PHOENICIAN TRADE OF RAW MATERIALS AND CHANGES IN METAL PRODUCTION PATTERNS IN SW IBERIA DURING THE ORIENTALIZING PERIOD

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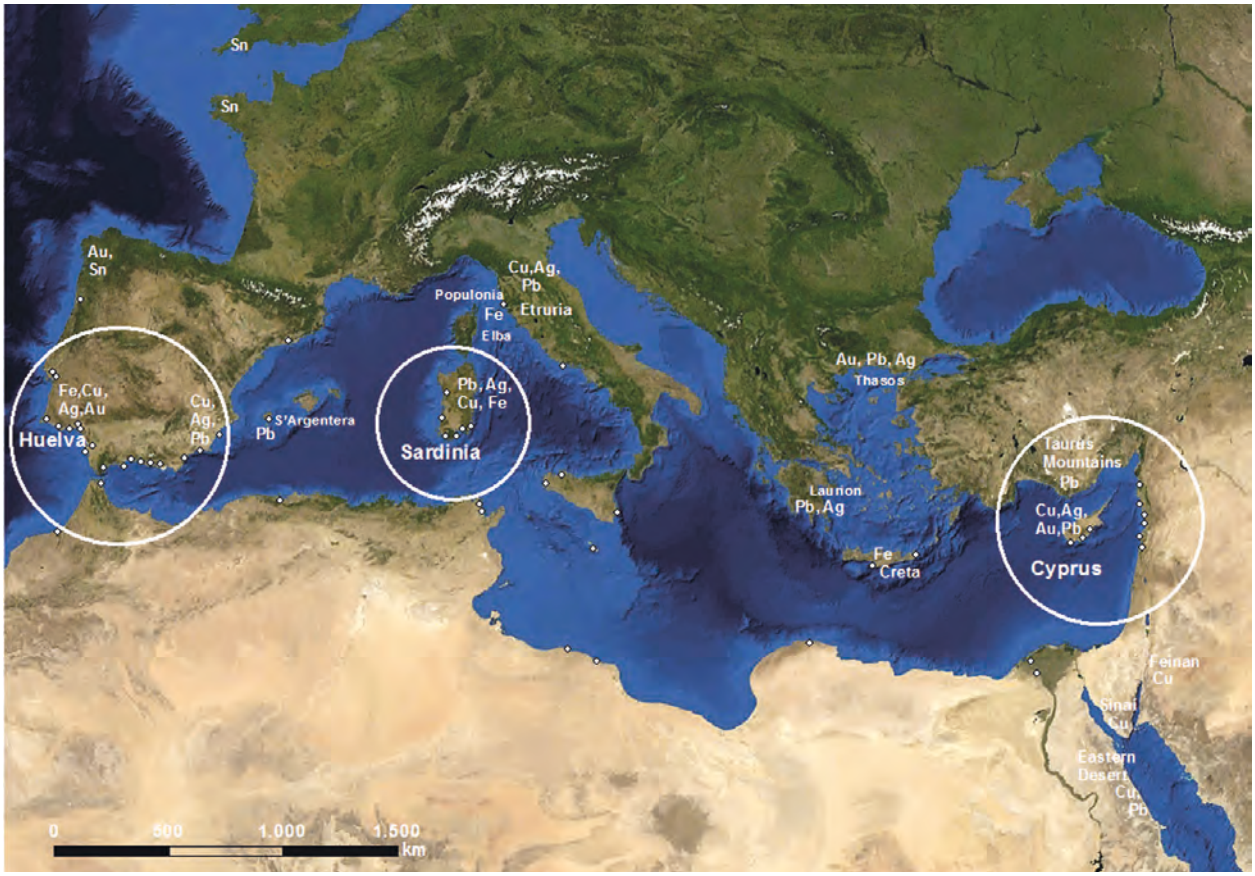
In the southwest of the Iberian Peninsula resides one of the largest concentrations of massive sulfides in the earth's surface (Tornos, 2008, p.13), the Iberian Pyrite Belt. It began to be mined more than 5000 years ago as confirmed in the analysis of ^{14}C AMS in the earliest copper production site known until now as Cabezo Juré (Nocete, et al., 2011, p.3281) and as shown in the analysis of metal contamination in post-Flandrian sediments deposited at the bottom of the marsh of Doñana (Carretero, et al., 2011, pp.1215-1223). There is also abundant archaeometallurgical evidence suggesting that mining continued even after the Orientalizing and Roman Periods, principally for copper, gold and silver from the gossan caps and underlying supergene enrichment zones of exposed ore bodies (Rothenberg and Blanco, 1981; Salkield, 1987; Pérez Macias, 1996). And the archaeological record leaves no doubt that the metallurgical richness of this area was what attracted the attention of traders around the Mediterranean, especially the Phoenicians in the middle of the first millennium BC. (González de Canales, et al., 2004).

Contextual and geographical framework

Between the 9th - 6th centuries BC the Phoenicians established themselves around the Mediterranean and parts of the Atlantic (see Fig. 1), especially in regions

Fig. 1: Distribution map of the network of Phoenician settlements throughout the Mediterranean between 900-600 BC, usually situated in relation to the proximity of important saline and metalliferous resources such as gold, silver, copper, lead and iron (adoption of Gras, M., Rouillard, P., Teixidor, J., 1995, pp.124-125)



with abundant mineral resources (Gras, et al., 1995, p.126), as it has been documented archaeologically in Cyprus (Karageorghis, 2005), Sardinia (Bartoloni, 2009) and southwest of the Iberian Peninsula (Rothenberg and Blanco, 1981). The search for silver was in this sense one of the main objectives of the Phoenicians and in the ancient East the precious metal was well known and was the basis of commercial transactions (Balmuth, 1975, p.294). In the context of the southwestern Iberian Peninsula the extraction of mineral resources and the mechanisms of metal production were probably in the hands of local indigenous societies (Rothenberg and Blanco, 1981, p.172). Without doubt a part of the production, which came mostly from the mines of Andévalo, would have been smelted by Phoenicians themselves in the port center of Huelva.

From a commercial perspective silver would be obtained by the Phoenicians in the two main Ports of Trade (as defined here Polanyi, 1963, p.30) which were then Huelva and Cadiz. The port of Huelva was very important because most of the mining sites are located in the basins of the rivers Tinto and Odiel, which formed its estuary. Also the location on an island like Cadiz compared to a mainland provided direct access to raw materials for the Phoenicians, where all routes would converge. Here two different procedures can be identified through which the Phoenicians acquired silver, the first corresponding to a trade between elites, i.e. between the leaderships of the indigenous and Phoenician wealthy merchants through the established practice of exchanging gifts, according to the idea that can be deduced from the richness of the goods deposited in the princely tomb N ° 17 of La Joya (Garrido and Orta, 1978, pp.63-124; Láms. XXXIV a XXXXVIII). They are suspected to be goods obtained from Phoenician traders, as is documented also in the tomb 79 of Salamis in Cyprus (Karageorghis, 1973, pp.4-122). On the other hand, as a second procedure, commerce through regular exchange of trade centers where the Phoenicians were collecting silver pieces that were cut and measured out through a weight system (González de Canales, et al., 2004, pp.154-155).

The trade relations between Phoenicians and the indigenous in the area of Huelva, around the end of the 9th century BC will bring not only a process of stratification in society, where the process of production and consumption of metals and luxury items promote the development and consolidation of indigenous elites, but also entail a real hierarchy of settlements and infrastructure. We can glimpse the different patterns of existing settlements with mining centers, or mining and metallurgical centers, or strictly metallurgical and metal export centers (Ruiz Mata, 1989). This new production and population structure, the regional and inter-regional trade routes have been evaluated and shown through spatial analysis with GIS (see Fig. 3 and Fig. 4).

Distribution and type of mining

According to recent studies and analysis of the contamination of heavy metals on the Rio Tinto, we know that the exploitation of minerals and metals in Huelva dates back to the 3rd millennium for copper and to the end of the 2nd millennium for silver (Carretero, et al., 2011, pp.1215-1223).

Copper mining in the Late Bronze Age was directed primarily to exploit both copper carbonates at the surface of polymetallic sulfide deposits and small seams of copper sulfides in the southwest of the Iberian Peninsula (Pérez Macias, 2013, pp.458-459). Secondary copper mineralization may occur in association to massive sulfide deposits, where copper carbonates exist at the surface (Pérez Macias, 2008b, p.19). For their part seams usually occur abroad in oxidized outcrops where copper minerals are associated with quartz veins (Pérez Macias and Rivera, 2012, p.493). The mining technique to mine copper was by trenches, in which the extraction in the case of the seams was adapted to the structure of the mineral veins (Pérez Macias, 2008b, p.33). Although to carry out this work, as is well observed in the archaeological record of the Southwest, primarily grooved stone hammers were used (Hunt, 2003, p.282) other places such as Masegoso show different mining traces. Here a trench mine of irregular form excavated in hard rock and with tool marks has been documented, suggesting the use of iron chisels (Rothenberg and Blanco, 1981, p.49). Usually copper minerals were smelted by the reduction technique of crucibles, which explains the low presence of slag in copper production sites from the Southwest (Perez, et al., 2002, p.65).

During the Orientalizing period silver workings of the jarosite mineralization were widespread present in the gossan cap derived from the oxidation of pyrite and therefore in the surface area of large massive sulfide deposits, consisting in an open pit mining-type of extensive character and a bit intrusive (see Fig. 2). The best examples were found in Riotinto. The most interesting part was between 2-20 meters below the topographic surface (Amoros, et al., 1981, p.206), although jarosite occurs also between 50-70 meters with high lead content, plumbojarosite. These deeper deposits were impossible to mine from

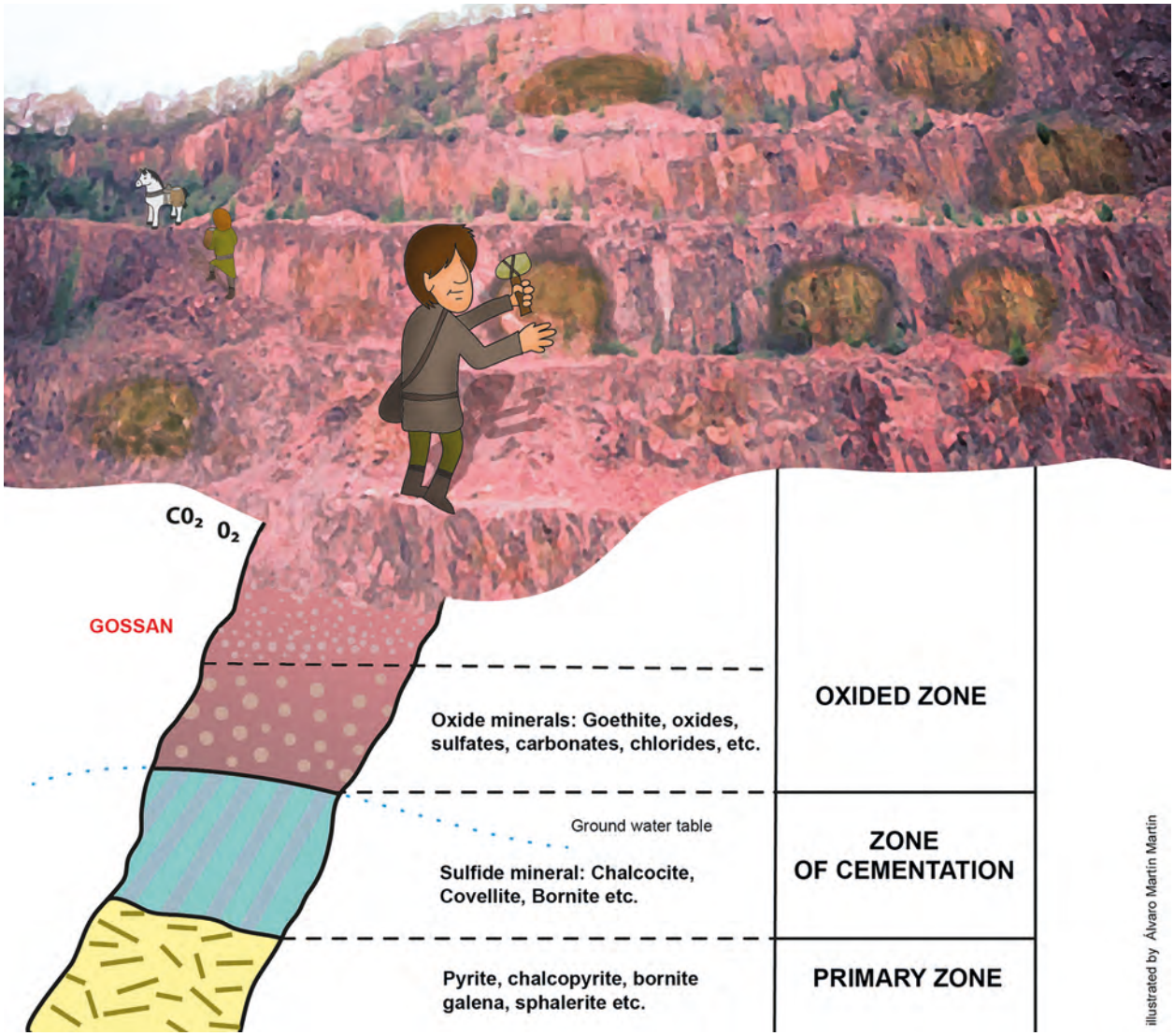


Fig. 2: Above: Ideal scenery of gossaned landscape, with abundant jarosite, the main carrier of silver and a surface extraction model. Below: Schematic representation of an oxidation profile and supergene enrichment of a sulfide deposit (adoption of Hauptmann, 2007, p.118; López García, 1991, p.476)

the upper zones of the outcrop.The principle form of exploitation was performed through openings in the sides of the gossan caps (Pérez Macias and Delgado, 2007, p.290). Usually jarosite was extracted directly by using grooved stone hammers following the mineral veins and also by more complex actions. Either by mining works like an irregular shaft that has been documented as such at the foot of a hill nearby of Quebrantahuesos (Rothenberg and Blanco, 1981, p.100) or galleries opened in the side from the slopes to benefit the jarosite mineralizations, as mentioned earlier and documented for Corta del Lago (Pérez Macias, 1996, pp.97-100). According to Felix García Palomero the volume of holdings obtained through the slag tonnages, that can be dated to the Iron Age and Roman periods, is estimated about 6-8 million tons. These were located between the zones of Filón Norte and Filón Sur (García Palomero, 1992, p.1343). These large volumes correspond to an industrial stage and it´s about a concept of exploitation in a regional context that implies profound socio-economic and environmental transformations connected to a large demand for raw materials and products (as shown in the model defined by Stöllner, 2003, p.431).

Landscape transformation between the Late Bronze Age and the Orientalizing Period

During the Late Bronze Age the splendor known as the extractive seams mining and metallurgical production intensive of copper took place (Pérez Macias, 2008b, pp.9-36; Pérez Macias, 2012, pp.491-516; Pérez Macias, 2013, pp.457-460). They have documented a

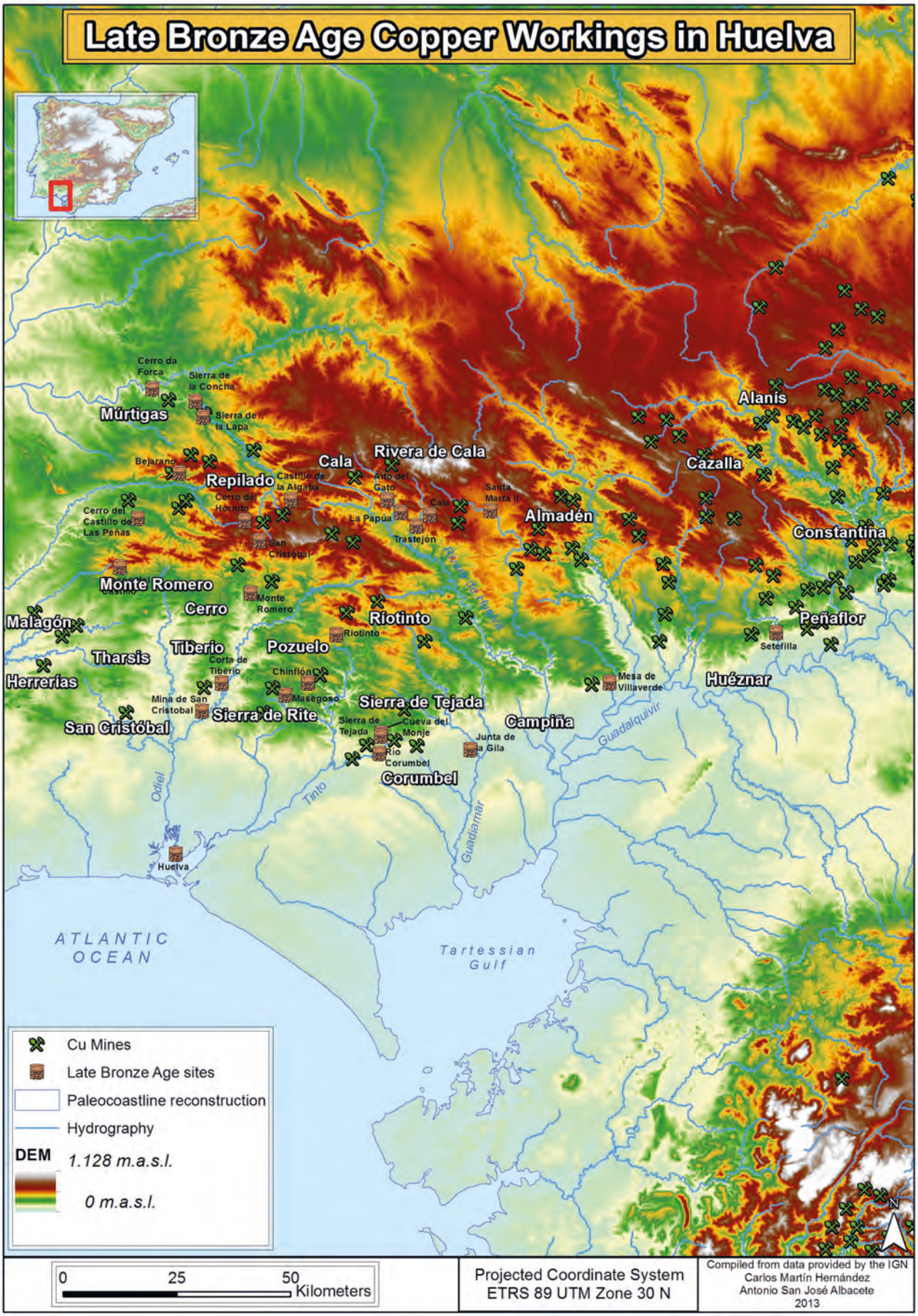


Fig. 3: Map of archaeological sites related to mining and production of copper in the southwest of the Iberian Peninsula during the Late Bronze Age (adoption of Pérez Macias, 2008b, p.11; reconstruction of the paleocoastline based on the models proposed by Schulz, 1995, p.224; Schulz, 2004, p.228; Rambaud, 1997, p.76; Morales González and Ojeda Zújar, 2011, p.34).

dense network of seasonal camps located mainly in the vicinity of small vein deposits of copper sulfides regarding Late Bronze pottery (Pérez Macias, 2013, p.458). They spread mainly north of the province of Huelva, in the mining area of Andévalo and benefited minerals of an oxidic nature surface copper carbonates of the type of malachite and azurite (Pérez Macias, 2012, p.512). An example for such a settlement is Chinflón, where an abundance of grooved stone hammers, crushers, slag, crucibles and hand-made ceramics, without turning, typical for Southwest Late Bronze Age were documented (Pellicer and Hurtado, 1980). The most tangible archaeological evidence in general are the narrow trenches open on the floor along with the characteristic grooved stone hammers, which contrasts with the little slagged material that until now has been documented, and it´s due to the exploitation and processing majority of pure copper minerals with little gangue content, which had to be disposed of in the reduction process (Rovira, 2011-12, p.108). Treatment of copper minerals was performed for the manufacture of objects of great typological diversity, composed primarily of ternary bronze, i.e. copper, lead and tin (Rovira, 2004, pp.28-35). Another part of surplus production, either through ingots or scrap, must also be integrated into commercial circuits proto-Phoenicians (concept as defined Gómez Toscano, 2012, p.323), that embedded in other regions of the Iberian Peninsula, as evidence for example axes-ingots found in the southeast (González Prats, 1985, pp.97-106). Or even to other places further away from the Eastern Mediterranean as well, either through direct contact or through other intermediaries in the Central Mediterranean, as is confirmed for bronze objects found in Nitovikla and Hala Sultan Tekke on Cyprus, whose isotopic signatures seem consistent with the southwest of the Iberian Peninsula, specifically the first of these with deposits of Monte Romero (Stos-Gale, 2010, p.399).

From the Orientalizing period between the 9th – 6th century BC a change occurred in the settlement pattern strategy, which caused the abandonment of settlements dedicated to the exploitation of copper sulfide seams (see Fig. 3), as has happened with some of the fortified sites located in the Rivera of Huelva, like La Papúa II (Hurtado, et al., 2011, pp.113-137) and Trastejón (García Sanjuán and Hurtado Pérez, 2011, p.160) or other from the Mountain range of Huelva such as San Cristobal, Sierra de la Lapa and Las Peñas (Perez Macias, 2001, p.429). Mining populations are instead concentrated in gossan caps like in Tharsis, Riotinto and Aznalcóllar (Pérez Macias, 2008a, p.252), which contained jarosite mineralization to produce silver (see Fig 4). This produced two immediate effects, on the one hand the increased specialization and diversification of the economy where metal production was alternated with farms and agricultural activities, as was documented for the sites like Peñalosa and Bartolomé de Almonte (García Sanz and Fernández Jurado, 2000, p.83) and on the other hand the consolidation of different commercial circuits of silver and lead minerals supply, which was the cause for important transformations in the mining area itself and changing production structures. Silver production sites were mainly in the mountainous areas in the regions of Andévalo, the Mountain range of Huelva and the Northwest Mountain range of Sevilla, some in close proximity of large deposits and others in the Huelva countryside, where much of the production took place as well. During this time large walled oppida were built, whose extents and fortifications suggests their hierarchical predominance in some cases nearby mineralizations like Castrejones (Hunt, 1995, pp.499-451) and others located in the inner points away from the main mineralization, for example in Niebla and Tejada la Vieja, where the smelting of minerals occurred and acted as redistributors both to the countryside towards the Ports of Trade of Huelva and Cadiz, places that mainly centralized the key exchange flows with the Phoenicians. As for the elements related to the production of silver the main evidence are the free silica slag always connected with silver-lead metallurgy (Rovira and Hunt, 2006, pp.217-222), that always appear in association with Phoenician material (Blanco and Luzón, 1969, p.130; Hunt, 2003).

Phoenician trade as an economic and productive stimulus

The Phoenicians were installing a network of commercial establishments in the Far West and developing generally in peripheral areas and near to the indigenous population centers strategically well placed from the point of view of communication, where the sanctuaries located in port areas had to function as binding links or channels for the smooth functioning of trade (Belén, 2000, pp.57-102). With it a cultural exchange took place from the outside to the inside, i.e. from Phoenician Ports of Trade to the hinterland mining, which involved cultural orientalization and the transfer of technological knowledge to the mining areas. The expansion and intensification of trade relations between Phoenicians and indigenous communities in the area of Huelva, around the end of the 9th century BC, generated on one hand, an indirect

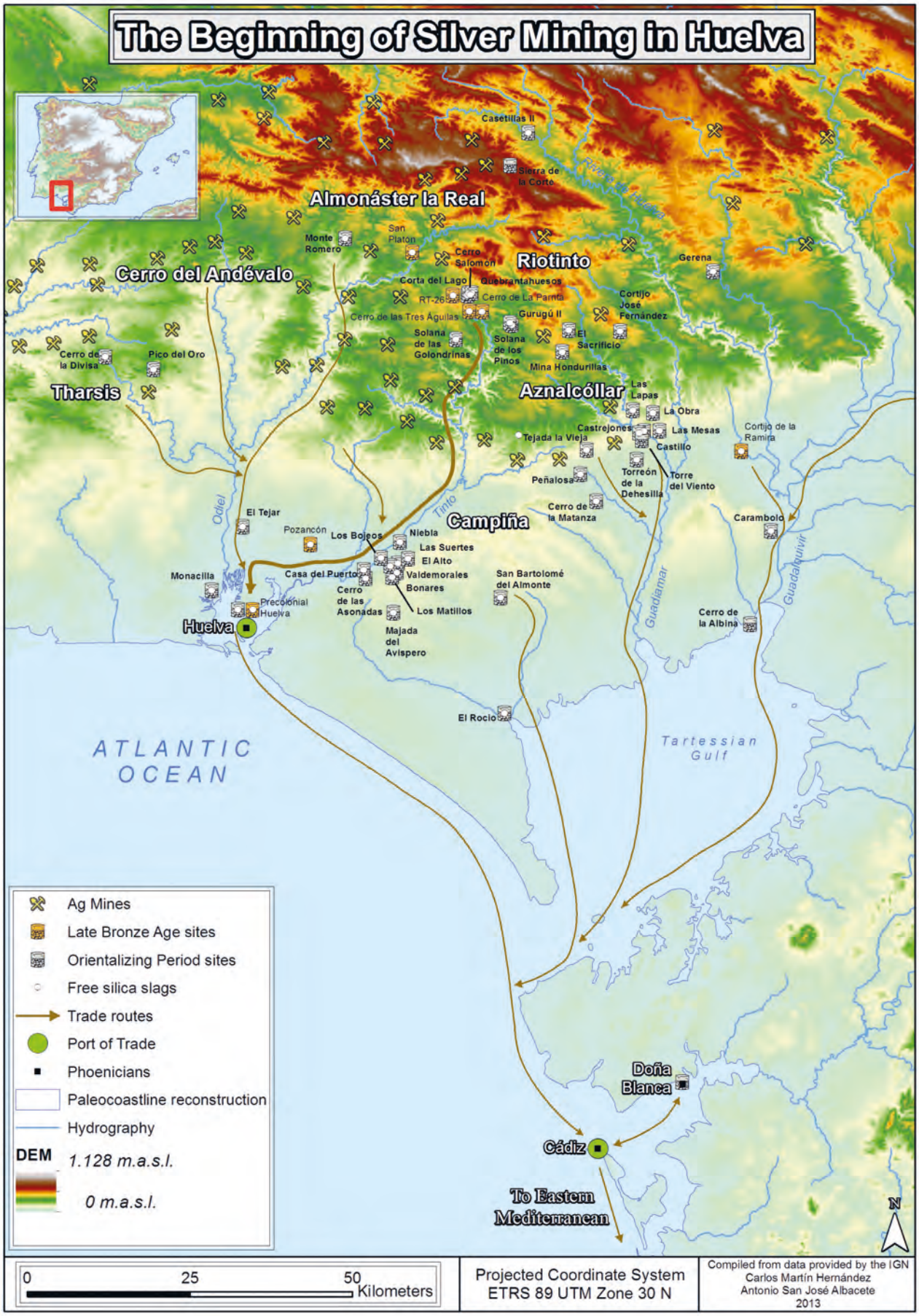


Fig. 4: Map of the mining region of southwest of the Iberian Peninsula where the principal mines and silver-producing sites from the Late Bronze Age and Orientalizing Period are located (adoption of García Alonso, 2010, p.87; reconstruction of the paleocoastline based on the models proposed by Schulz, 1995, p.224; Schulz, 2004, p.228; Rambaud, 1997, p.76; Morales González and Ojeda Zújar, 2011, p.34).

stimulus to the economy, leading to innovation and advancement of local societies to rise to the demand for metals and on the other hand, a direct stimulation to the economy, which lead to a direct intervention of the Phoenicians with secure participation as lead providers a metal essential for obtaining silver through smelting and cupellation and the resulting increase in silver production. This affected the economic dynamism in all aspects and is noticeable in the changes that occur in the hierarchical structure of the settlements.

Conclusion

To conclude, as we have observed, GIS applications are very useful to see how the fluctuations and the nature of trade can be inferred from settlement patterns in the mining hinterland and their strategic location close to the deposits. To deepen the study of the phenomenon of Phoenician colonization, which involves constant mobility of people and goods, the characterization of sites of silver production by lead isotopes will be important in future works, not only to better understand the dynamic trade flows between the different areas producers of lead that were supplying the southwest of Iberia for the silver production, but also to see if the same silver was intended for other regions of the Mediterranean, as it produces a contrast between the absence of silver produced objects that do not correspond to the huge amount of slag that appear in the archaeological record.

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Errata Metalla 20.2 (2013)

Pages 17-21

Change ‘seams’ to ‘lode and/or vein’

Page 21

Paragraph 1. Corrected reference : ... malachite and azurite (Pérez Macias and Rivera Jiménez, 2012, p.512).

Paragraph 2. Corrected reference: ... La Papúa II (Hurtado, et al., 2012, pp.113-137).

Paragraph 2. Corrected reference ... Trastejón (García Sanjuán and Hurtado Pérez, 2012, p.160)...

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Add to references: Pérez Macías, J. A., Rivera, T., and Romero, E., 2002. Crisoles-hornos en el Bronce del suroeste. *Bolskan*, 19, pp.65-73.