance of bronze objects found in Scandinavia suggest a complex picture for copper supply networks during the 2nd millennium BC;⁴⁵ this includes the presence of Cypriot copper in artefacts contemporary to the early oxhide ingot representations on rock panels. Such networks stretch all over the continent connecting the Mediterranean and the whole European continent in various ways.⁴⁶

To conclude, early oxhide ingots demonstrate the manifold use and consumption of the class and its broad distribution even during its early stage. According to the archaeological evidence (regarding whether they are real ingots or representations of them), oxhide ingots have been found both in utilitarian (metal workshops) and non-utilitarian contexts (treasures/deposits). They were definitely used to carry copper as well as tin. Miniature oxhide ingots were also already in circulation.

c. 1400-1200 BC

Archaeological evidence dating from the beginning of the 14th to the end of the 13th century BC suggests a broadening of geographical and cultural horizons (Fig. 4) for oxhide ingots inasmuch as there was a sharp increase in the number of known pieces.⁴⁷ It currently shows a considerable reduction of sources used and the striking dominance of copper from the Cypriot mine of Apliki⁴⁸

43. Bass 1967, 82-3.

44. E.g. Vandkilde 1996, 2010; Kristiansen 1998.

45. Ling *et al.* 2014.

46. See also Rowland and Ling 2013.

47. As far as numbers are concerned this is due to the recovery of the Uluburun relict and its incredibly rich cargo containing, among other things, 354 copper oxhide ingots (e.g. Pulak 1997, 1998, 2008).

48. Gale 1999, 2006, 2011; Gale and Stos-Gale 2005, 2012.

Aegean and Crete

In the Aegean area, the ingots from **Mycenae** including those from the so called Poros Wall Hoard date to LH IIIB-C which may still be within the 13th century BC.⁴⁹

Oxhide ingots from **Kommos, Crete**, were found in LMIIIB contexts.⁵⁰ Also at **Haghia Triada**, not far from the deposit of the *vano* 7 from which the LMIB ingots were recovered, two fragmentary oxhide ingots were retrieved together with votive equipment from the **Piazzale dei Sacelli** dating to LMIIC.⁵¹ Opposed to the earlier ingots, whose source is still unknown, LIA on these LMIIC fragments from Haghia Triada shows that they were made with copper from Apliki ore.

Anatolia and Uluburun

The **Uluburun shipwreck** excavated outside the southern coast of Turkey near the village of Kaş is currently dated to the very end of the 14th century BC. It is unrealistic to even attempt to provide a brief description of this impressive underwater find.⁵² The ship contained a cargo of huge dimensions (probably of about 20 tons) and variety (including metal, ceramics, resins, glass, ivory, timber and a multitude of various objects and goods). The bulk of the cargo consisted of *c.* 10 tons of copper, transported in the form of 354 oxhide ingots of Cypriote copper and over 150 other smaller ingots (bun and oval). It also shipped *c.* 1 ton of tin, in the form of variously shaped ingots, including oxhide ingots.⁵³ The ship was most likely sailing westwards towards the Aegean or Crete,⁵⁴ maybe Kommos,⁵⁵ from somewhere along the Levantine coast or Cyprus.⁵⁶

From the Anatolian mainland, one oxhide ingot fragment was found at **Boğazköy**, dated to the 14th-13th century BC.⁵⁷

A quarter of an oxide ingot was found at **İğdebağlari** in the so called Sarköy/Tekirdağ hoard on the north-western shore of the Marmara Sea. The hoard is a very interesting assemblage of items from both the Balkans and the

49. See Gale 1991, 221; Mangou and Ioannou 2000.

50. Shaw 2006, 725-726.

51. Lo Schiavo *et al.* 2013, 51.

52. E.g. Pulak 1997, 1998, 2008.

53. E.g. Pulak 1997, 239.

54. E.g. Pulak 2005a and 2008.

55. E.g. Bachhuber 2006; Muhly 2009.

56. E.g. Muhly 2009; Pulak 1997, 1998 and 2008.

57. Jones 2007, 56 and 420 with previous bibliography.

Mediterranean area.⁵⁸ From a chronological point of view it can be dated to the end of the 14th and the beginning of the 13th century BC.⁵⁹

Cyprus

Cyprus undoubtedly had a primary role as far as oxhide ingot production and, most likely, distribution are concerned. Not only do the results of the LIA give evidence of **Cypriot provenance for most of the known ingots so far**,⁶⁰ but also the manifold local iconographic reproductions (e.g. miniature oxhide ingots, ingot bearers on bronze stands, the so called Ingot God or the Bomfort statuette, both standing on a miniature ingot, as well as, several representations on seals⁶¹) confirm the important role that oxhide ingots must have had for the island.⁶²

A recent catalogue of the oxhide ingot finds from Cyprus by Vasiliki Kassianidou clearly demonstrates how, despite the undoubtedly large production of oxhide ingots or at least of copper used to manufacture them, the ingot finds from Cyprus are scarce.⁶³ Only 9 sites produced evidence for oxhide ingots, most of which are in a fragmentary condition.⁶⁴ Several were found in the city of **Enkomi**. Due to the history of the excavations at the site they are unfortunately also the most difficult to date, however, the oldest find appears to be an oxhide ingot fragment, which is likely lost, found in *Quartier 5W* by the French mission of 1949, which was dated to the Late Cypriot (LC) II or 14th century BC.⁶⁵

At least one other Cypriot oxhide ingot which ought to be dated to the 14th century is the example originating from the ‘basin building’ at the **Maroni-Vournes** site. Other fragments known from the same site might have a similar

58. Hansen 2005 with previous bibliography.

59. The hoard has been generally considered (e.g. Doncheva 2012, 686; Jones 2007, 421 and Pulak 2011, 299 with previous bibliography) to belong to the 12th-11th century BC. However a careful study by Svend Hansen (2005) seems to leave no doubt about the higher chronology of the context.

60. E.g. Gale 1999, 2006, 2011; Gale and Stos-Gale 2005, 2012.

61. A recent study (Papasavvas 2011) emerging from the Ingot God statuette’s technological characteristics provides interesting insights in the complex relationship between copper production and the political organisation of Cyprus when sanctuaries and ritual symbols might have played relevant roles in the attempt to establish the authority of competing social groups dealing with metalworking after the 14th century BC.

62. E.g. Knapp 1986; Kassianidou 2009, 2012; Papasavvas 2009, 2011

63. Kassianidou 2009.

64. Kassianidou 2009, 41.

65. See Kassianidou 2009, 44 with previous bibliography.

early chronology. They appear to have been found in association with other material demonstrating the existence of metallurgical activities which predate the construction of the local ‘Ashlar building’ which is generally placed during the 13th century BC.⁶⁶ Most of the oxhide ingots from Maroni-Vournes contain copper which matches the Apliki ore, although at least one sample could actually be from the mines of Skouriotissa and Mavrovouni.⁶⁷

Vasiliki Kassianidou argues convincingly to suggest that the finds from the so called ‘foundry hoard’, excavated by the British Museum at the beginning of the 19th century, should be dated to LCIIC and therefore to the 13th century BC.⁶⁸ The other finds from Enkomi are difficult to date; nevertheless they all illustrate intense metallurgical activities at the site.⁶⁹ On top of that, all of the analysed copper from Enkomi seems to match the Apliki ore,⁷⁰ which is one of the furthest away from it and thus creates an interesting question regarding the organisation of copper production on the island.⁷¹

Most of the recent discoveries from Maroni-Tsaroukkas, Aghios Dhimitrios-Kalavastos, Maa-Paleokastro and Pyla-Kokkinokrenos can be dated to the LCIIC.⁷² These finds generally come from contexts where metallurgical activities of various intensity were taking place. The still unpublished fragment from Maroni-Tsaroukkas appears to have been associated with other industrial activities. The site is apparently the harbour of the Maroni-Vournes settlement which lay just a few hundred meters away.⁷³ At Aghios Dhimitrios-Kalavastos the three local fragments of oxhide ingots were recovered in room A50 of building IX.⁷⁴ The whole building has been interpreted as a possible copper smith residence.⁷⁵ Contrary to what one might expect, the LI of the fragments shows similarities to the Apliki ore and not with the nearby mines of Kalavastos.⁷⁶ The fragmentary ingots at Pyla-Kokkinnokrenos came from a founder’s hoard which was probably deposited at the end of the short life of the site at the very

66. Kassianidou 2009, 46-48.

67. Gale 1999: 116; Stos-Gale *et al.* 1997, 110.

68. Kassianidou 2009, 43-44 with previous bibliography. The absolute chronology of the LCIIC has recently been radiocarbon-dated to *c.* 1340-1200 BC (see Manning *et al.* 2001).

69. E.g. Kassianidou 2009, 42-45 with previous bibliography.

70. Stos-Gale *et al.* 1997, 110.

71. Kassianidou 2009, 45.

72. E.g. Kassianidou 2009; Knapp 1990; Stos-Gale *et al.* 1997, 108.

73. Kassianidou 2009, 47-48 with previous bibliography.

74. South 1983, 104.

75. South *et al.* 1989, 320.

76. Kassianidou 2009, 49 with previous bibliography.

end of the 13th century BC.⁷⁷ Possibly contemporary to this example are the two fragments from the **Mathiati** hoard,⁷⁸ which appear difficult to date.⁷⁹ On the basis of the objects found in it, Hector W. Catling considered it to belong to the 12th century BC.⁸⁰ Such a chronology has been challenged and a possible dating to the 13th century BC is also proposed.⁸¹ What is interesting, as far as Mathiati is concerned, is that it seems to be a founder hoard containing several fragments of full-size oxhide ingots as well as miniature ones. Despite being located close to a copper-rich district, Mathiati's finds match the Apliki copper ore which is some 60 km away from the site.⁸²

Egypt

There are still representations of oxhide ingots in Theban tombs, generally carried by people which are generally interpreted as Syrian merchants during the 14th and the 13th century BC.⁸³ During the 14th century BC, other representations appear in the El Amarna tombs of Meryra, Meryra II and Huya. Again, the ingots were brought here by Syrians. The only known fragment from a full sized oxhide ingot found on Egyptian territory is not dated before the 13th century. Excavated at **Qantir** in the north-eastern part of Nile Delta, it also seems to have been produced with copper from Apliki on Cyprus.⁸⁴ At Qantir, which is identified with the city of Pi-Ramesse or Ramesse II's (c. 1279-1213 BC) capital, the excavations brought to light what could be considered a 13th century BC bronze factory with melting batteries and a series of large furnaces where enormous quantities of material must have been manufactured.⁸⁵ The presence of half an oxhide ingot confirms the utilitarian consumption of these ingots, as already shown in the Rekhmires tomb.⁸⁶ Given the size of the site, however, it also confirms that oxhide ingots do not represent the only source of copper within the extended Egyptian production.

77. Kassianidou 2009, 50 with previous bibliography.

78. Giumlia-Mair *et al.* 2011.

79. Kassianidou 2009, 52-54; Stos-Gale *et al.* 1997, 107-108.

80. Catling 1964, 283.

81. Knapp *et al.* 1988, 244-246.

82. See Kassianidou 2009, 54 with previous bibliography.

83. Bass 1967, 64, fig. 70-71.

84. Gale and Stos-Gale 1999, 272.

85. Push 1990; Rademakers *et al.* forthcoming.

86. E.g. Bass 1967, 63-65.

Germany

Significant non-Mediterranean evidence brings Continental Europe, with its social and economic changes relating to copper and metal circulation, into the picture. It also shed light on the complexity and far ranging copper supply networks in general, particularly those relating to oxhide ingots. Four fragments of oxhide ingots made from Cypriot copper were found in a hoard at **Oberwilflingen** in Baden-Württemberg, Germany. They are dated, at latest, to the end of the 14th/beginning of the 13th century BC.⁸⁷

Levant

A complete oxhide mould carved in limestone was found at the Syrian site of **Ras Ibn Hani**,⁸⁸ deposited in a workshop of the North Palace of the centre and dated to the 13th century BC.⁸⁹ Despite the extraordinary nature of the discovery, Ras Ibn Hani's mould seems to provide more questions than answers. First of all there are no copper ores within easy range of the site. At the same time, the analysis of the **copper drops found around the mould** show that Cypriot copper matching the Apliki ore had been cast in it.⁹⁰ The evidence suggests that raw copper was shipped to Syria and that at least part of the oxhide ingot production might have taken place outside the island.⁹¹ There is lively debate concerning how oxhide ingots were actually cast;⁹² interestingly enough the Ras Ibn Hani's mould does not provide much help. First of all its material (limestone) does not seem to be the greatest choice for such production, and secondly because no furnace installations were found in its vicinity.⁹³ Was the mould really there to be used?

The recently re-published finds from **Hishuley Carmel**, off the coast of Israel in the region of Haifa are most likely dated to the 13th century BC.⁹⁴

87. Primas 1997; Primas and Pernicka 1998.

88. E.g. Gale 1991, 203; Lagarce *et al.* 1983, 276-290.

89. E.g. Knapp 1990, 55-63.

90. Gale 2006, 5.

91. E.g. Artzy 2006, 20.

92. The list is very long. A more or less accurate discussion about the issue can be found among others in: Ben-Yosef 2012; Budd *et al.* 1995a, 1995b; Gale 2006; Hauptmann *et al.* 2002; Larson 2009; Merkel 1986; Jones 2007; Tylecote *et al.* 1984; Tylecote and Merkel 1985. For discussion about casting and LIA see: Begemann *et al.* 2001; Gale 1991; Gale and Stos Gale 1986, 1988, 1994 and 1995; Hauptmann 2009; Stos Gale 1988; Stos Gale and Gale 1992; Stos Gale and Macdonald 1991; Ling *et al.* 2014, 117-118.

93. Lagarce *et al.* 1983, 276-290; Larson 2009, 12.

94. Galili *et al.* 2012.

They belong to a **shipwreck** which was preliminarily investigated in 1980.⁹⁵ According to the authors, the wreck was probably already plundered in ancient times; nevertheless it revealed a cargo containing 14 variously shaped tin ingots and two copper oxhide ingots. The two full copper oxhide ingots were manufactured with copper matching that from Apliki on Cyprus, while the tin ingots excavated at the site seem to belong to different sources.⁹⁶ The ship has been estimated to have been similar in size to that of the Uluburun, but it is difficult to assess its character due to the lack of the majority of its content.

There is another wreck close by which also contained oxhide ingots; it was discovered at **Kfar Samir** and may date to the 14th-13th century BC.⁹⁷

Sardinia

Recent discoveries and a review of the Sardinian material provide evidence for the appearance of oxhide ingots on the island much earlier than previously considered.⁹⁸

The earliest known attestation of an oxhide ingot from the island is actually a clay representation of it, which was recently discovered on a fragmentary cylindrical vase from the **nuraghe Coi Casu** – S. Anna Arresi (CA).⁹⁹ The piece is dated to a mature phase of the local Middle Bronze Age which in absolute chronological terms relates at latest to the 14th century BC.¹⁰⁰ The oxhide ingot fragments from **Albucciu's nuraghe**, Arzachena (SS) are now dated to the Italian Recent Bronze Age (c. 2nd half of the 14th-13th century BC) largely corresponding to the LH IIIA-IIIIB.¹⁰¹

Several oxhide ingot fragments dated to the Recent Bronze Age (13th century BC) have recently been reported as having originating from the **Funtana Coberta-Ballao hoard**. The hoard was contained within a Nuragic jar of the type found in Kommos (locally dated to the LMIIC) and deposited in a room next to the external wall of a Nuragic well temple.¹⁰² The oxhide ingot fragment from under the floor of the **Serrucci-Gonnesa (CA) Nuragic tower A** is dated to a period towards the end of the local Recent Bronze Age/beginning of the Final Bronze Age and is therefore still within the 13th century BC.¹⁰³

95. Galili *et al.* 1986.

96. Galili *et al.* 2012, 13.

97. Galili *et al.* 2012, 1 with previous bibliography.

98. Lo Schiavo *et al.*, eds., 2009.

99. Manunza and Deffrassu 2009.

100. Depalmas 2009.

101. E.g. Ialongo 2010, 318-320; Lo Schiavo 2009a, 229-230 with previous bibliography.

102. Manunza 2008.

103. Santoni *et al.* 2012.

Sicily

Two finds from Sicily, from Cannatello and Thapsos, could be dated to sometime between the end of the 15th and the 13th century BC (LH IIIA-B).¹⁰⁴ Both finds are just fragments and there is no documentation about their specific context.

There is manifold evidence at Cannatello which shows a connection with the Aegean. Interestingly enough there is also evidence of contact with Sardinia. Relations with the Aegean are also clear at Thapsos, although the unfortunately scarcely published material from the site does not yet suggest the otherwise likely connections with Sardinia. Both have a strategic position as far as trade and maritime networks are concerned. At this point it is worth repeating that the western sword found on the Uluburun shipwreck which was identified as a Thapsos-Pertosa sword seems to have belonged to the Thapsos variety of the type and therefore to a fighting tradition connected to Sicily since the local Middle Bronze Age.¹⁰⁵ Trace elements from several of the oxhide ingots from Sicily are available, but no LIA has been carried out on any of the samples.¹⁰⁶

1400-1200 BC: Comments

This is the time when Cypriot copper, in particular that from the mine of Apliki, appears to become the main source of production for oxhide ingots.¹⁰⁷ It has been underlined how the presence of Cypriot material in the Aegean, not just the copper, becomes so consistent that by the mid-13th century the island actually managed to ‘dominate’ the market and exchange patterns.¹⁰⁸ In this sense, this goes some way to explaining the presence of oxhide ingots on Cypriot cylinder seals, a class closely related to trade, dated to the end of the 14th century and the beginning of the 13th century BC.¹⁰⁹ The ingots on these seals are not central representations, but parts of them,¹¹⁰ and are generally associated with other elements (predominantly human figures, trees and *buchrania*, but also various animals), which recur in other contexts or evidence in association with oxhide ingots (as for example the tree on the famous London bronze stand or the numerous *buchrania* found at Enkomi together with the Ingot and the Horned god¹¹¹). The political organisation

104. Lo Schiavo *et al.* 2009 with previous bibliography.

105. Bettelli 2006; Vagnetti and Lo Schiavo 1989, 222-224.

106. Lo Schiavo *et al.* 2009.

107. Gale and Stos-Gale 2012.

108. Muhly 2009, 33; Sherratt 2000, 89.

109. E.g. Graziadio 2003; Knapp 1986; Papasavvas 2009, 90-93.

110. Papasavvas 2009, 129.

111. Papasavvas 2009, 118; Webb 2001.

of Cyprus during the Late Bronze Age is a matter for debate and it does not help in the search for an explanation of the striking utilisation of Apliki copper all over the island when other ores much closer to several of the named sites could have been used instead.¹¹² As discussed later, possible branding necessities or political factors must have played a relevant role.

Oxhide ingots and related finds from the 14th and the 13th century BC have been found in different contexts showing a utilitarian as much as a non-utilitarian character of these objects. Many (particularly in what is today known as Greece, Germany, Sicily and Sardinia) have been found in hoards whose function is difficult to determine.¹¹³ Oxhide ingots were definitely used as frequently as they had been during the previous two centuries in large scale sea-based copper trade, clearly shown by the Uluburun cargo, the finds along the Anatolian and Israeli coast and/or the geographical position, particularly of the Sicilian sites. Considering the size of the Uluburun cargo, it is broadly accepted that to a certain extent such trade must have been managed by large political entities according to a fashion that very much seems to correspond to documented exchanges by the Amarna tablets;¹¹⁴ however other possibilities should not be ruled out and would actually be of greater help in order to understand the presence of oxhide ingots outside palace structures.¹¹⁵

As in the previous period the oxhide ingot phenomenon does not appear to be an exclusively Mediterranean question. The fragments from Germany also show how circulation of oxhide ingots had overcome Mediterranean frontiers¹¹⁶ during the 14th century BC, maybe seeking a continuous expansion?

Finally, the presence of Sardinia in the picture of oxhide ingot trade had been changing considerably throughout the last decades, as demonstrated in recent research.¹¹⁷ It now seems clear that oxhide ingots were already known on the island during the 14th century BC.

112. E.g. Kassianidou 2005, 2009, 2012; Knapp 2013; Lo Schiavo 2012; Papasavvas 2012.

113. Lo Schiavo (2012, 146) shows the numerous oxhide ingot fragments from Sardinia are generally retrieved in non-utilitarian contexts, unlike those found on Cyprus. In other words those fragments were hoarded in contexts where no metallurgical activity was found. Lo Schiavo (ibid.) suggests that what we find are just a few spare (for ritual purpose?) fragments out of a very large number of copper ingots which were all used.

114. Pulak 1998.

115. E.g. Monroe 2011.

116. As mentioned above, some of the Swedish rock art images depicting possible oxhide ingots could be dated between 1500 and 1300 BC (Ling & Stos-Gale 2015: 201-203); hence they could fall within this period rather than the earlier one.

117. Lo Schiavo 2009a, 2012.

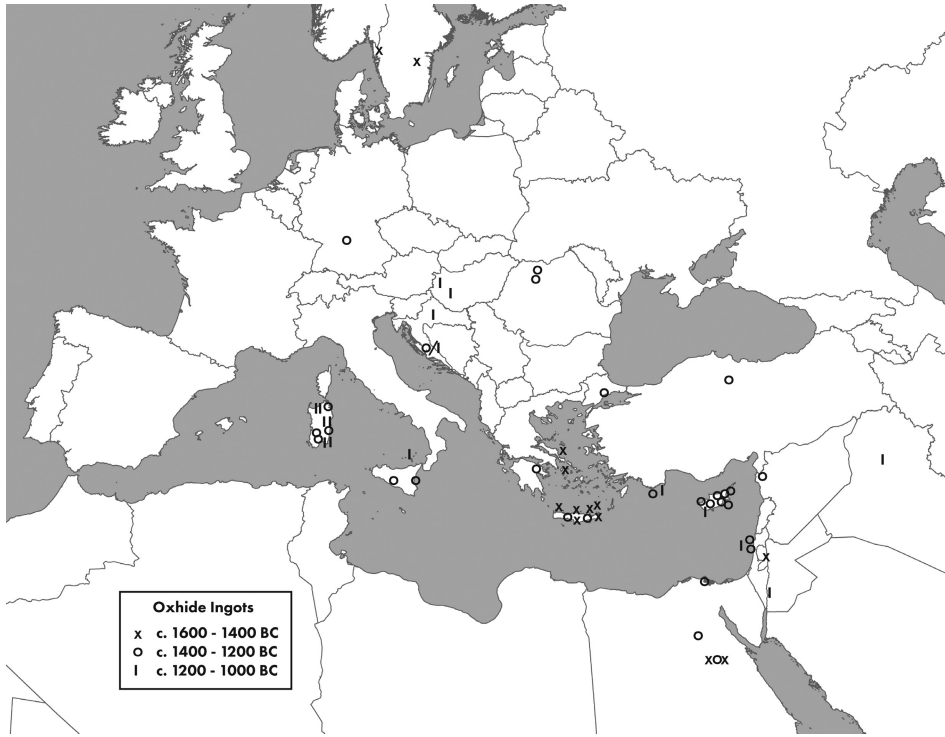


Fig. 5: Distribution map of the oxhide ingots dated to the 12th and 11th century BC.

c. 1200-1000BC

At the beginning of the 12th century BC oxhide ingots still had a ‘solid’ presence (Fig. 5). Unlike the previous phases, their distribution appears very significant in the central western part of the Mediterranean during this last period, particularly in Sardinia. Interesting finds from the Levant, however, suggest that the oxhide ingots were probably long-lived all over the Mediterranean and beyond.

Cape Gelidonya

Another fundamental underwater discovery is the **Cape Gelidonya shipwreck** which is dated to the end of the 13th century BC or the very beginning of the 12th century BC.¹¹⁸ The Cape Gelidonya boat was found some 25 years earlier than the Uluburun along the same stretch of Turkish coast. The two finds are generally compared with each other due to their similarities, but also because

118. E.g. Bass 1967 and 2005; Muhly 2009.

of their differences. The cargo was not as impressive in terms of luxurious goods and quantities, but comparable in terms of variety to that of the Uluburun wreck.¹¹⁹ The Cape Gelidonya ship was also transporting a considerable amount of metal including copper and tin ingots (at least 34 full copper oxhide ingots were recovered during excavation, while the softened nature of the tin on the seabed made it very difficult to recognize their ingot shape). Unlike the Uluburun, the Cape Gelidonya contained a significant amount of scrap material (e.g. broken bronze objects/tools, slags and so on) which would certainly have been reused and re-melted. According to George Bass, the Cape Gelidonya ship was sailing westwards, probably from Cyprus,¹²⁰ and was most likely not on the same sort of mission as the Uluburun, but instead following a circular trading route and stopping on its way to buy and sell goods. In other words it was probably a private enterprise apparently focused on the trade and exchange of metal.

Cyprus

It is possible to date the few fragments found at **Maa-Paleokastro**, whose LI also matches the Apliki copper ore field on Cyprus to the 1st half of the 12th century BC.¹²¹ The fragmentary oxhide ingots from **Alassa-Pano Mandilaris** and **Alassa-Palaiotaverna** are also likely dated to the 12th century BC, although their chronology is not clear and they could instead belong to the LCIIC (13th century BC). They are two fragmentary miniature ingots, one of which comes from a likely cultic unit of domestic nature,¹²² while the other is the corner of a full sized example.¹²³

Egypt

Four artefacts from Egypt are dated to the very end of the 13th century and the very beginning of the 12th century BC (c. 1209-1185 BC).¹²⁴ They are miniature oxhide ingots or ‘model ingots’, as the author calls them. The ingots were probably found in four different foundation deposits from the funerary temples of **Siptah and Tworse at Thebe** by W.M. Flinders Petrie in 1896; their copper

119. Bass 1967 and 2005; Pulak 2005b; Wachsmann 1998, 303-313.

120. Bass 2013, 70; Muhly 2009.

121. Gale 1999, 116; Kassianidou 2009, 50-51 with previous bibliography.

122. Hadjisavvas 1986, 66.

123. Hadjisavvas 2011, 22-23.

124. O'Connor 1967.

has not yet been analysed. At least one of them shows two incised Egyptian cartouches on its surface providing relevant information about their chronology and maybe suggesting a local production.¹²⁵ The meaning of the miniature oxhide ingots is still debatable, however, their use in foundation deposits seems to confirm the multiplicity of meaning and uses of oxhide ingots in territories, like Egypt, where there is no evidence suggesting that production was actually taking place.¹²⁶

Levant and Mesopotamia

The oxhide ingot found at **Hahotrim, one of the several shipwrecks outside the coast of Haifa**, Israel, could potentially be dated to the beginning of the 12th century BC.¹²⁷

A partly preserved oxhide ingot clay mould dated to the 11th century BC was recently recorded at the **Timna Valley** site 30, Israel.¹²⁸ As suggested the item fuels a twofold hypothesis: it could be late evidence of the phenomenon in the Levant or of the production of analogously shaped ingots due the efficiency of the shape when used for the transportation of heavy ingots.¹²⁹ It definitely opens up for new research as far as casting moulds are concerned; as the author discusses, clay is very difficult to detect in the field but it is indeed a good material for such mould.

The oxhide ingot fragment from **Dūr-Kurigalzu, Iraq** is dated to the 12th century BC.¹³⁰

Sardinia

Differing from Cyprus in that none of the pieces seem to have been manufactured with local copper, the evidence from Sardinia is manifold. Oxhide ingots, or fragments of them, are found on about 36 sites throughout the island; unfortunately, not many can be dated.

The oxhide ingot fragments from the hoard found in the **Baccus Simeone area, Villanovaforru (Ca)**, were in a jar with an x-shaped handle which is

125. O'Connor 1967, fig. 162.

126. E.g. Giumlia-Mair *et al.* 2011 with previous bibliography.

127. Galili *et al.* 2012,1-2; Jones 2007, 429; Wachsmann and Raveh 1984.

128. Ben-Yosef 2012.

129. Ben-Yosef 2012, 193.

130. Brinkman 1974, 401; Jones 2007, 72 and 425.

typical of the local Recent and Final Bronze Age 1-2 (1350-1050 BC).¹³¹ The finds could therefore be earlier than the 12th century BC.

A recently excavated hoard with oxide ingot fragments from the Nuragic village of **Serra Elveghes, Olbia**, can most likely be dated to an early phase (the beginning of the 12th century BC) of the Italian Final Bronze Age (c. 1200-975/950 BC).¹³²

The hoard from **Pattada (SS)** is dated to the Final Bronze Age 1-2 (c. 1200-1050 BC) and no later than the 11th century BC through parallels with LCII-III material from Cyprus.¹³³

The finds from the two hoards found at **Sa Carcaredda, Villagrande Strisàili (NU)** seem to belong to the beginning of the Final Bronze Age (approximately 12th century BC).¹³⁴

Based on the contextual information and the associated material, it seems possible to date the fragments of oxhide ingot from the nuraghe **Nastasi, Tertenia (NU)**, to the LH IIIC, which largely corresponds to the Italian Final Bronze Age.¹³⁵

While the oxhide ingot fragments from the two **Ittireddu (SS)** hoards cannot be precisely dated, they are estimated to have originated in the 12th-10th century BC. They were found in a Recent Bronze Age nuraghe. Despite the chronology of the monument itself, however, the excavations at the site have so far only provided material from the Final Bronze Age and the Early Iron Age.¹³⁶

The hoard from the **capanna delle canalette at S. Anastasia village, Sardara (CA)** was contained in a typical Final Bronze Age/Early Iron Age vessel, covered by another.¹³⁷ The bowl which served as a lid is dated to the Final Bronze Age and suggests that the Sardara finds could be from the 12th or 11th century BC.¹³⁸

The oxhide ingot fragments found at nuraghe **Bau Nuraxi, Triei (NU)**, are difficult to date as only partial excavations were carried out at the site. The context possibly belonged to the end of the Final Bronze Age/beginning of the Iron Age and therefore potentially to the 11th-10th century BC.

131. Campus and Leonelli 1999.

132. Ialongo 2010, 318; Lo Schiavo 2009a, 236-238 with previous bibliography.

133. Lo Schiavo 2009a, 296-301.

134. Lo Schiavo 2009a, 336-337

135. Peroni 1996, 264.

136. Lo Schiavo 2009a, 287-295.

137. Lo Schiavo 2009a, 362-363.

138. Campus and Leonelli 1999.

Oxhide ingot fragments were recovered together with numerous other metal fragments in the temple structure of S'Arcu 'e is Forros, Villagrande Strisàili, (NU), which although partly investigated, has also been damaged by illicit and subsequently undocumented exploitation. The fragments cannot be precisely dated, but the site shows a great degree of continuity from the Middle to the Final Bronze Age (e.g. 14th-10th century BC) and its peak between the Recent Bronze Age and the Final Bronze Age (13th-10th century BC). It also provides striking evidence of contact with Cyprus.¹³⁹

Sicily

The hoard from Lipari was most likely deposited at the end of the 12th century BC. The hoard contained a large number of oxhide ingot fragments together with objects which are dated to the Ausonio I period (13th and the 12th century BC). The hoard was found under the wall of an Ausonio II hut and most likely belonged to the end of the Ausonio I period.¹⁴⁰

Lipari is the 3rd site from Sicily with oxhide ingots. It appears to be slightly more recent than the other two, Cannatello and Thapsos, and has a different (in the Tyrrhenian Sea), but equally strategic position in terms of maritime connections and trade. It also presents evidence of contacts with both the Aegean and Sardinia, as seen in Cannatello.

1200-1000BC: Comments

The lack of precise chronological information about a large number of finds makes generalisation difficult, however it can be argued that oxhide ingots were probably disentangled from the character of gifts in Amarna's sense by the beginning of the 12th century BC. Evidence such as that provided by the Cape Gelidonya ship shows that they were used in trade of what was likely a private character. A large part of the known fragments from this period come from hoards such as those from Sardinia and Sicily. This does not mean that private trade did not take place in earlier periods, rather that the available evidence suggests that some sort of shift away from royal expedition and gift exchanges must have taken place as far as the circulation of oxhide ingots was concerned.

The last known Egyptian representations of oxhide ingots also belong to this period. They are found among the votive offerings on the relief of Ramesse III

139. Lo Schiavo 2009a, 332-335; Vagnetti and Lo Schiavo 1989.

140. Bernabò Brea and Cavalier 1980; Lo Schiavo *et al.* 2009 with previous bibliography.

(c. 1187-1157 BC) at Medinet Habu, which is generally dated to the 1st half of the 12th century BC.¹⁴¹

The 12th century was a time of great changes in international relations and trade; networking most definitely underwent different types of adjustments.¹⁴² The complex archaeological evidence from Sardinia and the Central Mediterranean suggests that oxhide ingots adjusted to changes and continued to be used during the 12th and the 11th century BC.

A consistent part of the Italian archaeological evidence for oxhide ingots from Sicily and Sardinia, following an exchange tradition well rooted in the previous centuries, seems to be datable to this later phase of the phenomenon.¹⁴³ It also appears clear that exchanges were east to west and vice versa, as proven by the presence of Nuragic pottery in Crete and Cyprus.¹⁴⁴ Interestingly enough, recent discoveries show that **between approximately 1500 and 900BC Sardinian copper, among other, was probably used in the production of bronzes as far away as Scandinavia.**¹⁴⁵ Thus the island must have been part of a vast network of copper supply which was not limited to the significant internal use,¹⁴⁶ nor to the Mediterranean, but able to fulfil the needs and demands coming from different directions including regions in the far north like Scandinavia.

Non datable and debated finds

There are a lamentably large amount of non-datable finds from key areas, including many which were not discussed above. The contextual information is completely lost for most of these finds and there is no hope of dating them in the future. Their geographical position (Fig. 6), however, provides important information about the distribution of oxhide ingots and in many cases shows trade patterns and ways of communication whose relevance are still not fully understood.

141. Bass 1967, 67.

142. E.g. Kassianidou 2003; Kassianidou and Knapp 2005; Sherratt 2000.

143. E.g. Campus *et al.* 2008; Lo Schiavo *et al.*, eds., 2005; Lo Schiavo *et al.*, eds., 2009.

144. E.g. Campus *et al.* 2008: 72; Lo Schiavo 2012; Watrous 1989.

145. Ling *et al.* 2014.

146. Lo Schiavo (2009b, 404) highlights how there must have been a very high internal demand for copper/bronze in Sardinia during the Bronze Age. She suggests that it was high enough to justify the use of local sources as well as foreign sources while involving the island in international copper trade.

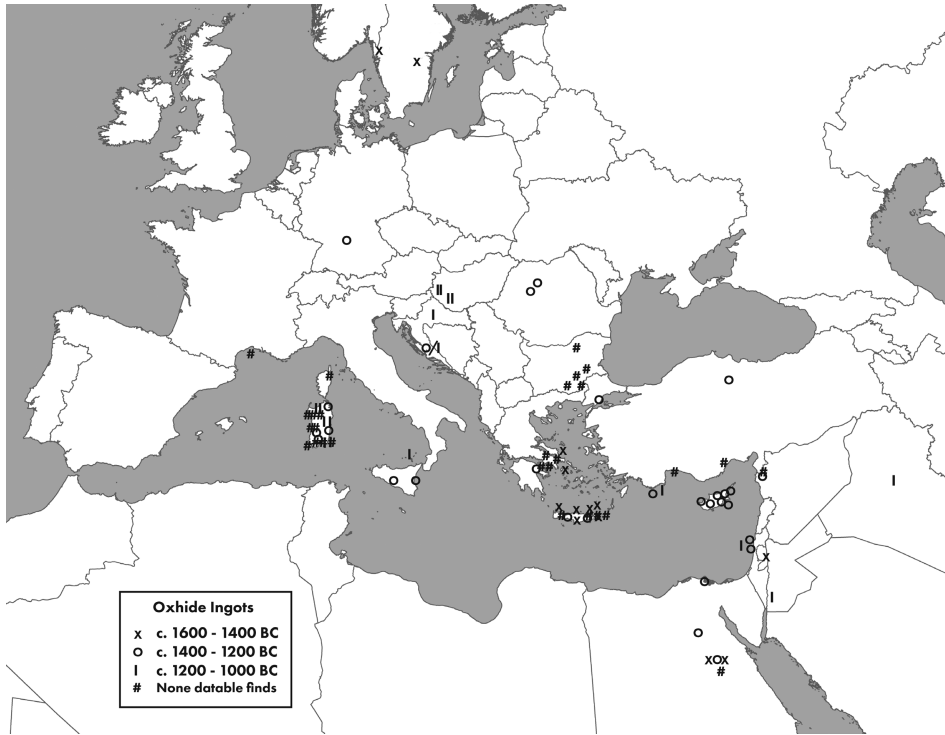


Fig. 6: Distribution map of the oxhide ingots with chronological information about each find.

Aegean and Crete

Fragmentary and full oxhide ingots which do not come from sufficiently reliable chronological contexts in the Aegean area include finds from Aegina, Athens, Thebes and Tiryns.¹⁴⁷ The finds on Crete from Poros, Sitia, Syme, and Palaikastro have also not been precisely dated.¹⁴⁸

Anatolia, the Levant and Mesopotamia

Oxhide ingots from archaeologically not clearly datable contexts have been recovered in Syria, at Ras Shamra and in Anatolia along the coast in the area of Antalya.¹⁴⁹

Due to the similarity of their shape, marks and isotopic composition to those found at Cape Gelidonya, it has been argued that the oxhide ingots found along

147. E.g. Bucholz 1959; Gale 1991; Mangou and Ioannou 2000; Jones 2007.

148. E.g. Liard 2010; Jones 2007, 417-418.

149. Bass 1967, 57-61; Gale 1991, 201; Jones 2007, 420.

Göksu Creek, in South-eastern Turkey, are probably dated to the end of the 13th-early 12th century BC.¹⁵⁰ Their inland position is very interesting as far as the movement of copper supply is concerned. It shows that Cypriot copper most likely also travelled terrestrially through Anatolia, potentially towards Mesopotamia, and through a region that is not far away (c. 170 km) from local large copper ores including the Ergani-Maden deposits.¹⁵¹

The scene uncovered at **Nimrud** in Mesopotamia is a dubious find. In the throne room of Shalmeneser III and on the so called Rassam or Black Obelisk, also from the Shalmeneser building, there are images which have been interpreted as possible ingots bearers.¹⁵² The context dates to the mid-9th century BC. It is here considered remarkable that the bearers do not carry the ingots in the same way as the Egyptian or Cypriot representations. The shape of the ingots is also rather ambiguous and they might very well be sacks instead. Should they actually be oxhide ingot representations, then the chronology of the finds would suggest a relatively isolated persistence of the shape eight centuries after the first oxhide ingots appeared.

Bulgaria

Regrettably, none of the finds from Bulgaria can be precisely dated. Nevertheless, the geographical position of their discovery provides some important insights in the ongoing debate regarding contact between the Aegean and the Black Sea.¹⁵³ Full size oxhide ingots, or fragments of them, have been found at **Kirilovo, Čerkovo and Černoze**m while a miniature example, maybe originally two, appears to have been recovered from **Yabalkovo**.¹⁵⁴ All of them are in the inland part of South-eastern Bulgaria along river valleys which must have played a key-role in local communication systems. It has been proposed that it was more profitable to use land routes offered by the south-eastern part of the Balkan Peninsula rather than to sail through the Bosphorus and the Dardanelles straits to reach the Black Sea.¹⁵⁵ The Bulgarian oxhide ingots therefore make perfect sense when considering the possible direction of this land route. A couple of oxhide ingots have recently been reported from **Kamenovo**, which is also an inland site, this time from the north-eastern part of Bulgaria and not far from the Danube basin.¹⁵⁶

150. Pulak 2011, 299.

151. Pulak 2011, 302.

152. Jones 2007, 77, fig. 8; Mallowan 1966, fig. 371a; Reade 1980, pl. III.

153. Doncheva 2012 with previous bibliography.

154. Doncheva 2012, 692-5; Leshtakov 2007, 451.

155. Kolb 2004, 592-593.

156. Doncheva 2012, 694-695.

As far as provenance is concerned, the find from Čerkovo and Černožem were analysed and their copper lead isotope falls into the Cypriot field.¹⁵⁷

Besides these inland finds there is one ingot which was reported as an underwater find from **Cape Kaliakra, near Sozopol**, which has a peculiar oxhide-like shape. Due to its weight and content the piece has been recently interpreted as an ingot datable to the 1300-1450AD.¹⁵⁸

Croatia

A miniature oxhide ingot, which was probably from a hoard, seems to have come from somewhere close to **Makarska in Croatia**. Its provenance, although likely, has been a matter of debate over the years.¹⁵⁹ If the composition of the hoard, currently found at the Ashmolean Museum in Oxford, could be confirmed it would most likely be dated to the 13th-12th century BC.¹⁶⁰

A second miniature ingot comes from a hoard discovered at **Kloštar Ivanić**, in north eastern Croatia, which is dated to Hallstatt A2 period or 12th-11th century BC.¹⁶¹

Cyprus

On Cyprus there are finds from the bay of **Soli and Skouriotissa** which do not have reliable contextual information.¹⁶²

This list also includes the full-sized oxhide ingots which are currently found in the Metropolitan, Nauplion and Cyprus Museums, along with the miniature example in Cyprus' museum, whose possible place of origin has been tentatively reconstructed.¹⁶³

Egypt

A miniature ingot in the Ashmolean museum in Oxford is said to have come from what is today known as **El Manshah, close to Abydos**. It has no archaeological context and therefore no reliable chronology. Its shape is also peculiar; one of

157. Respectively Stos-Gale *et al.* 1997, tab. 6 and Lichardus *et al.* 2002, 173-176.

158. E.g. Doncheva 2012, 683 with previous bibliography.

159. See Sherratt 2012; Vagnetti 1971.

160. Sherratt 2012.

161. Forenbaheer 1995 with previous bibliography.

162. E.g. Kassianidou 2009, 55-56; Stos-Gale *et al.* 1997, 107-108.

163. Kassianidou 2009, 54-56.

the long sides is longer than the other and it is convex rather than concave. It has been suggested that it is a pedestal for a statuette.¹⁶⁴

France

Regrettably, the oxhide ingots from France have no datable context. One ingot was found in deep water close to Sète in Southern France and another was found during agricultural works in North-eastern Corsica.¹⁶⁵ The ingot from Sète is very interesting due to its peculiar compact form. It has been interpreted as a possible Sardinian imitation of the well-known Cypriot oxhide ingots.¹⁶⁶ LIA for these French ingots are not yet available.

Hungary and Romania

A relatively large ingot fragment was found in the hoard of Pălatca, Transylvania, Romania, dated to the Bronze Age D/Hallstatt A or between the 13th and 11th century BC.¹⁶⁷ While it certainly appears to be an oxhide ingot fragment, it seems that the percentage of arsenic (3.39%) contained in the piece is very high compared to that of ‘traditional’ oxhide ingots;¹⁶⁸ further investigations are required in order to fully understand the meaning of this find.

There are also six oxhide-like miniature ingots from Cluj-Mănăstur, Transylvania, Romania, which may relate to the larger phenomenon.¹⁶⁹ They are dated to the Hallstatt A2 or the 12th-11th century BC.

Five miniature oxhide-like ingots have been found in metal hoards from Hungary.¹⁷⁰ They have been also considered as a manifestation of the connection

164. Nibbi 1987, 72-77.

165. D’Oriano 2013; Lo Schiavo 2009c, 2013.

166. Lo Schiavo 2009d, 2013.

167. Rotea *et al.* 2011. For a discussion about the local chronology see also Ciugudean 2010, fig. 4.

168. Giunlia-Mair 2011.

169. Wittenberg 2008, pl. 12; Schuster 2005.

170. At least one of them from the Birján hoard appears to be a ‘genuine’ piece (Moszolics 1985, pl. 62.6). It is dated to the local Kurd Horizon which corresponds approximately to the Hallstatt A1 or the 12th century BC (Ciugudean 2010, fig. 4). A second one comes from the hoard of Szentgáloskér (Moszolics 1985, pl. 114.1) which is also dated to the Kurd horizon (Ilon 1992, 253), while the pieces from the hoards of Beremend and Lovasberény (Moszolics 1985, pl. 245.10, 252.1) belong to the Gyermely horizon approximately corresponding to the Hallstatt A2 and thus to the 12th-11th century BC (Ciugudean 2010, fig. 4).

between the Mediterranean and the Hungarian plain.¹⁷¹ Also from Hungary is a sandstone mould for a miniature oxhide-like ingot which was found in a pit in **Gór-Kápolnadomb** settlement.¹⁷² The material associated to the mould dates the pit to the Hallstatt B2 period; a hypothesis which has been corroborated with the carbon dates from the same context suggesting a date between 1032 and 928 BC. The whole of this corpus has not yet been thoroughly studied or chemically analysed. Whether they are ‘authentic’ oxhide ingots, imitations of the Mediterranean ingots or they belong to a different system is a problematic and interesting issue worthy of further investigation.¹⁷³

Sardinia

A total of 36 sites, which are spread all over the island, are currently known to have oxhide ingots.¹⁷⁴ Various sized fragments of oxhide ingots have been recovered in 29 cases; a total of 7 complete ingots, respectively 5 and 2, were found at two sites (**Serra Ilixi, Nuragus** and **Bisarcio, Ozieri**). Aside from the sites discussed in the previous paragraphs, all the other ingots known so far do not have a reliable chronology.¹⁷⁵

Final Comments

It has been argued that the archaeological evidence for oxhide ingots and Cypriot copper production seems to be relatively small in scale.¹⁷⁶ In fact just by looking at the aforementioned contexts which oxhide ingots were recovered from, it seems obvious how copper circulated in different forms.¹⁷⁷ It also came

171. Ilon 1992.

172. Ilon 1992, fig. 6.2.

173. It is worth noting that the Hungarian miniature ingots in question are considered to have probably been weights (Pare 1999, 493-498). Interestingly enough such a possibility appears in contrast with recent conclusions about the weights of the miniature oxhide ingots from Cyprus (Giunlia-Mair *et al.* 2009). See also Sabatini, in press.

174. Lo Schiavo 2009a with previous bibliography and 2009b, 394-395.

175. Updated lists of the known oxhide ingots from Sardinia are to be found in Lo Schiavo 2009a and Miletta, eds., 2013.

176. Kolb 2004: 592.

177. E.g. Kassianidou and Knapp 2005; Mangou and Ioannou 2000. C. 1 ton of copper on the Uluburun ship was transported in the form of so called plano-convex or bun ingots (Pulak 1998). Most of the contexts mentioned in this work contained other types of ingots alongside the oxhide ingots (e.g. Bass 1967; Doncheva 2012; Kassianidou 2009; Leshtakov 2007; Lo Schiavo 2009a and 2012; Primas and Pernicka 1998).

from different sources.¹⁷⁸ In other words we clearly have more than one system of production and distribution in operation during the LBA in the Mediterranean and beyond. Metallurgy and the circulation of copper must have been complex and large scale;¹⁷⁹ oxhide ingots only represented a peculiar, yet impressive expression of it.

This paper does not have the scope to discuss in any detail the historical and political changes which occurred in the Mediterranean and beyond during the LBA,¹⁸⁰ but it must be kept in mind that in several cases such changes were in remarkable proportions and must have had considerable effects on markets, exchange patterns and trade routes. The limited, but significant results of recent LIA from Scandinavian BA bronze items provide an unexpected yet relevant idea of the variation in the channelling of the copper supply throughout Bronze Age Europe.¹⁸¹

Oxhide ingots can be defined as the most remarkable class of ingot in terms of shape, weight, purity and the technological and material efforts they required to be produced. Their distribution and chronology show a complex circulation involving multiple lands, cultures and therefore also political and economic systems. Consequently we also have to imagine a number of different methods of contributing to their circulation patterns (see Tab. 1), not least through time.

From an economic and pragmatic point of view, either as integrated components of the so called gift exchange economy or as commodities or goods, oxhide ingots were undoubtedly suitable for the transportation of large quantities of copper. We ought to assume that their peculiar, yet difficult to obtain shape was probably familiar to a variety of receivers/markets. It most likely embodied a message either connected to their weight, their content and purity, maybe the provenance of their copper and/or the skilled labour necessary for their production, which was not only recognized over a wide landscape, but also over an extremely long period of time. As it has been proposed they seem very much to embody all the characteristics of a brand commodity.¹⁸² The multifarious archaeological evidence does make the branding hypothesis intriguing.¹⁸³ Yet more, would the idea of considering oxhide ingots to be a

178. Bergemann *et al.* 2001; Donceva 2012; Gale 2006; Hauptmann *et al.* 2002; Lo Schiavo *et al.*, eds., 2009; Ling *et al.* 2014; Stos-Gale 2011.

179. Kassianidou and Knapp 2005; Ling *et al.* 2014; Lo Schiavo 2012; Pare, ed., 2000; Rowlands and Ling 2013; Sherratt 2000.

180. See Kassianidou and Knapp 2005 and Sherratt 2000, although both with focus on metal trade.

181. Ling *et al.* 2014.

182. Bevan 2010. Sabatini, in press.

183. Wengrow 2008.

brand commodity shed light on the reason why tin on board of the Uluburun ship was also transported in the form of oxhide ingots?¹⁸⁴ Silver coloured oxhide ingots represented in Egyptian tombs were most likely also tin ingots.¹⁸⁵ Was this done in order to make this indispensable component of bronze production as familiar as copper was to any market? Maybe tin sources will one day shed light on the origin of the oxhide ingot shape? The debate about which sources of tin were used and how they were exploited is ongoing.¹⁸⁶ We lack secure data, but as demonstrated in recent works, none of the possible candidates (Iberian peninsula, Brittany, Great Britain, Central European sources, sites further east than Mesopotamia) seem extraneous to the LBA Mediterranean world.¹⁸⁷

The known finds leave no doubt about the production and consumption of oxhide ingots being connected to systems of international distribution, exchange and trade. Most of the analysed ingots which are datable to the 14th century BC and onwards seem to not only have been made of Cypriot copper, but out of just one particular ore from Apliki.¹⁸⁸ We know little about the political organisation of Cyprus during the 2nd millennium BC, nonetheless the manifold evidence from the island confirms the important local role of those ingots.¹⁸⁹ We are not yet able to localize the copper source used for some of the oldest known oxhide ingots from Crete, but it seems clear that after the 14th century, they become very much a sort of Cypriot branded good throughout nearly three centuries.¹⁹⁰ What came before them? Did Cyprus made its own or was it someone else's brand? If the recent interpretation of the French oxhide ingot from Sète could be confirmed to the end of the 12th or the beginning of the 11th century BC then the Nuragic people most likely attempted a new translation.¹⁹¹ Although without apparent success, it seems that they tried to take over (for the second time in the history of oxhide ingots?) the oxhide ingot 'label' for a further (market?) expansion.

To conclude, oxhide ingots have primarily been a means of transporting copper throughout their long history; however, in doing so they must have embodied meanings. Their distribution, chronology, miniature manufacture, presence in ritual/funerary and cultic contexts or in association to metallurgical activities creates a multifarious picture.

184. Pulak 1997, 239.

185. Bass 1967, 63-67.

186. E.g. Giumlia-Mair and Lo Schiavo, eds., 2003.

187. Rowlands and Ling 2013.

188. E.g. Gale 2006, 2011; Gale and Stos-Gale 2012.

189. E.g. Kassianidou 2009; Papasavvas 2009.

190. E.g. Stos 2011.

191. Lo Schiavo 2009d, 2012, 2013.

When considering the increasingly complex spread of oxhide ingots, the chronology and distribution pattern of their representations should also be taken into account. Besides miniature ingots, which could also be considered as three-dimensional representations, there are oxhide ingot images in tomb paintings, temple reliefs, cylinder seals, Linear B tablets, pottery and rock panels.¹⁹² No such evidence has been discussed in detail in this paper, but it is interesting to note that several of the sources appear to predate any local appearance of ‘real’ copper oxhide ingots. How should we interpret this data? The sources rather pragmatically suggest that the oxhide ingot distribution patterns must have been significantly larger than what the archaeological record currently tells us and that most of the copper which was transported has been used. The Uluburun shipwreck provides a fairly impressive idea of the very large amount of metal that must have been in circulation during the LBA. **The complex and largely debated case of Sardinia, which seems to have produced copper at the same time as receiving a supply from Cyprus, speaks in favour of the intense movement of ingots, where the origin or purity of the copper had significant and specific values; these worth to be guaranteed through branding practices, and oxhide ingots embodying one such brand.**¹⁹³

One topic which has not been covered in this brief work is the existence of symbols both impressed during the cooling stage of the ingot, and/or incised at any time once the oxhide ingots were in circulation. Several signs have been considered as Cypro-Minoan marks, but this is highly debated.¹⁹⁴ Most of the incised symbols on the ingots from the Uluburun suggest, for example, that the people who made them were living and working in close contacts to the sea.¹⁹⁵ However it is likely that they provided clarification about the items themselves, possibly about their content, origin or maybe their destination.

All in all, the discussed evidence suggests that oxhide ingots could be considered as a symbol of networking and connectivity beyond cultural, political and economic differences. They seem to very much embody the characteristics of Bronze Age Europe and the Mediterranean as arenas where exchanges played a major role in the emergence, development and maintenance of the local/global systems.

192. Bass 1967; Ling and Stos-Gale 2015; Papasavvas 2009; Wachsmann 1987.

193. Bevan 2010; Wengrow 2008, 2010.

194. Amadasi Guzzo 2009; Buchholz 1988; Hirschfeld 1999; Jones 2007; Kaiser 2013; Pulak 1998; Sibella 1996.

195. Pulak 1998, 195.



When?	Where?	How?	What?	And?
<p>1600-1400 BC</p>	<p>Aegean (Keos, Euboea, possibly Kythera); Crete (several sites); Egypt (Thebe, Karnak); Palestina (Tell Beit Mirsim); Sweden (Torsbo, Östra Eneby)</p>	<p>There are already both full and miniature sized oxhide ingots. In Egypt oxhide ingots are images on tomb paintings and temple reliefs. The oxhide ingots from Sweden are carved images on rock panels</p>	<p>Cyprus copper and other sources not all known</p>	<p>Oxhide ingots are found in both utilitarian and non-utilitarian contexts. Thus they ought to have already at this early stage multiple meanings/functions. Egyptian evidence suggests they are part of the so called “gift exchange economy” in the eastern Mediterranean world. The recent finds from Sweden support the hypothesis of copper supply networks stretching between northern Europe and the Mediterranean.</p>
<p>1400-1200 BC</p>	<p>Aegean(Mycenae); Crete (Kommos, Haghia Triada); Cyprus (several sites); Egypt (Thebe, El Amarna, Quantir); Germany (Oberwilffingen); Levant (Hishuley Carmel, Kfar Samir, Ras Ibn Hani); Sardinia (several sites); Sicily (Cannatello, Thapsos); Turkey (Boğazköy, Uluburun, Sarköy/Tekirdağ)</p>	<p>To this period belong most of the finds from Cyprus. They come from all over the island. The piece from Quantir is so far the only full sized copper oxhide ingot known from Egypt; local tomb paintings and relief representations continue.</p>	<p>Cyprus copper, mostly Apliki ore</p>	<p>By the end of the 14th century BC the distribution area gets wider. The evidence is manifold. We cannot exclude that the newly involved territories were not so in earlier times, however no finds can confirm that yet. Evidence from the Eastern Mediterranean seems to imply the existence of palace-like entrepreneurship. Evidence from Cyprus, Sardinia and north of the Alps provides an impressive picture of the possible networks beyond production, distribution and consumption of copper/bronze in general and oxhide ingots in particular.</p>

1200-1000 BC	Cape Gelidonya; Cyprus (Maa- Paleokastro, Alassa); Egypt (Thebe); Levant (Dür-Kurigalzu; Hahotrim, Timna 30); Sardinia (several sites); Sicily (Lipari)	Tomb and temple representations from Egypt have come to end.	Cyprus copper, mostly Apliki copper ore	By the end of the 13 th /beginning of the 12 th century BC, Cape Gelidonya and the wrecks from the Israeli coast show the continuing combination of maritime copper trade and oxide ingots. Evidences from Sardinia, becomes predominant.
No certain date and/or debated finds	Several site from : Aegean, Anatolia, Bulgaria, Crete, Croatia, Cyprus, France, Greece, Hungary, Levant, Romania, Sardinia	The non-datable oxide ingots are miscellanea of finds (full size or miniature ingots) from both inland and underwater contexts. The 'debated' finds have in some cases precise dating.	Cyprus copper, mostly Apliki copper ore, when analyzed. None of the 'debated' finds has yet undergone complete archaeometallurgical analyses	These finds widen up the scope of the phenomenon. They suggest the existence of networks whose relevance is much to be understood, particularly as to metal circulation between the Mediterranean, the Balkans and the rest of Europe. The Sète ingot might be a Sardinian attempt to take over (?) the international the copper trade embodied by oxide ingots.

Table 1: Synoptic table of archaeological evidence for oxide ingots discussed in this work (chronology, context, formal characteristics, content and additional information).

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Bibliography

- Alberti, Maria Emanuela and Serena Sabatini. (2012) "Introduction. Transcultural interaction and local transformations in Europe and the Mediterranean from the Bronze Age to the Iron Age". In *Exchange Networks and Local Transformations Interaction and local change in Europe and the Mediterranean from the Bronze Age to the Iron Age*, edited by Maria Emanuela Alberti and Serena Sabatini, 1-5. Oxford: Oxbow Books.
- Albright, William F. (1938) *The Excavation of Tell Beit Mirsim. Vol. II: The Bronze Age (1936 - 1937)*. The Annual of the American Schools of Oriental Research 17. New Haven: American Schools of Oriental Research.
- Amadasi Guzzo, Maria G. (2009) "Marks on Central Mediterranean copper ingots. In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin, and Giumlia-Mair, 431-436. Biblioteca di Antichità Ciproite 8. Rome: ICEVO-CNR.
- Artzy, Michal. (2006) "The jatt metal hoard in northern Canaanite/Phoenician and Cypriote context". *Cuadernos de arqueología Mediterránea* 14.
- Bass, George F. (1967) "Cape Gelidonya: a Bronze Age shipwreck". *Transactions of American Philosophical Society* 57, no 8.
- Bass, George F. (1991) "Evidence of trade from Bronze Age shipwrecks". In *Bronze Age Trade in the Mediterranean*, edited by Noel H. Gale, 69-82. Studies in Mediterranean Archaeology 90. Gothenburg: P. Åströms Förlag
- Bass, George F. (2005) "Cargo from the Age of Bronze: Cape Gelidonya, Turkey". In *Beneath the Seven Seas* edited by George F. Bass, 48-55. New York and London: Thames & Hudson.
- Bass, George F. (2013) "Cape Gelidonya Redux". In *Cultures in contacts from Mesopotamia to the Mediterranean in the Second Millenium BC*, edited by Aruz, Graff, and Rasic, 62-70. New York: The Metropolitan Museum 2013.
- Bachhuber, Christopher. (2006) "Aegean interests on the Uluburun Ship". *American Journal of Archaeology* 110, no 3: 345-363.
- Begemann, Schmitt-Strecker, Pernicka, and Lo Schiavo. (2001) "Chemical Composition and Lead Isotopy of Copper and Bronze from Nuragic Sardinia". *European Journal of Archaeology* 4, no 1: 43-85.

- Ben-Yosef, Erez. (2012) "A unique casting mould from the new excavations at Timna Site 30 (Israel): evidence of western influence?". In *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC. A Conference in Honour of James D. Muhly. Nicosia, 10th-11th October 2009*. Oxford: Oxbow Books.
- Bernabò Brea, Luigi and Madeleine Cavalier. (1980) "Il ripostiglio di bronzo rinvenuto sotto la capanna α II". *Meligunis Lipara IV*: 733-789.
- Betancourt, Philip P. and Susan C. Ferrence, eds. (2011) *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*. Philadelphia, Pen.: INSTAP Academic Press.
- Bettelli, Marco. (2006) "Fogge simili, ma non identiche: alcune considerazioni sulle spade tipo Thapsos-Pertosa". In *Studi in onore di Renato Peroni*, 240-245. Florence: All'insegna del Giglio.
- Bevan, Andrew. (2010) "Making and Marking Relationships: Bronze Age Branding and Mediterranean Commodities". In *Cultures of Commodity Branding*, edited by Andrew Bevan and David Wengrow, 35-85. Walnut Creek, CA: Left Coast Press.
- Broodbank, Rehren, and Zianni. (2007) "Scientific Analysis of Metal Objects and Metallurgical Remains from Kastro, Kythera". *The Annual of the British School at Athens* 102: 219-238
- Brinkman, John Anthony. (1974) "The Monarchy in the Time of the Kassite Dynasty". In *Le palais et la royauté (archéologie et civilisation)*, edited by Paul Garelli, 395-408. Paris: Éditions Paul Geuthner.
- Buchholz, Hans-Günter. (1959) "Keftiubarren und Erzalen im zweiten vorchristlichen Jahrtausend". *Praehistorische Zeitschrift* 37: 1-40.
- Buchholz, Hans-Günter. (1988) "Der Metallhandel des zweiten Jahrtausends im Mittelmeerraum". In *Society and Economy in the Eastern Mediterranean, c. 1500-1000 BC (Orientalia Lovaniensia Analecta 23)*, edited by Michael Heltzer and Edward Lipiński, 187-228. Leuven: Uitgeverij Peeters.
- Budd, Pollard, Scaife, and Thomas. (1995a) "Oxhide ingots, recycling and the Mediterranean metal trade". *Journal of Mediterranean Archaeology* 8: 1-32.
- Budd, Pollard, Scaife, and Thomas. (1995b) "Lead isotope analysis and oxhide ingots: a final comment". *Journal of Mediterranean Archaeology* 8: 70-75.
- Caloi, Ilaria. (2006) "Le frazioni di lingotto oxhide. Una messa a punto". *Annali dell'Istituto Italiano di Numismatica* 52: 213-234.
- Campus, Leonelli, and Lo Schiavo. (2010) "La transizione culturale dall'età del bronzo all'età del ferro nella Sardegna nuragica in relazione con l'Italia tirrenica". *Bollettino di Archeologia online* 1: 62-76.
- Campus, Franco and Leonelli. (1999) "Appendice II. Considerazioni sui vasi-contenitori di lingotti di tipo oxhide e piano-convessi in ambito nuragico". In *Epi pònton plazòmenoi. Simposio italiano di Studi Egei in onore di Luigi Bernabò Brea e Giovanni Puglisi Caratelli*, edited by La Rosa, Palermo and Vagnetti. Rome: Scuola archeologica italiana di Atene.
- Catling, Hector W. (1964) *Cypriote bronzework in the Mycenaean world*. Oxford: Clarendon Press.
- Ciugudean, Horia I. (2010) "Late Bronze Age in Transylvania". *Satu Mare Studii Și Comunicări* 26, no 1: 157-181.
- Cummer, Willson and Elizabeth Schofield. (1984) *Keos III. Ayia Irini: House A*. Mainz: Philipp von Zabern.

- Depalmas, Anna. (2009) “Il bronzo medio della Sardegna”. In *XLIV Riunione Scientifica - La preistoria e la protostoria della Sardegna*, 123-160. Florence: Istituto Italiano di Preistoria e Protostoria.
- Dessel, Jean P. and Alexander H. Joffe. (2000) “Alternative Approaches to Early Bronze Age Pottery”. In *Ceramics and change in the Early Bronze Age of the Southern Levant*, edited by Philip Graham and Douglas Baird, 31-58. Sheffield: Sheffield Academic Press.
- Doncheva, Diana. (2012) “The Northern ‘Journey’ of Late Bronze Age Copper ingots”. In *ΗΡΑΚΛΕΟΥΣ ΣΩΤΗΡΟΣ ΘΑΣΙΩΝ* *Studia in honorem Iliae Prokopov sexagenario ab amicis et discipulis dedicate* edited by Evgeni Paunov and Svetoslava Filipova, 671-714. Veliko Turnovo: Faber Publishers.
- D’Oriano, Rubens. (2013) “Uno sguardo dalla Gallura sull’oxhide ingot di Sant’Anastasia e sul relitto del Golo in Corsica.” In *Les Lingots peau-de-boeuf et la navigation en Méditerranée central, Acte du IIème Colloque international Lucciana, Mariana, 15-18 septembre 2005*. Ajaccio: Édition Alain Piazzola.
- Forenbaher, Staso. (1995) “Trade and exchange in late Bronze and early Iron Age Croatia”. In *Handel, Tausch und Verkehr in bronze- und früheisenzeitlichen Südosteuropa*, edited by Bernard Hänsel, 269-282. München & Berlin: Südosteuropa-Gesellschaft.
- Gale, Noel H. (1991) “Copper oxhide ingots: their origin and their place in the Bronze Age metals trade in the Mediterranean”. In *Bronze Age Trade in the Mediterranean* edited by Noel H. Gale, 197-239. *Studies in Mediterranean Archaeology* 90. Göteborg: Paul Åströms Förlag.
- Gale, Noel H. (1999) “Lead isotope characterization of the ore deposits of Cyprus and Sardinia and its application to the discovery of the sources of copper for Late Bronze Age oxhide ingots”. In *Metals in Antiquity*, edited by Young, Pollard, Budd, and Ixer, 110-121. *British Archaeological Reports, International Series* 792. Oxford: Archaeopress.
- Gale, Noel H. (2006) “Lead Isotope Studies – Sardinia and the Mediterranean Provenance Studies of Artefacts found in Sardinia”. *Instrumentum* 23: 29-34.
- Gale, Noel H. (2011) “Copper Oxhide ingots and Lead Isotope Provenancing”. In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 213-220. Philadelphia, Pen.: INSTAP Academic Press.
- Gale, Noel and Zofia Stos-Gale. (1986) “Oxhide ingots from Sardinia, Crete and Cyprus in the Bronze Age copper trade: New scientific evidence” In *Studies in Sardinian Archaeology II: Sardinia in the Mediterranean*, edited by Miriam S. Balmuth, 115-162. Ann Arbor: University of Michigan Press.
- Gale, Noel and Zofia Stos-Gale. (1988) “Recent evidence for a possible Bronze age metal trade between Sardinia and the Aegeans”. In *Problems in Greek prehistory*. Bristol, edited by Elisabeth B. French and Ken A. Wardle, 349-384. Bristol: Bristol Classical Press.
- Gale Noel and Zofia Stos-Gale. (1994) “Provenience studies and Bronze Age Cyprus: data and methods”. In *Provenience studies and Bronze Age Cyprus*, edited by Bernard A. Knapp and John F. Cherry, 92-121. Madison, WIS: Prehistory Press.
- Gale, Noel and Zofia Stos-Gale. (1995) “Comments on oxhide ingots, recycling and the Mediterranean metal trade”. *Journal of Mediterranean Archaeology* 8: 33-41.
- Gale, Noel and Zofia Stos-Gale (1999) “Copper Oxhide Ingots and the Aegean Metals Trade”. In *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener as he enters his 65th Year*, edited by Betancourt, Karageorghis, Laffineur, and Niemeier, 267-278. Austin, TX: University of Texas at Austin.

- Gale, Noel H. and Zofia A. Stos-Gale. (2005) "Zur Herkunft der Kupferbarren aus dem Schiffswrack von Uluburun und der spätbronze-zeitliche Metallhandel im Mittelmeerraum". In *Das Schiff von Uluburun*, edited by Yalçın, Pulak, and Slotka, 117-131. Bochum: Deutsches Bergbau-Museum.
- Gale, Noel H. and Zofia A. Stos-Gale. (2012) "The role of Apliki mine region in the post c. 1400BC copper production and trade networks in Cyprus and in wider Mediterranean". In *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC. A Conference in Honour of James D. Muhly. Nicosia, 10th-11th October 2009*. Oxford: Oxbow Books.
- Gale, Stos-Gale, Raduncheva, Ivanov, Lilov, Todorov, and Panayotov. (2003) "Early Metallurgy in Bulgaria". In *Mining and Metal Production through the Ages*, edited by Paul Craddock and Janet Lang, 122-173. London: British Museum Press.
- Galili, Shmueli, and Artzy. (1986) "Bronze Age ship's cargo of copper and tin". *International Journal of Nautical Archaeology* 15: 25-37.
- Galili, Gale, and Rosen. (2012) "A Late Bronze Age Shipwreck with a Metal Cargo from Hishuley Carmel, Israel". *International Journal of Nautical Archaeology* 42, no. 1: 2-22.
- Giumlia-Mair, Alessandra. (2011) "The analyses of the copper-based finds from the LBA metallurgical site at Pălatca". *Acta Musei Napocensis* 45-46, no. 1: 37-49.
- Giumlia-Mair, Kassianidou, and Papasavvas. (2011) "Miniature ingots from Cyprus". In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 11-19. Philadelphia, Pen.: INSTAP Academic Press.
- Giumlia-Mair, Alessandra and Fulvia Lo Schiavo, eds. (2003) *The problem of tin*. British Archaeological Reports, International Series 1199. Oxford: Archaeopress.
- Gregory, Chris A. (1982) *Gift and Commodities*. London: Academic Press.
- Graziadio, Giampaolo. (2003) "I lingotti oxhide nella glittica cipriota". *Studi Micenei ed Egeo-Anatolici* 45: 27-69.
- Hadjisavvas, Sophocles. (1986) "Alassa. A New Cypriot Site". *Report of the Department of Antiquities of Cyprus*, 62-67.
- Hadjisavvas, Sophocles. (2011) "Broken Symbols: Aspects of Metallurgy at Alassa". In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 21-28. Philadelphia, Pen.: INSTAP Academic Press.
- Hansen, Svend. (2005) "Neue Forschungen zur Metallurgie der Bronzezeit in Südosteuropa". In *Anatolian Metal 3*, edited by Ünsal Yalçın, 89-104. Bochum: Deutsches Bergbau-Museum.
- Hauptmann, Maddin, and Prange. (2002) "On the Structure and Composition of Copper and Tin Ingots Excavated from the Shipwreck of Uluburun". *Bulletin of the American School of Oriental Research* 328: 1-30.
- Hauptmann, Andreas. (2009) "Lead isotope analysis and the origin of Sardinian metal objects" In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 499-514. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Hirschfeld, Nicolle. (1999) "Potmarks of the Late Bronze Age Eastern Mediterranean". PhD thesis, University of Texas at Austin, USA.
- Hornung, Krauss, and Warburton. (2006). *Ancient Egyptian Chronology*. Leiden: Brill.

- Ialongo, Nicola. (2010) "Ripostigli e complessi di bronzi votive della Sardegna nuragica tra bronzo recente e prima età del ferro. Proposta di una scansione cronologica". *Origini* 32, no. 4: 315-352.
- Ilon, Gabor. (1992) "Keftiubarren ingot from an urn-grave culture settlement at G6r-K6p6lnadomb (C. Vas)". *Acta Archaeologica Academiae Scientiarum Hungaricae* 44: 239-259.
- Jones, Michael R. (2007) "Oxhide Ingots, Copper Production, and the Mediterranean Trade in Copper and Other Metals in the Bronze Age". PhD Thesis, Texas A&M University, USA.
- Jones, Richard and Vagnetti. (1991) "Traders and craftsmen in the central Mediterranean". In *Bronze Age Trade in the Mediterranean*, edited by Noel H. Gale, 127-147. Studies in Mediterranean Archaeology 90. G6teborg: Paul 6str6ms F6rlag.
- Kaiser, Alaina M. (2013) "Copper oxhide ingot marks: a database and comparative analysis". MA Thesis, Cornell University Ithaca, NY, USA.
- Kassianidou, Vasiliki. (2003) "The trade of tin and island of copper". In *The problem of tin*, edited by Alessandra Giunlia-Mair and Fulvia Lo Schiavo, 109-119. British Archaeological Reports, International Series 1199. Oxford: Archaeopress.
- Kassianidou, Vasiliki. (2005) "Was copper production under divine protection in Late Bronze Age Cyprus? Some thoughts on an old question". In *Cyprus: Religion and Society, from the Late Bronze Age to the End of the Archaic Period. Proceedings of an International Symposium in Cypriote Archaeology, Erlangen 23rd - 24th July 2004*. M6hnesee: Bibliopolis Verlag.
- Kassianidou, Vasiliki. (2009) "Oxhide ingots in Cyprus". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giunlia-Mair, 41-88. Biblioteca di Antichit6 Cipriote 8. Rome: ICEVO-CNR.
- Kassianidou, Vasiliki. (2012) "Copper oxhide ingots and Cyprus – The story so far". *Numismatic Reports* XXXIL-XLIII: 9-54.
- Kassianidou, Vasiliki. (2013) "Mining landscapes of prehistoric Cyprus". *Metalla* 20, no 2: 36-35.
- Kassianidou, Vasiliki and Knapp. (2005) "Archaeometallurgy in the Mediterranean: the social contexts of Mining, Technology, and Trading". In *The archaeology of the Mediterranean Prehistory*, edited by Emma Blake and Bernard A. Knapp, 215-251. Oxford: Blackwell Publishing.
- Kassianidou, Vasiliki and Papasavvas, eds. (2012) *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC. A Conference in Honour of James D. Muhly. Nicosia, 10th-11th October 2009*. Oxford: Oxbow Books.
- Knapp, A. Bernard. (1985) "Production and exchange in the Aegean and eastern Mediterranean: an overview". In *Prehistoric production and exchange*, edited by Bernard A. Knapp and Tamara Stech, 1-11. Los Angeles: Institute of Archaeology, University of California.
- Knapp, A. Bernard. (1986) *Copper production and divine protection*. Gothenburg: P. 6str6ms F6rlag.
- Knapp, A. Bernard. (1990) "Cyprus Crete and copper: a comment on Catling's paradox". *Report of the Department of Antiquities of Cyprus*, 55-63.
- Knapp, A. Bernard. (2000) "Archaeology, science based archaeology and the Mediterranean Bronze Age metal trade". *European Journal of Archaeology* 3, no 1: 31-49.
- Knapp, A. Bernard. (2013) *The Archaeology of Cyprus: From Earliest Prehistory through the Bronze Age*. Cambridge: Cambridge University Press.

- Knapp, Muhly, and Muhly. (1988) "To hoard is human: late Bronze Age metal deposits in Cyprus and the Aegean". *Report of the Department of Antiquities of Cyprus*, 233-262.
- Kaul, Flemming. (1998) *Ship on bronzes*. Copenhagen: National Museum.
- Kolb, Frank. (2004) "Troy VI: a Trading Center and a Commercial City?" *American Journal of Archaeology* 108, no. 4: 577-613.
- Kristiansen, Kristian. (1998) *Europe before history*. Cambridge: Cambridge University Press.
- Lagarce, Lagarce, Bounni and Saliby. (1983) Les fouilles à Ras Ibn Hani en Syrie (campagnes de 1980, 1981 et 1982). Contribution à l'étude de quelques aspects de la civilisation ugaritique. *Comptes-rendus des séances de l'Académie des Inscriptions et Belles-Lettres*, 127, no. 2: 249-290.
- Larson, Thomas S. (2009) "Experiments Concerning the Mold Materials Used in the Production of the Copper Ingots from the Late Bronze Age Shipwreck Excavated at Uluburun, Turkey". MA Thesis, Texas A&M University, USA.
- Leshtakov, Krassimir. (2007) The Eastern Balkans in the Aegean Economic system during the LBA. Oxhide and bun ingots in Bulgarian lands. In *Aegaeum 27. Between the Aegean and Baltic Seas: Prehistory across Borders: Proceedings of the International Conference "Bronze and Early Iron Age Interconnections and Contemporary Developments between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe: University of Zagreb, 11-14 April 2005*. Liège: Université de Liège.
- Liard, Florence. (2010) "Le cuivre Chypriote et la Crète: Les régions d'importation des lingots «peau-de boeuf»". *Revue Archeologique* 1: 47-65
- Lichardus, Echt, Iliev, Christov, Becker, and Thiele. (2002) "Die Spätbronzezeit an der unteren Tundza und die ostägäischen Verbindungen in Südostbulgarien". *Eurasia Antiqua* 8: 135-184.
- Ling, Johan. (2008) *Elevated rock art. Towards a maritime understanding of rock art in northern Bohuslän, Sweden*. GOTARC Series B. no. 49. Göteborg: Göteborg University.
- Ling, Stos-Gale, Grandin, Billström, Hjärthner- Holdar, and Persson. (2014) "Moving metals in the Bronze Age II: the origin of copper-based artefacts from Sweden". *Journal of Archaeological Science* 41: 106-132.
- Ling, Johan and Michael Rowlands. (2013) "Structure from the north content from the south. Rock art, metal trade and cosmopolitical codes". In *Art as a source of history. PAPERS XXV Valcamonica Symposium 2013*. Capo di Ponte: Edizioni del Centro.
- Ling, Johan and Zofia Stos-Gale. (2015) "Representations of Oxhide ingots on Scandinavian Rocks? Traces after a Bronze Age traveller's tale". *Antiquity* 89, no. 343: 191-209.
- Liverani, Mario. (1990) *Prestige and Interest. International Relations in the Near East ca. 1600-1100 B.C.* Padua: Sargon.
- Lo Schiavo, Fulvia. (1982) Copper metallurgy in Sardinia during the Late Bronze Age. In *Early metallurgy in Cyprus 4000-500 B.C.*, edited by Muhly, Maddin and Karageorghis, 271-282. Nicosia: University of Cyprus.
- Lo Schiavo, Fulvia. (1982) "La componente egea e cipriota nella metallurgia della tarda età del bronzo in Italia." In *"Magna Grecia" e Mondo Miceneo, Atti XXII Convegno Magna Grecia*. Taranto: ISAMG.
- Lo Schiavo, Fulvia. (1986) "Sardinian metallurgy: The archaeological background". In *Studies in Sardinian Archaeology II: Sardinia in the Mediterranean* edited by Miriam S. Balmuth, 231-250. Ann Arbor: University of Michigan Press.

- Lo Schiavo, Fulvia. (1995) "Cyprus and Sardinia in the Mediterranean Trade". In *Proceedings of the International symposium "Cyprus and the sea"*. Nicosia: University of Cyprus.
- Lo Schiavo, Fulvia. (2009a) "Oxhide ingots in nuragic Sardinia". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 225-390. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Fulvia. (2009b) "Oxhide ingots hoarding, fragmentation and use in Nuragic Sardinia". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 391-407. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Fulvia. (2009c) "The oxhide ingot from Sant'Anastasia, Borgo (Corsica)". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 411-417. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Fulvia. (2009d) "The oxhide ingot from Sète, Hérault (France)". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 421-427. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Fulvia. (2012) "Cyprus and Sardinia beyond the oxhide ingots". In *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC. A Conference in Honour of James D. Muhly. Nicosia, 10th-11th October 2009*. Oxford: Oxbow Books.
- Lo Schiavo, Fulvia. (2013) "I lingotti "a forma di pelle di bue" da S.Anastasia (Borgo) e da Sète, nel quadro della problematica della navigazione e degli scambi nel Mediterraneo centrale". In *Les Lingots peau-de-boeuf et la navigation en Méditerranée central, Acte du IIème Colloque international Lucciana, Mariana, 15-18 septembre 2005*. Ajaccio: Édition Alain Piazzola.
- Lo Schiavo, Albanese Procelli, and Giumlia-Mair. (2009) "Oxhide ingots in Sicily". In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 135-221. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Giumlia-Mair, Sanna, and Valera, eds. (2005) *Archaeometallurgy in Sardinia: from the origin to the beginning of the Early iron Age*. Monographies Instrumentum 30. Montagnac: Editions Monique Mergoil.
- Lo Schiavo, Macnamara, and Vagnetti. (1985) "Late Cypriote imports to Italy and their influence on local bronzework". *Papers of the British School at Rome* 53: 1-71.
- Lo Schiavo, Muhly, Maddin, and Giumlia-Mair, eds. (2009) *The oxhide ingots in the central Mediterranean*. Biblioteca di Antichità Cipriote 8. Rome: ICEVO-CNR.
- Lo Schiavo, Sorge, Cucuzza, Gale, and Stos-Gale. (2013) "An Oxhide Ingot Fragment from *Piazzale dei Sacelli*, Ayia Triada (Crete) to the National Archaeological Museum, Florence". In *Φιλική Συνδιάλεια Studies in Mediterranean Archaeology for Mario Benzi*, edited by Graziadio, Guglielmino, Lenuzza, and Vitale, 49-60. British Archaeological Reports, International Series 2460. Oxford: Archaeopress.
- Lo Schiavo, Fulvia and Lucia Vagnetti. (1980) "Micenei in Sardegna?" *Rendiconti dell'Accademia dei Lincei* 35, no 5-6: 371-391.
- Mallowan, Max E. L. (1966) *Nimrud and its remains*. New York: Dodd, Mead & Company
- Mangou, Helen and Panayiotis V. Ioannou. (2000) "Studies of the Late Bronze Age Copper-based Ingots found in Greece". *Annual of the British School at Athens* 95: 207-217.
- Manning, Weninger, South, Kling, Kuniholm, Muhly, Hadjisavvas, Sewell and Cadogan. (2001) "Absolute age range of the Late Cypriot IIC Period on Cyprus". *Antiquity* 75, no 288: 328-340.

- Manunza, Maria Rosaria, ed. (2008) *Funtana Coberta. Tempio nuragico a Ballao nel Gerrei*. Cagliari: Scuola Sarda Ed.
- Manunza, Maria Rosaria and Pietrangela Defrassu. (2009) “Scavi al nuraghe Coi Casu (S. Anna Arresi - CA)”. In *XLIV Riunione Scientifica - La preistoria e la protostoria della Sardegna, 1361-1363*. Florence: Istituto Italiano di Preistoria e Protostoria.
- Maran, Joseph and Philipp W., Stockhammer, eds. (2012) *Materiality and Social practice. Transformative capacities of intercultural encounters*. Oxford: Oxbow.
- Merkel, John F. (1986) “Ancient smelting and casting of copper for oxhide ingots”. In *Studies in Sardinian Archaeology II: Sardinia in the Mediterranean* edited by Miriam S. Balmuth, 251-264. Ann Arbor: University of Michigan Press.
- Monroe, Christopher. (2011) “From Luxuries to Anxieties: A liminal view of the Late Bronze Age World System”. In *Interweaving Worlds. Systemic Interactions in Eurasia 7th to 1st millennia B.C.*, edited by Wilkinson, Sherratt and Bennett, 87-99. Oxford: Oxbow Books.
- Matič, Uroš. (2012) “Out of the Word and Out of the Picture? Keftiu and Materializations of ‘Minoans’”. In *Encountering Imagery. Materialities, Perceptions, Relations.*, edited by Back Danielsson, Fahlander and Sjöstrand, 235-253. Stockholm Studies in Archaeology 57. Stockholm: Stockholm University.
- Miletti, Matteo. (2013). *Les Lingots peau-de-boeuf et la navigation en Méditerranée central, Acte du IIème Colloque international Lucciana, Mariana, 15-18 septembre 2005*. Ajaccio: Édition Alain Piazzola.
- Moran, William. (1992) *The Amarna Letters*. Baltimore: Johns Hopkins University Press.
- Moszolics, Amália. (1985) *Bronzefunde aus Ungarn*. Budapest: Oetker-Voges.
- Muhly, James D. (1991) “The development of copper metallurgy in the late Bronze Age Cyprus”. In *Bronze Age Trade in the Mediterranean*, edited by Noel H. Gale, 180-196. Studies in Mediterranean Archaeology 90. Gothenburg: P. Åströms Förlag.
- Muhly, James D. (1995). “Lead isotope analysis and the Archaeologist”. *Journal of Mediterranean Archaeology* 8: 54-58.
- Muhly, James D. (2009). “Oxhide Ingots in the Aegean and Egypt”. In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin, and Giumlia-Mair, 17-39. Biblioteca di Antichità Ciproite 8. Rome: ICEVO-CNR.
- Muhly, Maddin, and Stech. (1988) “Cyprus, Crete and Sardinia: copper oxhide ingots and the Bronze Age metal trade”. *Report of the Department of Antiquities of Cyprus*, 281-298.
- Nibbi, Alessandra. (1987) *Ancient Egyptian Pot Bellows and the Oxhide Ingot Shape*. Oxford: DE Publications.
- O’Connor, David. (1967) “Model ingots in Egyptian foundation deposits”. *Transaction of the American Philosophical Society* 57, no 8: 172-174.
- Papasavvas, George. (2009) “The iconography of the oxhide ingots”. In *The oxhide ingots in the central Mediterranean*, edited by Lo Schiavo, Muhly, Maddin and Giumlia-Mair, 83-117. Biblioteca di Antichità Ciproite 8. Rome: ICEVO-CNR.
- Papasavvas, George. (2011) “From Smiting to smithing: The transformation of a Cypriot God”. In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 59-66. Philadelphia, Pen.: INSTAP Academic Press.

- Papasavvas, George. (2012) "Profusion of Cypriot copper abroad, dearth of bronzes at home: a paradox in Late Bronze Age Cyprus". In *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC. A Conference in Honour of James D. Muhly. Nicosia, 10th-11th October 2009*. Oxford: Oxbow Books.
- Pare, Christopher F.E. (1999) "Weights and weighting in Bronze Age central Europe." In *Eliten in der Bronzezeit*, edited by Imma Kilian-Dirlmeier and Markus Egg 421-514. Mainz: Verlag des Römisch-Germanischen Zentralmuseums.
- Pare, Christopher F.E., ed. (2000) *Metals Make the World Go Round: The Supply and Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Oxford: Oxbow Books.
- Parise, Nicola. (1968) "I pani di rame nel II millennio a.C. Considerazioni preliminari". In *Atti e memorie del I congresso di miceneologia (Roma 27/9-3/10/1967), Incunabula Graeca*. Roma: Ediz.dell'Ateneo.
- Parise, Nicola. (1986) "Unità ponderali egee". In *Traffici micenei nel Mediterraneo, Atti del convegno (Palermo, 11-12/5 and 3-4/12/1984)*. Taranto: Istituto per la storia e l'archeologia della Magna Grecia.
- Peroni, Renato. (1996) *L'Italia alle soglie della storia*. Bari: Laterza.
- Platon, Nicholas. (1985) *Zakros. The discovery of a lost Palace of Ancient Crete*. Amsterdam: Dolf M. Hakkert.
- Primas, Margarita. (1997) "Bronze Age Economy and Ideology: Central Europe in Focus". *Journal of European Archaeology* 5, no 1: 115-130.
- Primas, Margarita and Ernst Pernicka. (1998) "Der Depotfund von Oberwilflingen". *Germania* 76: 25-65.
- Pulak, Cemal. (1988) "The Bronze Age shipwreck at Ulu Burun, Turkey: 1985 campaign". *American Journal of Archaeology* 92, no 1: 1-37.
- Pulak, Cemal. (1998) "The Uluburun shipwreck: an overview". *The International Journal of Nautical Archaeology* 27, no 3: 188-224.
- Pulak, Cemal. (1997) "The Uluburun shipwreck". In *Res Maritimae, Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity*, edited by Swiny, Hohlfelder and Wyld Swiny, 233-262. Atlanta: American Schools of Oriental Research.
- Pulak, Cemal. (2005a) "Who were the Mycenaeans aboard the Uluburun ship?" In *Aegaeum 25. Emporia. Aegeans in the central and Eastern Mediterranean, Proceedings of the 10th International Aegean Conference: Italian School of Archaeology, Athens, 14-18 April 2004*. Liège: Université de Liège.
- Pulak, Cemal. (2005b) "Discovering a Royal Ship from the Age of King Tut: Uluburun, Turkey". In *Beneath the Seven Seas*, edited by Bass, George F., 34-47. New York: Thames & Hudson.
- Pulak, Cemal. (2008) "The Uluburun Shipwreck and Late Bronze Age Trade". In *Beyond Babylon: Art, Trade, and Diplomacy in the Second Millennium B.C.*, edited by Aruz, Benzel and Evans, 288-310. New York: The Metropolitan Museum.
- Pulak, Cemal. (2011) "Three Copper Oxhide Ingots in the Şanlıurfa Archaeology Museum, Turkey". In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 295-308. Philadelphia, Pen.: INSTAP Academic Press.
- Pusch, Edgar. (1990) "Metallverarbeitende Werkstätten der frühen Ramessidenzeit in Qantir-Piramesse/Nord". *Ägypten und Levante* 1: 75-113, Pl. I-VIII.

- Rademakers, Rehren, and Push. (forthcoming) “Bronze production in Pi-Ramesse: Alloying technology and material use”. In *Mining for copper: Essays in Honour of Professor Beno Rothenberg*, edited by Erez Ben-Yosef and Yuval Goren. Tel Aviv: Institute of Archaeology.
- Reade, Julian E. (1980) The Rassam Obelisk. *Iraq* 42: 1-22.
- Rowland, Michael and Johan Ling. (2013) “Boundaries, Flows and Connectivities: Mobility and Stasis in the Bronze Age”. In *Counterpoint: Essays in Archaeology and Heritage Studies in Honour of Professor Kristiansen Kristiansen*, edited by Sophie Bergerbrant and Serena Sabatini, 517-529. British Archaeological Reports, International Series 2508. Oxford: Archaeopress.
- Rotea, Wittenberger, Tecar, and Tecar. (2011) “Bronze Age metallurgy in Transylvania: craft, art and ritual/magic”. *Acta Musei Napocensis* 45–46, no 1: 5–36.
- Sabatini, Serena (in press) Late Bronze Age oxhide and oxhide-like ingots from other areas than the Mediterranean: problems and challenges. *Oxford Journal of Archaeology*.
- Santoni, Bacco, and Lo Schiavo. (2012) “Frammento di lingotto ‘a forma di pelle di bue’ dal nuraghe Serucci, Gonnese (Cagliari). In *La Preistoria e Protostoria della Sardegna, XLIV Riun. Scient. IIPP, Cagliari-Barumini-Sassari 23-28 Novembre 2009 (Sessione X. Risorse e Tecnologia, IV Posters)*. Florence: IIPP.
- Schuster, Cristian. (2005) Zu den Ochsenhautbarren (?) in Rumänien. *Studii de Preistorie* 2: 191-201.
- Shaw, Joseph W. (2006) “Metals and Metalworking”. In *Kommos V. The Monumental Minoan Buildings at Kommos*, edited by Joseph W. Shaw and Maria C. Shaw, 717-729. Princeton-Oxford: Princeton University Press.
- Sherratt, Susan. (2000) “Circulation of Metals at the End of the Bronze Age in the Eastern Mediterranean”. In *Metals Make the World Go Round: The Supply and Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Oxford: Oxbow Books.
- Sherratt, Susan. (2012) “The intercultural transformative capacities of irregularly appropriated good”. In *Materiality and Social Practice Transformative Capacities of Intercultural Encounters*, edited by Joseph Maran and Philipp W. Stockhammer, 152-172. Oxford: Oxbow Books.
- Sherratt, Andrew and Susan Sherratt. (1991) “From luxuries to commodities”. In *Bronze Age Trade in the Mediterranean*, edited by Noel H. Gale, 351-386. Studies in Mediterranean Archaeology 90. Göteborg: Paul Åströms Förlag
- Sibella, Patricia. (1996) “The copper oxhide and bun ingots”. *The INA Quarterly* 23, no 1: 9-11.
- Soles, Jeffrey S. (2004) “The Greek-American Excavations at Mochlos”. *Kentro: The Newsletter of the INSTAP Study Center for East Crete* 7: 2-5.
- South, Alison K. (1983) “Kalavassos-Ayios Dhimitrios 1982”. *Report of the Department of Antiquities of Cyprus*, 92-116.
- South, Todd, Russel, and Schuster Keswani, eds. (1989) *Kalavassos-Ayios-Dhimitrios II. Ceramics, Objects, Tombs, Specialist Studies*. Studies in Mediterranean Archaeology 71.3. Göteborg: Paul Aströms Förlag.
- Stech, Tamara. (1985) “Copper and society in late Bronze Age Cyprus”. In *Prehistoric production and exchange*, edited by Bernard A. Knapp and Tamara Stech, 100-105. Los Angeles: Institute of Archaeology, University of California.

- Stech, Maddin, and Muhly. (1985) "Copper production at Kition in the late Bronze Age". In *Excavation at Kition V*, edited by Vassos Karageorghis and Martha Demas, 388-402. Nicosia: Department of Antiquities.
- Stos-Gale, Zofia. (1988) "Lead evidence for trade in copper from Cyprus during the Late Bronze Age". In *Problems in Greek prehistory*, edited by French Elisabeth B. and Ken A. Wardle, 265-282. Bristol: Bristol Classical Press.
- Stos-Gale, Zofia A. (2009) "Across the wine dark seas...sailor tinkers and royal cargoes in the Late Bronze Age eastern Mediterranean". In *From Mine to Microscope Advances in the Study of Ancient technology*, edited by Shortland, Freestone and Rehren, 163-180. Oxford: Oxbow Books.
- Stos-Gale, Zofia A. (2011) "'Biscuits with Ears:' A Search for the origin of the earliest Oxhide Ingots". In *Metallurgy: Understanding how, learning why. Studies in honour of James D. Muhly*, edited by Philip P. Betancourt and Susan C. Ferrence, 221-229. Philadelphia, Pen.: INSTAP Academic Press.
- Stos-Gale, Maliotis, Gale, and Annetts. (1997) "Lead isotope characteristics of the Cyprus copper ore deposits applied to provenance studies of copper oxhide ingots". *Archaeometry* 39: 83-123.
- Stos-Gale, Zofia and Macdonald Colin F. (1991) "Sources of metals and trade in the Bronze Age Aegean". In *Bronze Age Trade in the Mediterranean*, edited by Noel H. Gale, 249-288. Studies in Mediterranean Archaeology 90. Göteborg: Paul Åströms Förlag
- Stos-Gale, Zofia and Gale, Noel. (1992) "New light on the provenience of the copper oxhide ingots found in Sardinia". In *Sardinia in the Mediterranean: a Footprint in the Sea, Studies in Sardinian Archaeology Presented to Miriam S. Balmuth*, edited by Robert H. Tykot and Tamsey K. Andrews, 317-346. Sheffield: Sheffield Academic Press.
- Tylecote, Balmuth, and Massoli-Novelli. (1984) "Copper and bronze metallurgy in Sardinia". In *Studies of Sardinian Archaeology I*, edited by Miriam S. Balmuth and Robert J. Rowland, 115-162. Ann Arbor: University of Michigan Press.
- Tylecote, Ronald F. and John F. Merkel. (1985) "Experimental smelting techniques: achievements and future". In *Furnaces and smelting technology in antiquity*, edited by Paul T. Craddock and Michael J. Hughes, 1-20. British Museum Occasional Papers 48. London: British Museum.
- Vagnetti, Lucia. (1971) "Osservazioni sul cosidetto ripostiglio di Makarska (including an appendix by P. S. de Jesus)." *Studi Ciprioti e Rapporti di Scavo* 1: 203-216.
- Vagnetti, Lucia and Fulvia Lo Schiavo. (1989) "Late Bronze Age long distance trade: the role of the Cypriots". In *Early Societies in Cyprus*, edited by Edgar Peltenburg, 217-243. Edinburgh: University Press.
- Vandkilde, Helle. (1996) *From Stone to Bronze. The Metalwork of the Late Neolithic and Earliest Bronze Age in Denmark*. Jutland Archaeological Society Publications 32. Aarhus: Aarhus University.
- Vandkilde, Helle. (2010) "Metallurgy, inequality and globalization in the Bronze Age – discussant's commentary on the papers in the metallurgy session". In *Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen*, edited by Harald Meller and Francois Bertemes, 903-910. Halle: Landesmuseum für Vorgeschichte.
- Wachsmann, Shelley. (1987) *Aegeans in the Theban tombs*. Orientalia Lovaniensia Analecta 20. Leuven: Peeters Publishers

- Wachsmann, Shelley. (1998) *Seagoing ships and seamanship in the Bronze Age Levant*. College Station: Texas A&M University Press.
- Wachsmann, Shelley. (2013) *The Gurob-ship cart model and its Mediterranean context*. College Station: Texas A&M University Press.
- Wachsmann, Shelley and Kurt Raveh. (1984) "Concerning a lead Ingot fragment from Hahotrim, Israel". *International Journal of Nautical Archaeology* 13: 169–176.
- Watrous, L. Vance. (1989) "A preliminary report on imported 'Italian' wares from the Late Bronze Age site of Kommos on Crete". *Studi Micenei ed egeo-anatolici* 27: 69-79.
- Webb, Jennifer. (2001) "The sanctuary of the ingot god at Enkomi. A new reading of its construction, use and abandonment". In *Contributions to the Archaeology and History of the Bronze and Iron Age in the Eastern Mediterranean, Studies in honour of Paul Åström*, edited by Peter M. Fischer, 69-82. Vienna: Österreichisches Archäologisches Institut.
- Wengrow, David. (2008) "Prehistories of Commodity Branding". *Current Anthropology* 49, no 1: 7-34.
- Wengrow, David. (2010) "Introduction. Commodity Branding in Archaeological and Anthropological Perspectives". In *Cultures of Commodity Branding*, edited by Andrew Bevan and David Wengrow. 11-33. Walnut Creek, CA: Left Coast Press.
- Wilkinson, Bennet, and Sherratt, eds. (2011) *Interweaving Worlds: Systemic Interactions in Eurasia, 7th to the 1st Millennia BC*. Oxford: Oxbow Books.
- Wittenberg, Mihai. (2008) "Economical life in Noua Culture". *Acta Musei Napocensis* 43-44, no. 1: 5-42.
- Zaccagnini, Carlo. (1986) "Aspects of copper trade in the eastern Mediterranean during the Late Bronze Age". In *Traffici micenei nel Mediterraneo, Atti del convegno (Palermo, 11-12/5 and 3-4/12/1984)*. Taranto: Istituto per la storia e l'archeologia della Magna Grecia.