GREEK LEAD
Ingots from a Shipwreck Raise Questions about Metal Trade in Classical Times

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Metals and metallurgy are of great interest to archaeologists, and much has been written in these pages and elsewhere recently about copper, tin, and gold. The question of the time and place of the origin of bronze has sent archaeologists stalking the elusive tin and documenting better-known copper sources. Gold has always been held in awe—treasures from the tomb of Tutankhamen recently exhibited in the United States and Canada exemplify man’s fascination with it. Silver has taken fourth place, perhaps because of its limited technical uses, although no one would deny its great intrinsic value nor its usefulness for coinage.

But mention the word lead, and you are met with polite amusement, this despite the facts that lead has been in use since the 4th millennium B.C., lead sources were widely known, it is relatively simple to mine, and had a broad range of uses in antiquity. The problem with lead is that for 20th century folk it is not exotic. We may speak of a Bronze Age culture, or the golden or silver ages of Latin literature, but the only metaphorical use of lead that comes to mind is the proverbial lead balloon.

But if there is glamor to gold and mystery to tin, there is a feature of lead which appeals to the detective in students of ancient metallurgy: it leaves fingerprints. Lead has four stable isotopes, designated as Pb²⁰⁴, Pb²⁰⁶, Pb²⁰⁷, and Pb²⁰⁸. In any given sample of lead, the proportion of these isotopes can be determined by mass spectrometry and varies depending on the geographical source of the lead. In this respect, lead differs from other metals. The isotope composition, which is generally expressed as a ratio, in a sample of lead ore from a particular geographical area is different from the isotopic composition of a lead ore from another area. Consequently, if the isotopic composition (the “fingerprint”) of a lead artifact can be determined and can be compared with the fingerprint of an ore sample, some knowledge can be gained about the possible sources of lead exploited in antiquity.

One of the advantages to this kind of analysis is that it requires a very small sample which need not be a pure metal. Another is that isotopic composition of a sample is not affected by its chemical history; in other words, smelting, melting, casting, and corrosion do not change the isotopic composition. Limitations, however, include the possibility that leads from different sources could be and were melted together and reused, resulting in isotope ratios somewhere between those of the original metals. Another limitation is that each lead source does not necessarily have a unique isotope make-up. Some leads from far distant sources are very similar. As a result, in some instances we can determine only where a lead sample did not originate. But as the body of data grows and improved accuracy in testing methods is coupled with chemical determinations, this last problem seems to diminish.

The most prominent lead sources are in naturally occurring galena ores (lead sulfide), which are very common. Most galenas are silver-bearing, and although the proportion of silver to lead is generally so low as to be expressed in ounces of silver per ton of lead, in antiquity galena was worked primarily for silver, lead being a by-product. Lead was so mundane a commodity in antiquity and so few writers ever bothered to mention it that we are hard pressed to gain much insight into lead mining from the texts. But this cloud has its silver lining. Because lead and silver were recovered from common ores, what we know from ancient writers about the location and exploitation of silver mines can be extended to lead mining. Silver was more widely used for coinage in antiquity than any other metal,
and it was a subject of considerable interest to ancient writers. The study of lead—its sources and commerce in antiquity—has enjoyed some popularity in the past twenty years. It received its impetus from Robert H. Brill at the Corning Museum of Glass, who became interested in sources of lead found in lead-containing ancient glasses and glazes. The success of Brill's work attracted the attention of others, and scientists and archaeologists are now joining forces to study lead found in silver, gold, and bronze coins, bronze statues and implements, white lead pigments and kohl. At the same time, ores from mines, leads from ancient ingots, and lead objects from closely dated archaeological contexts have been sampled, and a large body of data is now available as a basis for further study. The earliest work of Brill and his colleagues identified isotopic ratios for leads from Laurion in Attica (Group 1), southern Spain (Group 5), and Roman Britain (Group E). More recently, studies at the Max Planck Institute for Nuclear Physics in Heidelberg and at Oxford University have given us data which help to distinguish leads from Laurion, Thassos, and Siphnos, three important sources of lead and silver for Classical Greece. I became interested in lead studies when I began examining material excavated by a University Museum team from a shipwreck found near the village of Porticello in southern Italy. The ship was carrying a mixed cargo of wine, salt fish, monumental bronze sculpture, ink, and lead in ingot form. Although the site was discovered and heavily plundered by local treasure hunters before archaeologists learned of its existence, enough remained of the cargo and some of the vessel's fittings to add to our knowledge of maritime trade around the year 400 B.C., when the ship sank. She was carrying something twenty or more lead ingots, and all but two of these were sold by the looters for scrap. Other lead items recovered included pieces of lead sheeting used to protect the outer hull of the vessel.

1. Lead and silver mine

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1. A whole lead ingot, believed to have come from the Porticello shipwreck and confiscated by Roman authorities. The ingot was in a secondary deposit, and its presence in the shipwreck is evidence of the widespread use of lead in Roman antiquity.

2. A partial lead ingot recovered by archaeologists from the cargo area of the Porticello shipwreck. Length 27 cm.

3. Lead isotope diagram of ores and slags from the Aegean region. Well-defined fields are Laurion and Siphnos.

4. A cross-section of the Porticello shipwreck, showing the arrangement of the cargo and the position of the lead ingots.
Two pieces of lead sheeting from the shipwreck’s hull. These provide the earliest evidence of this practice on vessels built in the Mediterranean, which is widely documented in Roman times. Strips of lead were attached to the hull by small nails or tenons. On the left piece (1.31 cm) wall holes are preserved; on the right (1.23 cm) the concreted nail heads are still visible.

Isolated remains for leads from the Porticello site are still visible.

name of a person, mine, or other establishment associated with the production of the final products at Laurion, the weight or price of the ingot, the sign of the metronomos authenticating the ingot’s weight, or the stamp of a merchant involved in the lead trade.

If the letters in the stamp represent arithmophonic numerals, they might stand for 101 stater (although, actually, if this is what the sign is supposed to mean it would probably have taken a different form). Now a stater was both a weight standard and a coin used in the 5th century; if the sign signifies the ingot’s weight, the ingot should weigh 92.475 grams, and actually it weights only 25.750 g.

Leaving aside the question of the stamp momentarily, if we apply the other weight standard employed in that period, in which 4,000 weight drachmas equal one weight talent, we have a talent weighing 28,190 g. This figure is so close to our ingot’s weight that there is a strong possibility that our ingot was deliberately cast to weigh a talent. If we accept this premise, then the stamp cannot represent the ingot’s price of 101 coin staters, because lead was much cheaper at this time. Building records for the Erechtheum on the Acropolis (IG I 374) show that lead sold for about 3 drachmas per talent.

If not weight nor price, the stamp can only then signify a name or names of miners or people involved in the industry. We know many such names for Laurion from Laurion mine leases. But the leases all date to the middle or second half of the 4th century, and it would be foolish to seek a correlation between the names in the inscriptions and the letters on the ingot.

The fact that the letters are in a ligature suggests that the stamp’s owner was heavily involved in lead mining or trading.

A final word about the ingot’s weight. Literary and epigraphical references to lead usually indicate that it was sold by the talent. However, in the accounts for the manufacture of bronze cult statues for the Hefaistosion in the Athenian Agora (IG II 370/371), lead is listed as having been bought by the krateia, which is generally believed to be a pig or ingot of a certain size. Unfortunately, we do not know the size, and the price of the krateia in the Hefaistosion inscription is not preserved to give us a clue. Is the Porticello ingot one of these?

We know from ancient texts that several sources of silver and lead were exploited in the 5th century: Chersonesus alone mentions Laurion (VII 144), Siphnos (III 57), Lake Parnassus (V 17), Mt. Pangaeon (VII 112), and Thrace (V 23). Of these, only the mines at Laurion are well known. But archaeological investigations of mining regions and isotopic and chemical studies of silver ore, lead objects, and area and slag are greatly clarifying the picture of mining exploitation in the Aegean. We are less fortunate, however, for sources in the West. In Roman times, lead and silver were obtained in large amounts from mines in Spain, Sicily, and Italy, according to archaeological and textual indications. Phoenicians were working Spanish mines near Rota and Cartagena from the 8th century B.C. If not earlier, and Brill’s isotopic studies now show that mines at Campiglia Marittima in central Italy might have been the source of lead which has been recovered at sites in Sicily and Italy in 7th and 6th century contexts. But many questions remain to be answered. Did
sounding leads and scarpers are also documented. Ordinary too soft for weapons, it was, however, used for making bullets, perhaps because it was readily available, cheap, and easy to fashion. By itself, lead was used occasionally for lamps, pots, cinerary urns and sarcophagi, and statuettes, but it was also useful when alloyed with other metals, particularly bronze, to improve fusibility and malleability and to lower its melting point; it was also employed as a soldering metal.

Traces of lead occur in silver and electrum, and occasionally lead was added intentionally to debase coinage. More legitimately, lead was widely used for seals, stamps, tokens and tickets and for admission to theatre or festival performances. White lead and lead red were important coloring agents, and lead also had medical uses, not only as medications, but also in some surgical instruments.

Finding it useful as a weight or as a core for fine bronze counter-balances.

What can be learned from tests on such objects includes not only information about commerce in lead, but also about exploitation of lead and silver mines in antiquity and the ever-changing availability of silver for coin. Though lacking in glamour, lead holds secrets which reflect the fortunes of silver.

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Bibliography


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