'ASIATIC COPPER' IN NEW KINGDOM EGYPT

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Abstract

This work presents a combination of Lead Isotope Analysis (LIA) and ancient Egyptian texts and depictions in order to describe the history of the ox-hide copper ingots presence in Egypt, which were called by the Egyptians "Asiatic copper". Ox-hide ingots in Egypt represent a particular case where the information given by ancient sources and modern chemical analyses might be combined in order to establish the provenance of archaeological objects and the history of a particular material during the Bronze Age.

Ox-hide ingots arrived to Egypt where the first kings of the Egyptian New Kingdom developed an impressive building program through the entire country and needed a supply of copper and other materials. The "Asiatic copper" was depicted in different tombs and temples from the 18th to the 20th dynasties in Thebes and Amarna. According to depictions and texts, three different regions supplied copper according to ancient Egyptians: Syria, Cyprus and Crete. However, the LIA of the lead present in mined copper permits to establish that the ingots were made of copper from Apliki mines, in Central Cyprus. The depictions in Egyptian tombs and temples probably represented not only the actual region of provenance but also the peoples involved in the trade, because the ingots were traded by Syrian merchants following a route that passed Syria, Cyprus, Crete and Greece.

1. Introduction: Provenance studies based on chemical composition of materials

The provenance of some archaeological objects might be determined through the study of the composition of the materials that make the object, because the chemical composition of some materials differs slightly depending on the geographical region of provenance. Thus, provenance studies based on chemical composition compare the chemical composition of the material from different quarries or mines worked in antiquity with the chemical composition of the material found in an archaeological site. From this comparison, the most likely source or sources of the archaeological material and, therefore, of the archaeological object, might be elucidated (Pollard et al., 2007). For example, a previous work in this journal described on one hand the application of the

geographical variation of the obsidian chemical composition to establish that the most likely sources of obsidian objects found in Egyptian predynastic sites were some volcanoes in central Ethiopia (Giménez, 2015; Giménez et al., 2016). On the other hand, the isotopy of the lead present in the lead antimonite used to make opaque ancient glasses permitted to establish the provenance of the raw materials used for the fabrication of glass during the Egyptian New Kingdom. The results indicated that ancient Egyptian artisans used lead antimonite made of galena of the Gebel Zeit mines in the coast of the Red Sea (Giménez, 2015).

The main objective of this work is the description of another application of the Lead Isotope Analysis (LIA) to the Egyptian archaeology: the determination of the geographical provenance of the copper called "Asiatic copper" by ancient Egyptians, a particular type of copper ingot that had the shape of a hide taken from a real ox (see Figure 1) and are nowadays named ox-hide ingots. Ox-hide copper ingots appeared during the XVII century BC in Crete, and the last ingots are dated to the X century BC and were found in Sardinia. Ox-hide ingots were excavated in different archaeological sites in the Mediterranean, especially in Sardinia, Crete and Cyprus but also in the south of the Anatolian peninsula and in the Levantine coast. Depictions of these ingots were found in some Egyptian tombs and temples dated between the reigns of Hatshepsut and Ramses III. The ancient Egyptian sources, in particular, texts describing the depictions of the ingots in tombs and temples, convey contradictory information about their provenance, because they indicate that the ingots could come from either Asia, Crete or Cyprus. The LIA of the ingots, based on the amount of lead always present in mined copper, might shed light on the actual provenance of the copper.

2. Ox-hide copper ingots in Egypt

There are two main sources of information in Egypt regarding the ox-hide ingots: (1) scenes in the walls of tombs and temples and accompanying texts, and (2) physical objects found in excavations. The first depictions of the ox-hide ingots were found in some Theban tombs dated to the reigns of Hatshepsut and Thutmose III (although it is likely that the ingots arrived earlier to Egypt) while the latest were found in the Ramses III funerary temple in Medinet Habu (Luxor) and in the Ramses III tomb in the Valley of the Kings, and are evidently dated to the reign of Ramses III.

2.1 Ancient Egyptian depictions of ox-hide ingots in tombs and temples (and accompanying texts)

There are more than twenty depictions of ox-hide ingots in Egyptian tombs and temples (Bass et al., 1967). The depictions show four different types of scenes, where ox-hide ingots appear as (a) foreign tribute (b) the target of arrows shot by a king (c) a raw material in metallurgical activities and (d) an offering of an Egyptian king to a god. Figure 2 shows some examples of these types of scenes. The depictions of ox-hide copper ingots almost disappeared in Egyptian tombs at the end of the 18th dynasty, although there is one later depiction in the tomb of Ramses III in the Valley of the Kings (KV11). Only two more depictions are known from the 19th dynasty onwards, both on the walls of the funerary temple of Ramses III, although these could be copies of similar scenes in the funerary temple of Ramses II, the Ramesseum (Bass et al., 1967).

In some tombs, depictions are accompanied by a text that provides clues to the provenance of the ingots. In particular, the Rekhmire Theban tomb (TT100) contains some of the most important texts dealing with the provenance of ox-hide ingots according to ancient Egyptians. On one hand, in one register showing foreigners bringing ox-hide ingots, the text indicates that such foreigners are "*the chiefs of the land of Keftiu (and) the islands that are in the Great Sea*". On the other hand, in another register showing again foreigners bearing ox-hide ingots, the texts reads "*the chiefs of Retenu and of the farthest Asia*". Indeed, in another wall of the tomb, a text accompanies a depiction of the metallurgical work carried out using as a raw material the "*Asiatic copper that the King obtained after His victory in the land of Retenu in order to build the two doors of the Amun Temple in Karnak*". Other tombs also included references to the provenance of the ingots, as the tomb of Useramun (TT131, in Thebes), where a text accompanying a depiction of ox-hide ingots reads "*Reception of the booty that His Majesty brought from the Northern countries, from the confines of Asia, and from the islands amidst the sea*".

The texts corroborate the different ethnic characteristics of the foreigners depicted in the Rekhmire tomb. For example, Figure 3 shows two depictions of foreigners carrying ox-hide ingots. As it can be seen, the ethnic characteristics of both foreigners are very different, representing characters of a different provenance, Syria and Crete. Therefore, texts and depictions in the tombs describe the three regions that ancient Egyptians considered as the suppliers of ox-hide copper ingots:

a) Asia-Retenu, probably the region of Syria, including Ugarit, "*the chiefs of Retenu and of the farthest Asia*"

b) Greek islands, mainly Crete, "*the chiefs of the land of the Keftiu*".

c) Cyprus, "*the islands that are in the Great Sea*"

2.2 Archaeological artifacts associated with ox-hide ingots in Egypt

Depictions in tombs and temples are not the only source of information available in Egypt about ox-hide copper ingots. On one hand, there is a mold for fabricating miniature ox-hide ingots found in the copper mines in Timna (Ben-Yosef, 2012). The mold could have been used to fabricate miniature ingots such as those excavated in the foundation deposits of two funerary temples in Thebes (of Tausert and Siptah) that, at least in one case, were engraved with the names of the king, as it was discovered after the chemical cleaning of one of the miniature ingots (Bass et al., 1967). The Timna mold would indicate that ingots were also fabricated in Egypt, and probably with Timna copper, keeping in mind that only one mold was found and only for miniature ingots.

The only fragment of an ox-hide ingot found in Egypt comes from the excavations of Qantir Pi-Ramesses (Pusch, 1995). This is a very important object related to the provenance of the ingots, because it is the only object found in Egypt with a known lead isotopic composition. This composition coincided with that of the copper mined from the Apliki mines, in Central Cyprus (Gale and Stos-Gale, 1999). Unfortunately, in spite of the relatively large number of ox-hide depictions in Egypt, this was the only fragment of an actual ox-hide ingot found in Egypt and for the time being it remains the only result from a provenance study.

3. Ox-hide ingots in the Mediterranean: history and provenance studies

The determination of the provenance of copper by using the LIA procedure presents some difficulties. In particular, copper might be re-used, and bronze or copper objects could be melted in order to fabricate new metal objects. In such case, the re-molten copper could be the product of the mixing of copper from different geographical regions. If this is the case, lead isotopic composition could not correspond to any mine because it would be the mixture of different isotopic compositions. Being aware of this and other minor limitations, the copper provenance studies based on LIA showed that the copper from different mines in the Oriental Mediterranean had in general different lead isotopic compositions and the provenance of most copper objects (in particular, ox-hide ingots) could be determined. The results obtained indicate that the provenance of the copper used as the raw material for ox-hide ingots varied from the XVII century BC (when ox-hide ingots appeared in the Mediterranean) to the X century (when ox-hide ingots disappeared).

3.1 XVII to XVI centuries BC

The earliest ox-hide ingots were found in Crete and are dated between the XVII and the XVI century BC. Stos-Gale (1992) determined the lead isotopic composition of ox-hide ingots from the Cretan palaces of Kato Zakro and Hagia Triadgha. The main result of the comparison between the isotopic composition of copper ores and archaeological ingots was that neither Crete nor Cyprus were the sources of the ox-hide ingots, because the ingots always had much higher $^{208}Pb/^{206}Pb$ and $^{207}Pb/^{206}Pb$ ratios (Gale and Stos-Gale, 1982). According to the authors, such high ratios corresponded to very old formations and pointed to a Middle Eastern provenance, therefore, copper would arrive to Crete following a route through the Anatolian Peninsula, with Troy as a critical city dealing with the copper trade (Stos-Gale, 1992). However, other copper mines provide copper with relatively high $^{208}Pb/^{206}Pb$ and $^{207}Pb/^{206}Pb$ ratios and could have been the source of Middle East copper, such as Samad, Suhar and Nizwa ores in Oman (Begemann et al., 2010), see Figure 4. Copper mines from Oman were the main source of Mesopotamian copper during the Third and Second Millennia BC, and the possibility of copper from Oman arriving to Crete for the fabrication of ox-hide ingots should not be discarded.

3.2 XV to XII centuries BC

From the XV century BC, the monopoly of the ox-hide copper ingots fabrication seems to have shifted to Cyprus. According to the LIA results, the copper used to fabricate the ox-hide ingots mainly proceeded from the Apliki mines in Cyprus, especially from the XIII century (Stos-Gale et al., 1997). Figure 5 shows the comparison between lead isotopic ratios of copper ox-hide ingots from this period and of Mediterranean copper mines. As it can be seen, the isotopic composition of ox-hide ingots from different archaeological sites coincides with the isotopic composition of the Cypriot mines, in particular, of the Apliki mines.

However, the source of the copper of some ox-hide ingots found in shipwrecks that occurred in this period in the Oriental Mediterranean was outside Cyprus. Most ingots recovered from the Uluburun and the Cape Gelidonya shipwrecks showed isotopic ratios

consistent with a Cypriot origin (Stos, 2009) but there were some ingots found in the Uluburun and in the Cape Gelidonya shipwrecks with isotopic compositions consistent with copper from Lavrion mines, near Athens (Stos, 2009; Gale 2009). In addition, one of the two ox-hide ingots found in another shipwreck, in Hishuley Carmel, in the coast of Israel, had an isotopic composition that could be ascribed to a Greek provenance (Galili et al., 2013). On the contrary, fragments of ox-hide ingots found on a shipwreck in Kefar Samir, very near Hishuley Carmel, might be related to an Apliki origin according to the lead isotopic composition (Yahalom-Mack et al., 2014). The isotopic composition of these ingots is shown in Figure 6. The existence of non-Cypriot ingots, together with the lower quality of such ingots, suggests the existence of an informal trade of copper through the Mediterranean, in parallel to the official trade of ox-hide ingots made of copper from Apliki mines (Yahalom-Mack et al., 2014).

3.3 XII to X centuries BC

The trade of ox-hide copper ingots in the Mediterranean changed drastically at the end of the Bronze Age, probably because of the Sea Peoples event, which critically affected many important sites involved in the trade routes in the Mediterranean. From the XII century BC, ox-hide ingots disappeared in the Oriental Mediterranean and were only found in Sardinia. The provenance of such ox-hide ingots and of Sardinian copper and bronze artifacts was established by LIA. The results obtained show that ox-hide ingots found in Sardinia have isotopic compositions corresponding to the Apliki mines (Gale, 2006), which indicates that after the Sea Peoples event, Cyprus managed to restore its capacity to export copper, but the trade was circumscribed to Sardinia. Although copper was still worked in the Oriental Mediterranean, it seems that the use of ox-hide ingots was circumscribed to Sardinia until their disappearance, during the XI century BC. Perhaps the arrival of the Sea Peoples affected the official trade of copper from Cyprus but the informal trade of copper still continued.

4. History and provenance of ox-hide ingots in Egypt

4.1 The arrival of the ox-hide ingots to Egypt: start of the 18th dynasty.

As it is said above, ox-hide ingots were firstly depicted in Egypt during the reigns of Hatshepsut and Thutmose III, in the TT119 tomb in Thebes (from an official with a lost name). Therefore, some decades after their appearance in the Mediterranean, ox-hide copper ingots were already in Egypt. The use of foreigner copper in Egypt could be due to the necessity of large quantities of copper for the ambitious building project throughout the country started by king Ahmose after the end of the Second Intermediate Period and the reunification of Egypt (Shaw, 2004). Once the kingdom was re-united, and especially during the Ahmose's reign, there was an increase of the foreign exchanges between Egypt and some of its neighbors. In particular, contacts between Egypt and Crete were documented even during the Hyksos period in Egypt (Warren, 1995). The excavations carried out in Tell el-Dab'a, which exposed paintings of Minoan manufacture (Morgan, 1995; Bietak, 1996; Cline 1998) corroborate the contacts with Minoans already indicated by the exchange of different objects and materials (Bietak, 1995; Merrillees, 1997). Actually, in addition to the contacts between Egypt and Crete, there were also important contacts between Egypt and Cyprus. The amount of Cypriot pottery found in Tell el-

Dab'a was exceptionally high, even higher than the amount found in Syrian and Levantine sites such as Ras Shamra and Akko (Maguire, 1995).

The increasing contacts between Egypt and the Mediterranean, driven by the increase of the Egyptian building projects, could have included the exchange of ox-hide ingots, that could have later been depicted in tombs and temples, perhaps even as a symbol of the Egyptian assimilation of the foreigners (Giménez, 2016).

4.2 The use of the ox-hide ingots in Egypt: 18th and 19th dynasties.

Ox-hide copper ingots seem to have been widely used in Egypt during the New Kingdom. The depictions in tombs and temples include both their arrival to Egypt, their storage and their use as a raw material in metallurgy activities.

The LIA indicates that the ingots used in Egypt mainly proceeded from the Apliki mines in Cyprus. On one hand, the only Egyptian fragment analyzed had an isotopic composition coinciding with the copper from the copper from the Apliki mines. On the other hand, during the Egyptian 18th and 19th dynasties, Cyprus was the main supplier of copper used in the Mediterranean (although small amounts of copper were traded through a non-official exchange route). In addition, the role of Cyprus as the main supplier of copper could be corroborated by the texts accompanying the ox-hide ingots depictions in Egyptian tombs, which cited the *islands amidst the sea* as one of the suppliers of ox-hide ingots. Other Egyptian textual sources describe the copper from Alashiya (Graziadio, 2014; Jones, 2007). In the Thutmose III annals in the Karnak Temple, the pharaoh received after his campaigns 200 kg of copper from Isy (probably Cyprus), and in texts from Ramses II the pharaoh received "*silver and bronze in uncountable quantities, millions, hundreds of millions… from Alashiya*". On the other hand, different Amarna letters numbered the huge quantities of copper from Alashiya that were given to the pharaoh (about 30 Tons), copper that could have been depicted as ox-hide ingots in at least two Amarna tombs (Bass et al., 1967)

From the point of view of the ancient Egyptians, Cyprus was not the only region supplying the ox-hide ingots to Egypt, as the representation of the characters carrying the ingots reveal. However, it should not be forgotten that the literacy of the so-called 'tribute scenes' in private tombs in Thebes has been the object of a long discussion, in particular the question of the ethnicity of the characters who brought the 'tribute' and the provenance of such 'tribute'. Actually, in the case of the ox-hide ingots, the depictions and the texts indicate that the ingots came from Retenu. This probably reflected the ethnicity of the merchants controlling the exchange routes through the Mediterranean, which were mostly Syrian (Merrillees, 1997). In addition, ox-hide ingots could be made of Cypriot copper but the actual fabrication of the ingots could have been carried out in Syria. The discovering of a mold for making ox-hide ingots in Ras Ibn-Hani could corroborate that Cypriot copper was shipped to fabricate ingots in Syria. Actually, the lead isotopic composition of droplets of copper metal probably ejected from the Syrian mould indicated that the copper came from Cyprus (Rehak, 1997).

On the other hand, the depiction of ox-hide ingots carried by Minoan characters together with texts referring to the 'land of Keftiu' could be a consequence of Minoans being intermediaries in the exchange of ox-hide ingots. The counter-clockwise exchange route in the Oriental Mediterranean would imply that copper reached Egypt after passing Crete and Greece. Therefore, Minoans (and even Mycenaean, could have been believed

to be the suppliers of ox-hide ingots, besides the fact that a part of the ship's crew could have been Greek, as Mycenaean sailors were enrolled in the Uluburun ship.

4.3 The disappearance of the ox-hide ingots in Egypt: 20th dynasty.

The situation drastically changed during the reign of Ramses III and the intervention of the Sea Peoples, which caused an irreversible change in the geopolitical situation in the Oriental Mediterranean and critically affected the commercial routes that crossed the sea. The net result concerning the ox-hide copper ingots was that their exchange ceased in the Oriental Mediterranean and they never reached again Egypt. The last depictions of ox-hide ingots in Egypt are dated to the reign of Ramses III. On one hand, there are two depictions of the ingots in the Ramses III funerary temple in Medinet Habu, and, on the other hand, ox-hide copper ingots were depicted in a wall of his tomb in the Valley of the Kings. Copper was still in use in Egypt, but it was now extracted from the Timna mines.

5. Conclusions

The history of ox-hide ingots in Egypt during the New Kingdom provides a good example of the utility of LIA on Egyptology combined with the description of images and texts in Egyptian tombs and temples. LIA permits to establish the provenance of "Asiatic copper" and helps to understand the level of literacy of Egyptian depictions. The presence of Asiatic, Cretan, Mycenaean and Cypriot characters in the scenes showing the arrival of ox-hide ingots to Egypt should be understood in a mythic context, with foreigners paying tribute to the Land of the Gods. However, the depiction of the tribute scenes were based on the provenance of the ingots according to ancient Egyptians. Therefore, Egyptians did not only depicted Cypriot characters coming from the actual supplier of the ingots, as it is demonstrated by LIA, but also Syrian and Greek, which were directly involved in the ingots' trade.

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Figure Captions:

Figure 1. Shape of an ox-hide copper ingot.

Figure 2. Depictions of ox-hide ingots in Egypt (a) The Amenhotep II stela from Karnak Temple (Luxor Museum, J. 129), drawing after Chevrier (1929) (b) Ramses III making offerings to Amun-Re as Thoth keeps record. Treasury of the Medinet Habu temple (The Epigraphic Survey, 1932) (c) bearers in Amenemopet tomb, TT276 (after Bass et al., 1967).

Figure 3. Depictions of foreigners carrying ox-hide copper ingots in the tomb of Rekhmire. (a) Minoan or Mycenaean, (b) Syrian. Pictures from de Garis Davies (1943).

Figure 4. Comparison of the XVII-XVI century BC ox-hide copper ingots with copper from different mines in the Mediterranean. Data from the Lead Isotope Ratios for Mediterranean Ores database: http://brettscaife.net/lead/data/

Figure 5. Comparison of the XV-XII century BC ox-hide copper ingots with copper from different mines in the Mediterranean. Data from the Lead Isotope Ratios for Mediterranean Ores database: http://brettscaife.net/lead/data/

Figure 6. Comparison of the isotopic compositions of ox-hide ingots not corresponding to a Cypriot provenance found in shipwrecks with copper from different mines in the Mediterranean. Data from the Lead Isotope Ratios for Mediterranean Ores database: http://brettscaife.net/lead/data/

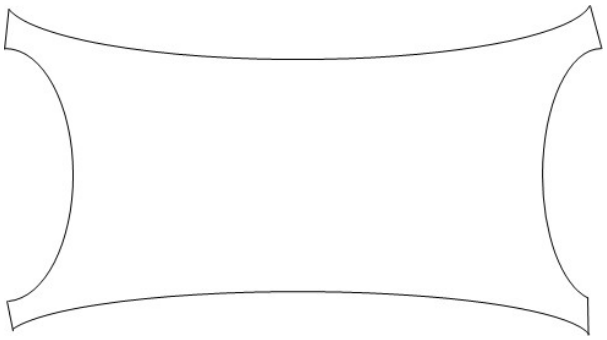
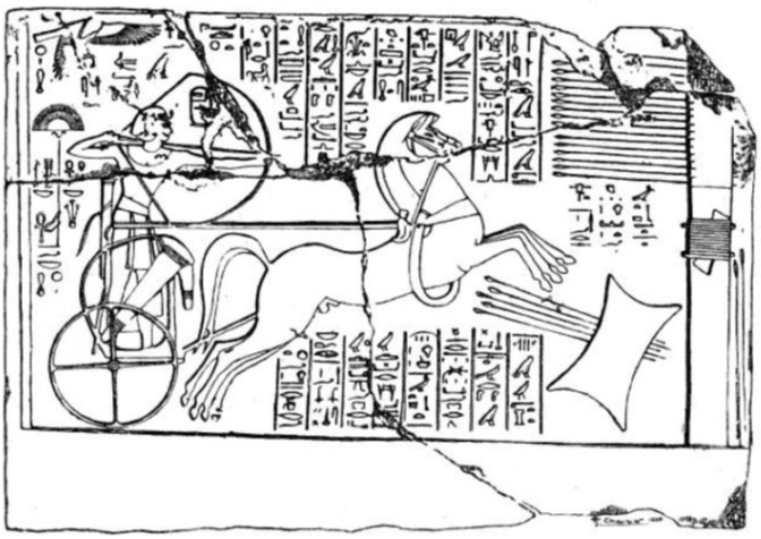


Fig. 1



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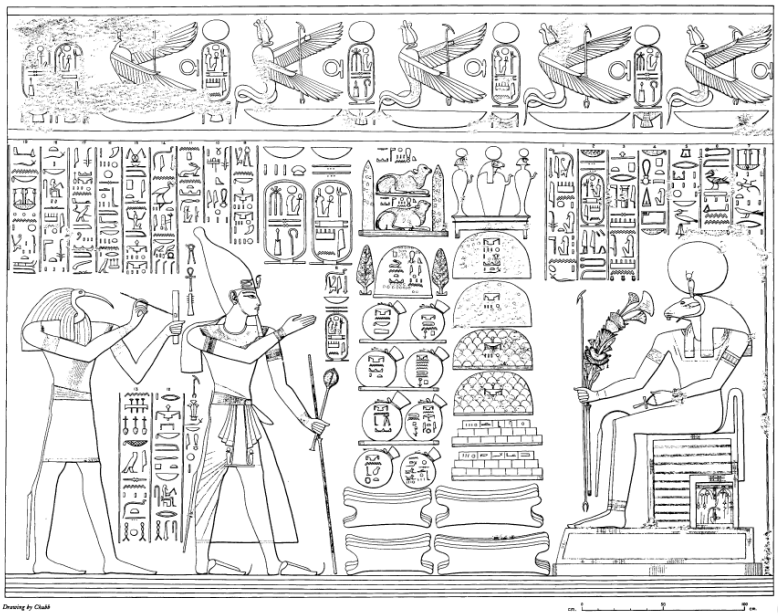

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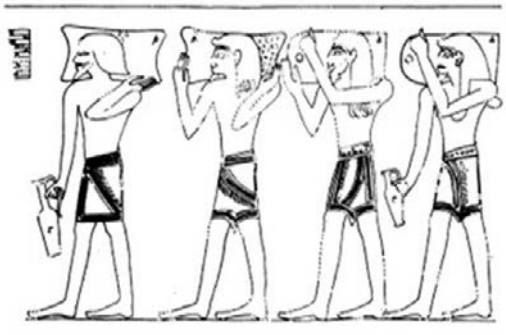

(c)

Fig. 2.

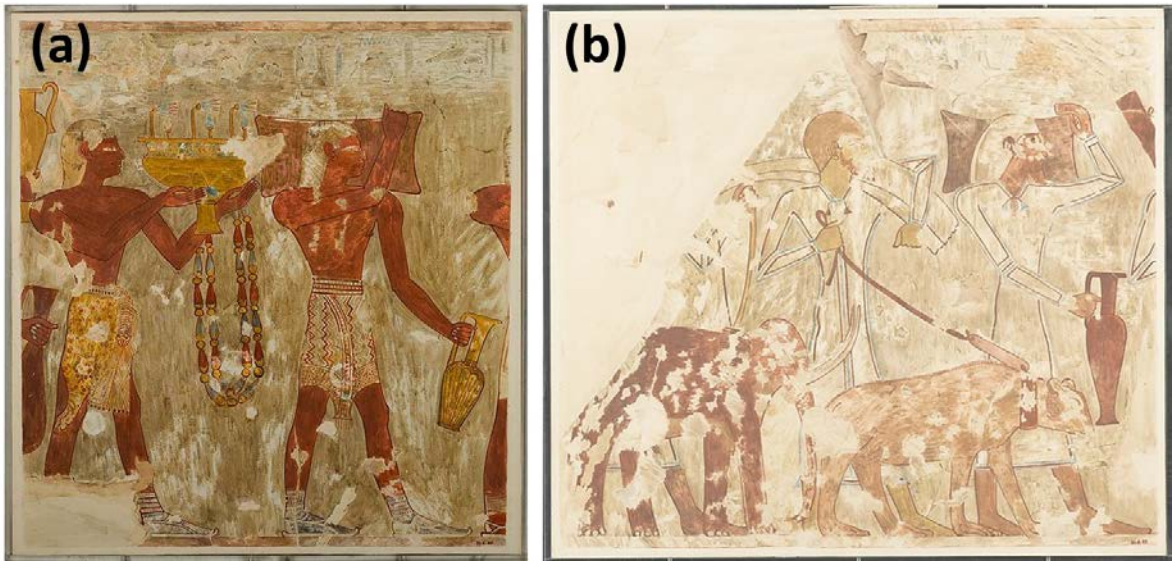

Fig. 3

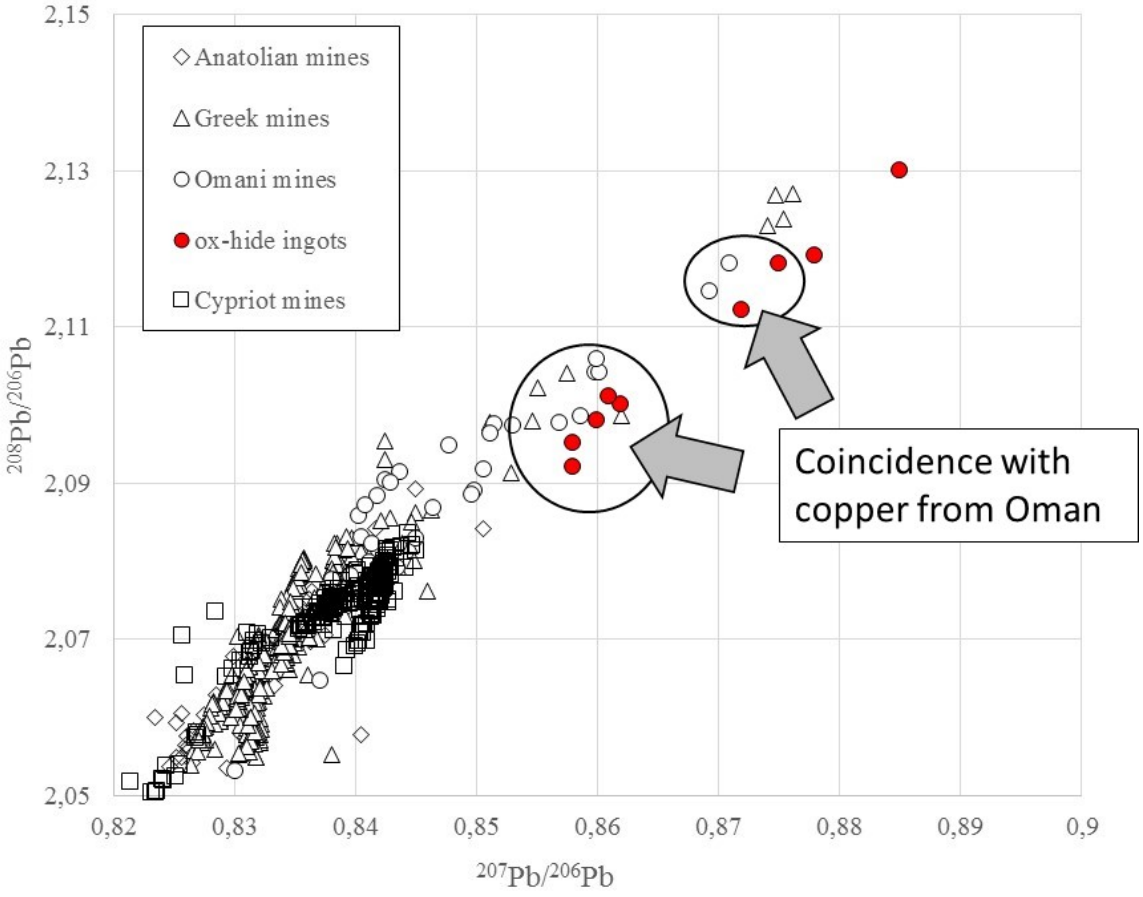
Anatolian mines
Greek mines
Omani mines
ox-hide ingots
Cypriot mines
Coincidence with copper from Oman
2,15
2,13
2,11
2,09
2,07
2,05
208Pb/206Pb
0,82
0,83
0,84
0,85
0,86
0,87
0,88
0,89
0,9
207Pb/206Pb

Fig. 4

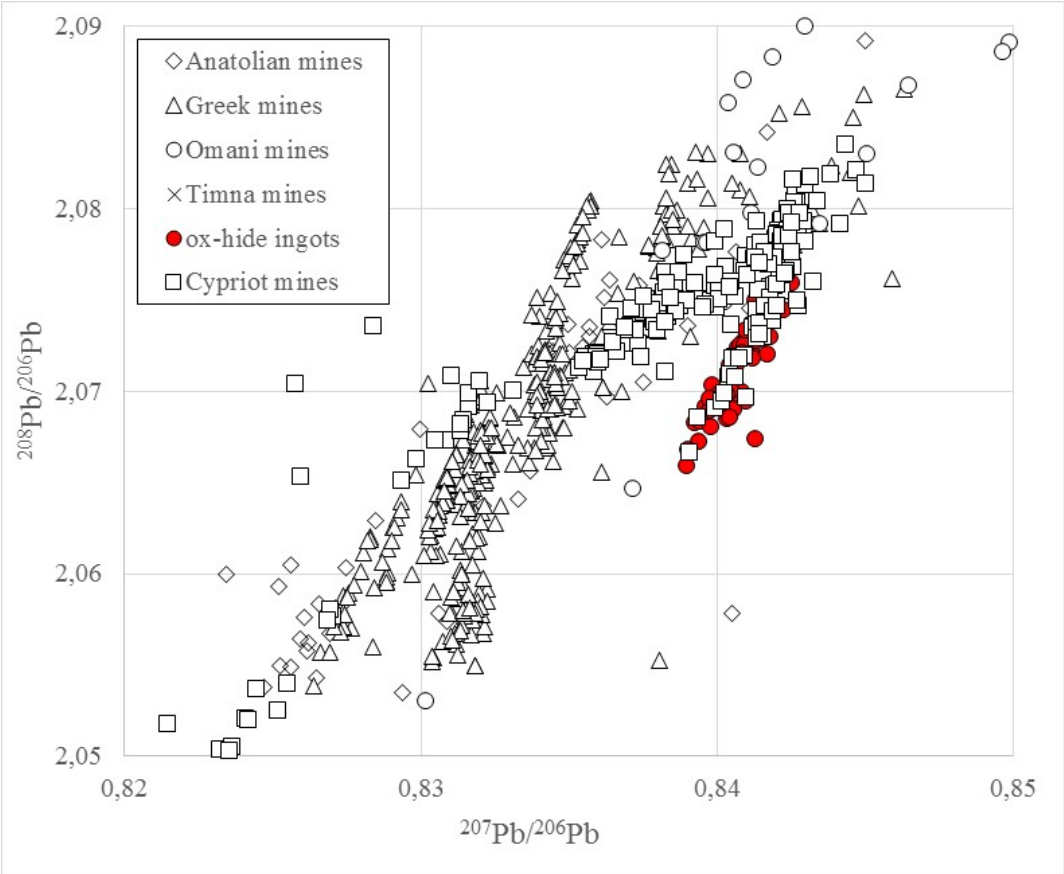
2,09
2,08
2,07
2,06
2,05
0,82
0,83
0,84
0,85
208Pb/206Pb
207Pb/206Pb
Anatolian mines
Greek mines
Omani mines
Timna mines
ox-hide ingots
Cypriot mines

Fig. 5

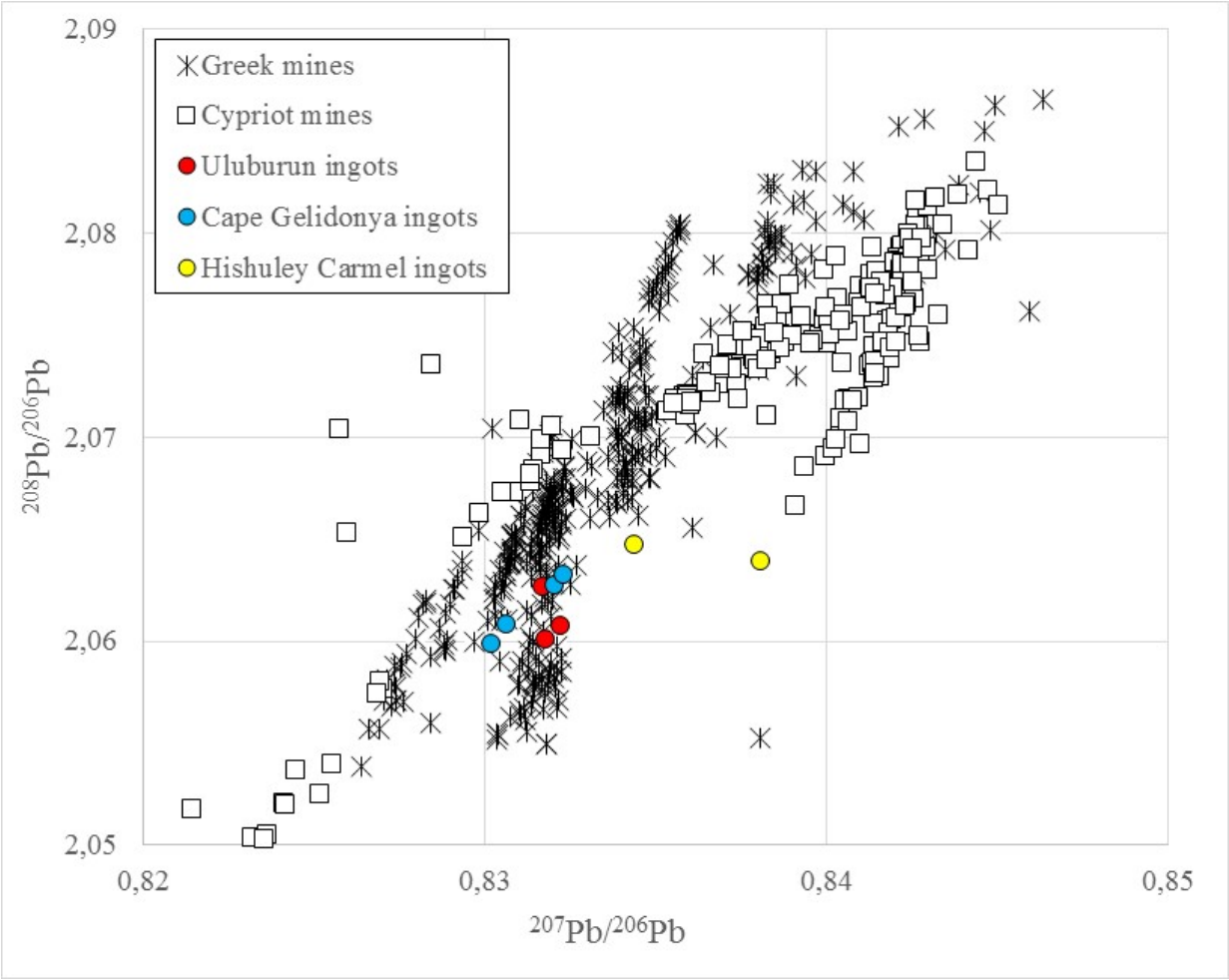
Greek mines
Cypriot mines
Uluburun ingots
Cape Gelidonya ingots
Hishuley Carmel ingots
2,09
2,08
2,07
2,06
2,05
208Pb/206Pb
0,82
0,83
0,84
0,85
207Pb/206Pb

Fig. 6