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Pre-Roman Mining Activities in the El Molar-Bellmunt-Falset District (Tarragonia, Spain): Indirect Proofs Based on Lead Isotopes Analysis

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Abstract

The Molar-Bellmunt-Falset (MBF) mining district was an important source of lead and silver from medieval times to the 20th century, as many historical documents show. Pre-Roman operations have not been documented in the area, but a few fragments of Roman pottery were recovered during 20th century mining. Two field surveys did not provide any evidence of ancient exploitation. However, some evidence of lead metallurgy has been documented at some prehistoric sites within the region.

This study is based on lead (Pb) isotope analysis (LIA) and tries to identify the provenance of archaeological items prior to the Roman conquest of the region. Early Iron Age occupation horizons show that MBF mineral resources were exploited for their metals. We also try to investigate if archaeological material from other parts of the Iberian Peninsula could be related to the MBF district to infer the patterns of trade.

Introduction

The Molar-Bellmunt-Falset (MBF) mining district has been an important source of lead and silver from medieval times on. The discovery of Phoenician artifacts in the lower Ebro basin has suggested the existence of a Phoenician trade network in the area. It has been widely supposed, but never proven, that silver was one of the most important resources that motivated Phoenician interests. In the MBF area mining operations prior to medieval times have not been documented except for a few fragments of late Roman pottery, but some prehistoric sites in the
region show evidence of lead metallurgy. The low silver content of galenas from the MBF area casts doubt on whether argentiferous galena was the main incentive for the Phoenician ‘colonization’ and raises the possibility of galena being mined, not for silver, but for lead.

The lead isotope analyses (LIA) tries to identify the provenance of pre-Roman lead from this region. Lead isotopes of artefacts from other areas of the Iberian Peninsula suggested that their metal came from the MBF mining district, so patterns of lead trade can be proposed.

Methodology

The bulk chemical compositions of the assemblage was analysed by energy dispersive X-ray florescence (ED-XRF) using a Spectro Metorex X-MET 920 at the Archaeological National Museum. The results permitted sampling of metallurgical sub-products with higher metal contents, which were then mounted in resin and polished to 0.25 µm for studies using the scanning electron microscopy with energy dispersive spectrometry (SEM-EDS). This was done using a Philips XL30 with an EDAX DX4i microanalyser at the Autonomous University of Madrid. To establish provenance LIA was done on both geological and archaeological samples using a Finnigan Mat 262 thermal ionization mass spectrometer (TIMS) belonging to the Geochronology and Isotopic Geochemical Service of the UPV-EHU (University of the Basque Country). Lead standards used were NBS-981 or SRM-981. In addition certified reference materials from the National Institute of Standards and Technology (NIST) was used to monitor the reliability of the analyses (Santos Zalduegui et al., 2004).

The MBF Mining Region

The Catalanian Coastal Ranges consist of Hercynian basement rocks and Mesozoic to Cenozoic cover sequences. Enclosed within the Paleozoic rocks are mineralized veins (Pb, Zn, Ag and Cu) that locally cut across lower Triassic strata. Pb and Pb-Zn-rich veins with gangue, predominantly carbonates, are enclosed exclusively within the Hercynian basement (Canals & Cardellach, 1997). Surface veins were found mainly in the Molar area. Geological data indicated the occurrence of silver and lead minerals, but bearing in mind that the exploitative technology available in antiquity to obtain silver from galena was differed from today, it was necessary to measure silver levels in those minerals to evaluate whether those minerals could have represented silver sources in antiquity. Two field surveys were carried out in 2005 and 2008 to collect mineral samples.

Mining in the area has been intense during historical periods. It is been mentioned in medieval and modern documents (Abella et al., 2001; Martinez Elcacho, 2004) and was recognized in the field. We did not have specific dating, but some pre-industrial evidence and structures could be identified. Prehistoric or ancient mining works were not documented because the
landscape has been greatly altered by more recent anthropogenic operations. However, it was easy to collect samples for further analyses.

During the Late Bronze Age/First Iron Age, territorial control of the MBF mining district is documented around two main (Calvari del Molar and Puig Roig). Those sites are located close to the ore deposits with visual control over them, although Calvari seems to have played a leading role in the control and management of the mines. The network of settlements that controlled the mining production during the Early Iron Age suffered a crisis in the 6th century BC since the sites of Calvari and Puig Roig were abandoned, although mining in the MBF district continued into the 3rd century BC (Rafel et al. 2008).

Analytical Data

Geological and archaeological galena samples analysed by XRF show low silver levels, 260 ppm being the average of the 49 samples studied. They do not have enough silver contents to have been exploited for silver in antiquity (ca. 400 ppm would be necessary; Tylecote, 1987). This implies that they have been used not for silver but for lead production. Moreover, some lead slags and other lead sub-products have been documented at El Calvari (Gener et al., 2007), these being the only evidence of metallurgy on the site so far. Silver sub-products have not yet been recovered at El Calvari.

Our objective was to confirm the use of local lead resources suggested by the proximity of the ore deposits to the sites (the modern Linda Mariquita mine is located less than 1 km from El Calvari). The LIA study confirmed the concordance between the archaeological and geological samples. Archaeological galenas as well as the slags and metallic lead are grouped in the same isotopic region as the geological galena samples (Montero-Ruiz et al., 2008; 2009) and, what is more important, all archaeological samples (galena, lead slag and metallic lead) coincide with the surface veins samples (Fig. 1). In addition, there is no full overlapping with other isotopic regions. Some ores from the Linares district and Sardinia are close to the MBF ratios, but they can be distinguished combining some graphics. Thus, the provenance of the archaeological materials investigated can be reliability assumed despite the absence of field evidence for prehistoric mining (Montero et al., 2008).

Ore bodies in eastern Iberia have been assumed to be the source of the silver and lead found in southwest Iberia. The ore provenance has been traditionally associated with the Cartagena and Linares mining districts. However, this study suggests that the Molar-Bellmunt mining area could have been another lead supplying area, as some of items from the SW published by Hunt (2003) coincided with the isotopic region of the MBF (Fig. 2).
Fig. 1: Pb-Pb data of lead artefacts from El Calvari, Empúries and Castellet de Banyoles (dark symbols) which correlate with ores from the MBF mining area (open circles).
Fig. 2. Pb-Pb data of artefacts from the South West of Iberia that correlate with ores from the MBF mining area.
Conclusions

This study confirmed the importance of the MBF mining district in metallurgy during the early phases of Phoenician colonization. It lost its importance at the end of 3rd century BC in favour of other mining areas such as the SE of Iberia. We conclude that:

1. Archaeological samples of galena and lead artefacts from El Calvari (8th BC-6th BC), Emporion (5th BC-3rd BC) and Castellet Banyoles-Tivissa (3rd BC) have demonstrated exploitation of ores from the MBF mining district from the 8th century BC to the 3rd century BC. Archaeological lead from other Catalonian sites and dated in the 2nd and 1st century BC shows a different Pb isotopic signature and thus provenance.

2. Archaeological data show that galena exploitation during the first millennium BC was linked to lead production. Its use for silver was not suitable in antiquity due to its low silver levels.

3. Galena or lead from the MBF mining district had a broader distribution than previously though, being a source of supply for the SW of Iberia at least during the Phoenician period.

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