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INTEGRATING SCIENTIFIC DATA WITH ARCHAEOLOGICAL THEORY

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## Chapter 11

# Lead and copper mining in Priorat county (Tarragona, Spain): From cooperative exchange networks to colonial trade (2600–500 BC)

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### Introduction

Research into the role of mining and metallurgy in ancient societies has attracted considerable attention and has been approached from diverse interpretative perspectives. Some authors attribute an essential role to metal in the socioeconomic development of prehistoric communities and, more specifically, to its control by elites (see for example, Kristiansen 1987; Pare 2000; Vandkilde 2010). Others tend to relativise its importance in the creation and maintenance of power (Kuijpers 2012; Stöllner 2012). Along the same lines as other authors who have tackled this question (for a summary see O'Brien 2015, 290–98), we suggest that these perspectives are not mutually exclusive. Only a detailed study of each individual case can lead us to models based not only on prior theoretical positions, but also on interpretations that take into account both the theoretical frameworks and, above all, their particular empirical grounds.

A research programme begun in the year 2000 in the mining basins of Priorat county (Tarragona, Spain) is providing abundant data on prehistoric exploitations. These show a general scenario of their nature within the framework of the socioeconomic developments in the area during different temporal and cultural phases. This picture reveals very different situations depending on the phases, allowing us to suggest two very different management models for the area's metal-mineral resources. The evidence we present here shows how the economic appreciation of mining and its relationship with the ruling elites present very different panoramas, depending on the chronological and social contexts.

### The mining basins studied

Although the northeast of the Iberian Peninsula is not an area with major metal-mineral resources, Priorat county, our

study area, has a relatively high concentration of them. They are spread across the whole county and, for the purposes of this study, we have divided them into two basins: Montsant and Molar-Bellmunt-Falset (hereinafter MBF) (Figure 11.1).

Priorat county is in the Catalan Pre-Coastal Range and acts as a hinge between the Ebro, the flat lands of the Tarragona coast and southern part of the province of Lleida. The morphostructural unit of the Catalànids (made up of the Pre-Coastal and Coastal Mountains) formed during the Palaeozoic and Mesozoic eras. The Palaeozoic basement is from the Carboniferous period with a granitic intrusion that creates a small contact metamorphic aureole which has been revealed by the erosion of the Mesozoic cover. The county's mineral veins are found in this Palaeozoic basement.

The point where the Catalan Pre-Coastal Range divides into two marks the northern edge of the Montsant mining basin. This basin extends southwards and the greatest concentration of metal-mineral resources is in the Cornudella-Ulldemolins ridge, which originates from the aforementioned separation of the Catalan Pre-Coastal Range. This is also where the Palaeozoic basement outcrops and where the veins, mainly in slate and sandstone, are found. Of the mineralisations recorded in this basin of the Montsant (IGME 1974; Mata 1990), the most important formations are filonian. Outstanding among them are those of lead (Pb) at Cornudella de Montsant and copper (Cu) (mainly as sulphur-bearing minerals) at Cornudella-Alforja. The latter are very extensive and their exploitation is documented in the historical period; they cover the municipal areas of Arbolí and Riudecols, as well as the previously mentioned municipalities of Cornudella and Alforja. They are characterised by mineralisations in veins hosted in the carboniferous slates and here we find the Els Crossos copper mine to which a prehistoric origin (as yet unconfirmed) has been attributed. We also recently discovered La Turquesa

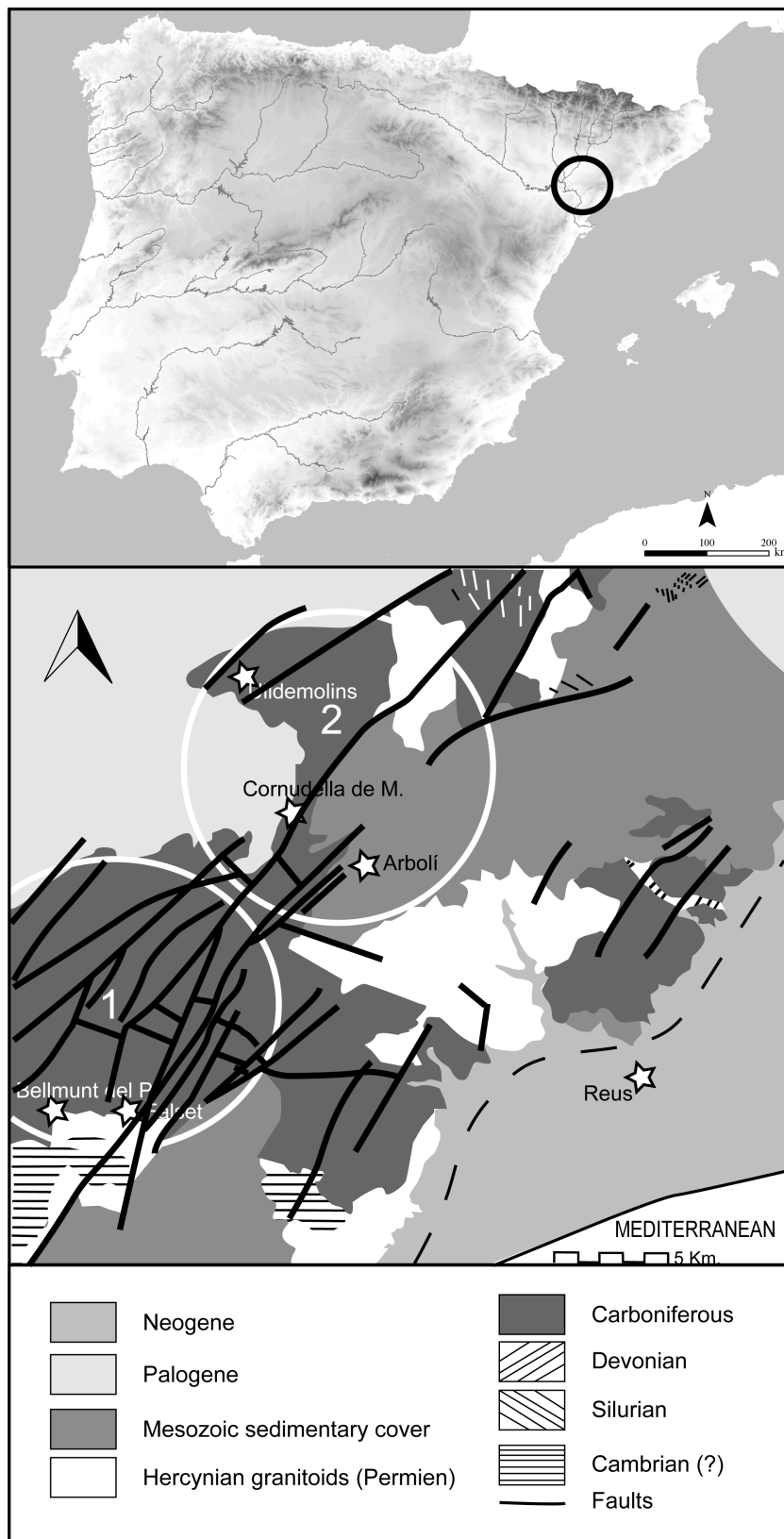


Figure 11.1 The location of Priorat county in the northeastern Iberian Peninsula and a geological map of the study area showing the two main mining basins: 1. MBF; 2. Montsant

or Mas de les Moreres mine here (Soriano *et al.* 2017). In the first area, Cornudella de Montsant, the brecciated veins, also hosted in carboniferous slates, offer the most common minerals of galena, calcite and quartz. This is where we find the Barranc Fondo Mine (Pb-Zn), in which copper (Cu-Fe) is also documented. Mineralisations of volcanic origin are documented in Ulldemolins and the neighbouring municipality of Vilanova de Prades. They consist mainly of galena, chalcopryite and sphalerite, with other minority minerals, among which grey copper is of particular note; mineral alterations such as malachite and the azurite are also documented. The prehistoric mine of La Solana del Bepo and the mines of El Bessó and El Barranc de Sant Joan are located in this area as well.

The Baix Priorat or MBF mining basin is best known for its abundance of lead, which was mined up until the 1970s. The basin also has copper and silver resources, although these are less abundant. The galena has very low concentrations of silver and has historically usually been most appreciated for the purity of its lead. Hosted in the Palaeozoic rocks (slates) are the mineralised veins; they are mainly of lead, but there is also some silver, copper and zinc (Canals and Cardellach 1997). The most important mines of this type are, from west to east, Linda Mariquita, Raimunda, Jalapa, San José Norte and Regia. Aside from their exploitation in prehistory, to which we will refer below, their historical importance has been well documented from the mediaeval Christian era to the 20th century and it is more than likely that they were worked in the Andalusi and Roman eras. For the latter period, we have proposed identifying it with Pliny's *plumbum nigrum oleastrense* (*Naturalis Historia* XXXIV, 49, 164) (Rafel and Armada 2010). Native silver and silver minerals (argentite, chlorargyrite) have been documented (Mata 1990, 128–150; Rafel *et al.* 2003; Abella 2008); they were also extensively mined in the Middle Ages (14th century) by the Count of Prades (Rafel *et al.* 2003; Martínez i Elcacho 2014).

### **The exploitation model in the Late Chalcolithic/Bell-Beaker Period (2600–2300 cal BC) and the Early and Middle Bronze Ages (2300–1300 cal BC)**

From the Late Chalcolithic through the Middle Bronze Age, both the population and the mining were concentrated in the Montsant basin. The earliest exploitations we have been able to document correspond to the period between the Late Chalcolithic (Bell Beaker period) and the Middle Bronze Age. At that time, copper minerals were being extracted at La Turquesa (or Mas de les Moreres) mine; its excavation revealed the mined vein, as well as a small shaft and the remains of other starts. All are modified by

more recent industrial workings (Figure 11.2). This mine also provided an abundant collection of stone mining tools and natural supports for their manufacture (127 items). Most of them are artefacts made with igneous, metamorphic and sedimentary rocks and have a low degree of standardisation and a high degree of use. Only 8% of the items have T-shaped hafts (Soriano *et al.* 2017). As far as their dating is concerned, so far we only have indirect data from lead isotope analyses. A copper awl dated to the Late Chalcolithic–Early Bronze Age and found in the neighbouring L'Heura Cave (Ulldemolins) presents an isotopic signature compatible with that of La Turquesa Mine. Likewise, a reduction vessel from El Buldó Cave and another from Cau del Duc (Montblanc), datable to the Early–Middle Bronze Age, also present an isotopic identification with the same mine (Rafel *et al.* 2017).

A large number of stone mining picks from La Solana del Bepo copper mine have been studied since the 1940s (Vilaseca and Vilaseca 1957; Rafel *et al.* 2016; 2017). Recent excavations (still unpublished) have given us stone utensils for which radiocarbon dating indicates the mine was exploited during the Middle Bronze Age, although we cannot rule out that the site was worked prior to that time. The total assemblage of mining tools now stands at 106, most of which are picks (Figure 11.3). Their manufacture, of local hornfels and granite, involved a high degree of transformation; they were also well-used. The vast majority of the items that preserve their proximal end have a T-shaped hafting device. The lead isotope analysis data, although still preliminary due to the small number of samples analysed, suggest a link between this mine and a riveted dagger found at Cova de la Font Major (L'Espluga del Francolí) (Rafel *et al.* 2017). This dagger has been dated typologically to the beginning of the Middle Bronze Age, coinciding with the radiocarbon dates from the mining. Although, unlike those two mines (Turquesa and Solana del Bepo), we do not have any direct evidence of working, it is possible that El Barranc Fondo mine was also exploited at that time. This is suggested by the correspondence detected in the lead isotope analyses between values for the mine and archaeological metal items dated to those periods (Rafel *et al.* 2017).

Although, as we have already mentioned, the prehistoric mine workings are mainly identified in the Montsant copper veins, we have also documented a Palmela point from El Tossal de les Benes (Rojals) and a lead necklace bead from L'Heura Cave, whose isotopic signatures correspond to the Linda Mariquita mine in the MBF basin. The bead, the only lead bead known to date in the whole of the Iberian Peninsula, corresponds to a type that can be clearly linked to the south of France. These pieces, which are very abundant in that area, are associated above all with Chalcolithic horizons (from Fontbouïsse, but also present in the Ferrières





Figure 11.2 Aerial view of La Turquesa Mine after the excavation had been completed (2015). The arrow indicates the pre-industrial workings

facies), although with continuations into the Early Bronze Age (Rafel *et al.* 2016).

The vast majority of the archaeological sites from this period (Figure 11.4) are known from early excavations carried out in limited methodological conditions. Schematic-abstract style rock art is represented by seventeen archaeological sites that are mainly concentrated in the municipality of Cornudella. They are difficult to date, although we can place them in a chronological range between the Neolithic and the Bronze Age. In consonance with the abundance of evaporitic flint in the county, we have documented 15 archaeological sites of the so-called ‘flint workshop’ type, *i.e.* open air areas where there are no signs of habitat, but abundant remains of knapping and flint utensils that attest the nature of the activities. They are in the Prades Mountains and the Montsant Massif, as well as in the far southeast of the county. Habitat is represented by fourteen archaeological sites, of which eight are in caves and the rest in the open air. Eight burial caves reveal funerary customs based on collective burials. Only in the Late Chalcolithic do we detect – synchronous with use of collective tombs – individual funerary rituals associated with Bell-Beaker materials (Palmela points, tanged daggers, pyramidal buttons with v-shaped perforations). This funerary duality

with two completely contrasting traditions (collective vs individual) is a constant feature during the Late Chalcolithic in the northeastern Iberian Peninsula.

The reassessment of these archaeological sites shows a scenario of communities linked to the territory, but with a certain mobility within their catchment area. They were organised into small groups who lived in caves, rock shelters and open air habitats and they buried their dead collectively, and in some cases individually, in natural caves or paradolmens. The basis of their economy was agricultural and obtaining raw materials was a part-time activity undertaken on a limited scale. They exploited the copper-bearing resources of the Montsant Basin, the rich and abundant veins of flint and, possibly at certain times, the lead and copper of the MBF Basin. Finds of flint from Priorat county at archaeological sites in the province of Lleida (Palomo *et al.* 2012; Esteve *et al.* 2015) tell us of the existence of trade routes, although of limited scope. The current data we have on copper minerals from the Montsant area suggest they were distributed within a radius of about 50 km (Figure 11.5) and that there were also exchange networks between nearby communities. Although no open-air habitat has been excavated to date in the county, the survey data indicate a population structured in villages



Figure 11.3 Picks with a T-shaped haft from La Solana del Bepo mine. 2016 excavation campaign

with simple constructions of perishable materials and little stability, as was the norm in the whole north-east at that time (Rafel *et al.* 2008).

### The irruption of colonial trade and the new exploitation model of the 8th–6th centuries BC

The Late Bronze Age in the northern Priorat – the location of the Montsant mining basin – saw a phase of decline, above all in its final period. This appears to have been caused by the concentration of the population farther south. Although there is no lack of settlement evidence, there appears to have been a notable reduction in population in comparison to the prior Late Chalcolithic–Middle Bronze Age phase.

At the same time, we see a significant reorganisation of the territory in the southern Priorat. This would undoubtedly have been accompanied by other important changes in the social structure of the communities. The concentrated population, the emergence of stable proto-urban settlements with buildings constructed with stone socles, urnfield-type cremation burial sites, material finds related to the western urnfields, and a concentration of the population around the MBF basin all point to significant structural changes.

Nevertheless, the material culture also shows clear signs of cultural continuity from the prior period.

In summary, the population became more fixed in the territory; there was a consolidation of sedentary lifeways, an abandonment of cave-dwelling, a significant concentration of the population in a few settlements, a significant intensification of contacts and a displacement of the centre of interest from the north to the south. The southern territory of the county and the MBF mining basin constitute a landscape of hills that are lower and less fractured than those to the north and offer better possibilities for agricultural use. Above all, they have easy access to the major communications artery of the time, the Ebro river, which is only 4 km from the main settlement in the southern Priorat, Calvari (El Molar). These are settlements – the most important being the aforementioned Calvari and El Puig Roig (Masroig) – whose locations were determined, firstly, by the proximity of the metal-mineral sites (Cu, Pb) and, secondly, by ease of access to the previously-mentioned main communications route in southern Catalonia, the Ebro River. These changes occurred at a time when inter-regional relations and long-distance trade were expanding.

During the Late Bronze Age, we see the first timid signs of inequality. Nevertheless, the nuclear family appears to have



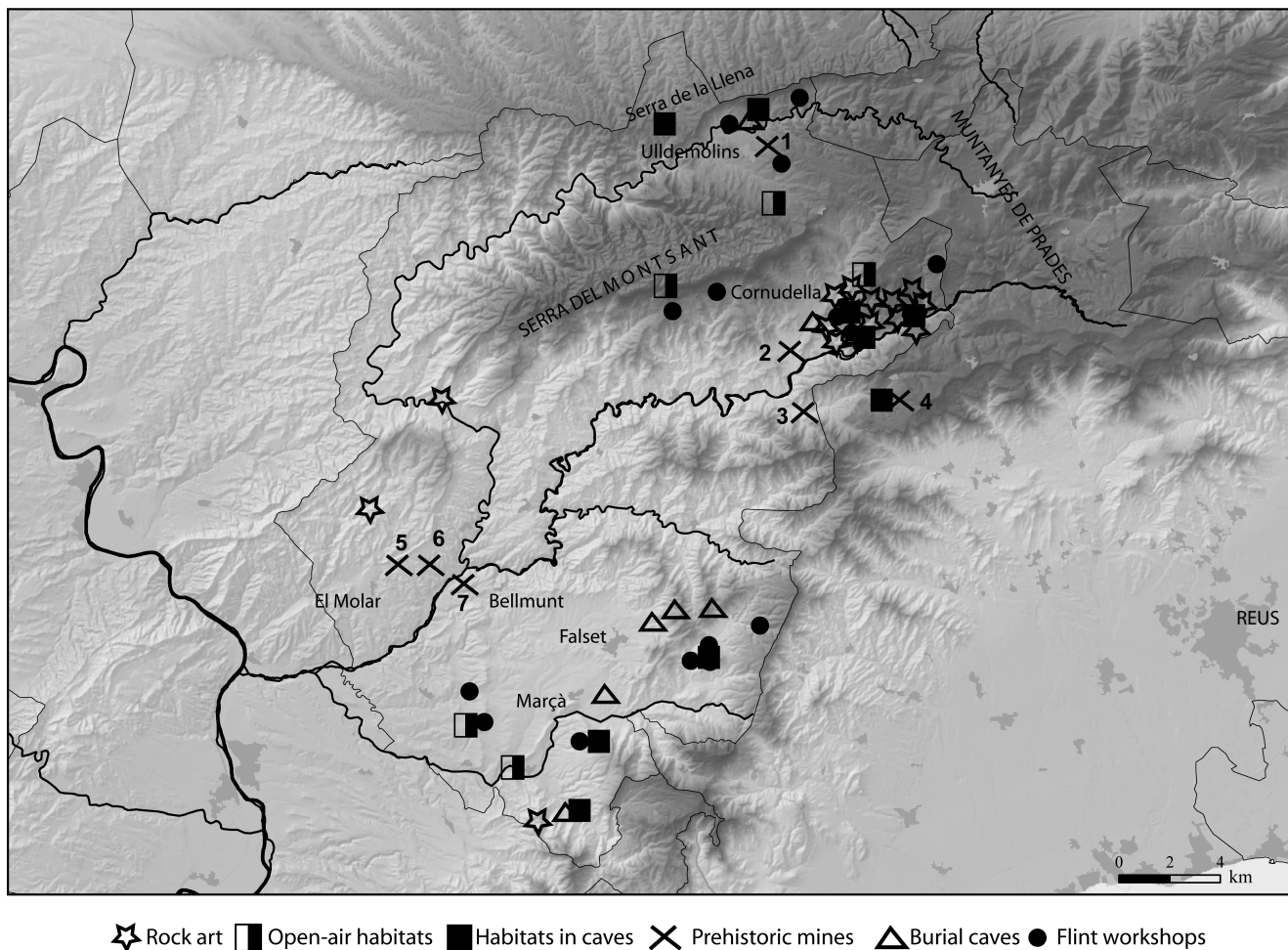


Figure 11.4 Late Chalcolithic and Early and Middle Bronze Age archaeological sites. Mines: 1. Solana del Bepo; 2. Turquesa; 3. Barranc Fondo; 4. Els Crossos; 5. Linda Mariquita; 6. Jalapa; 7. Barranco Hondo

been the basic unit of exploitation in a general economic framework that did not produce surpluses. Chronologically, the new population structure had its roots in the 9th century, although its full formalisation took place in the 8th century, and its moment of *flourit* in the 7th century and the first half of the 6th century BC. The society of this time shows signs of incipient hierarchisation, thus demonstrating the evolution of the egalitarian Bronze Age communities towards more ranked, unequal formations that anticipated the emergence of the Iberian aristocracies (Rafel and Armada 2009; Armada *et al.* 2013). We have to look for the beginning of this process in the evolution of the local communities themselves, although the irruption of Phoenician trade in the northeast provided a crucial impetus. The Phoenician presence was consolidated in the south of the Iberian Peninsula and on the island of Ibiza from the 8th century BC, along with their southern trade networks. From that point, the Phoenician trade network spread along the Mediterranean façade, where it was particularly active on the lower reaches of the Ebro (Garcia i Rubert and Gracia Alonso 2010). This expansion

was not conducted as a search for specific materials, but rather to extend their markets. Due to its proximity to the river, the southern Priorat was involved in that trade, as attested by the finds of Phoenician amphoras.

The intensive archaeological and archaeometric study programmes undertaken in the MBF mining basin have demonstrated that, although it is quite possible that in the 10th–9th centuries the inhabitants mined the local copper, from the 8th century, and especially during the 7th and 6th centuries BC, they received copper from the southeast of the Peninsula and above all from the Linares mining basin (Jaén) (Montero-Ruiz *et al.* 2012). The analytical data we have so far, which constitutes quite a large empirical base, reveals that all the bronze objects were manufactured with exogenous copper. In contrast, the mining activity of the MBF basin populations at that time focused mainly, if not exclusively, on local galena, the main sources of which were nearby the settlements of El Molar and El Puig Roig. In relation to this last aspect, it is necessary to note that this was a time when lead was a metal barely used by the local

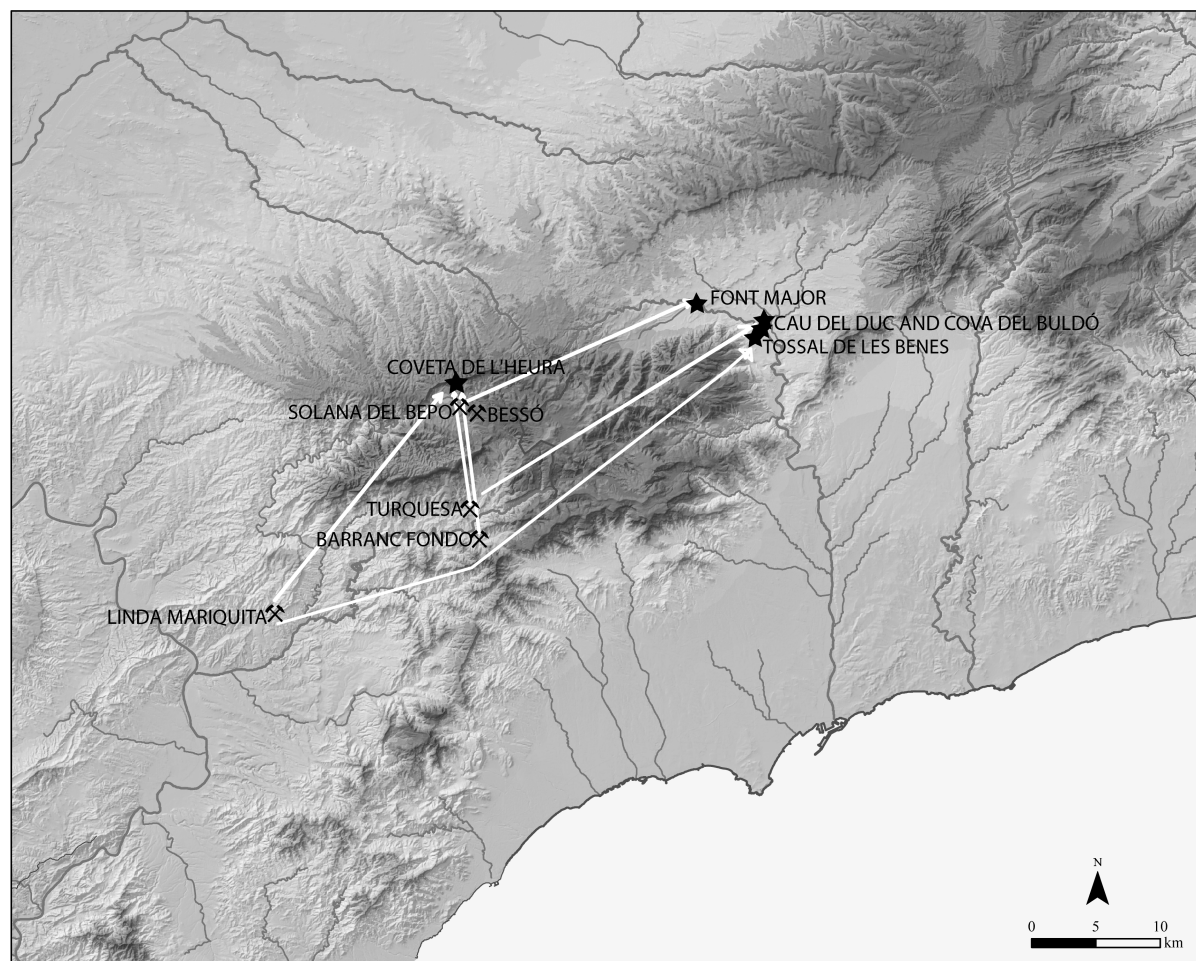


Figure 11.5 Mines in the Montsant and MBF basins with exploitation data from the Late Chalcolithic and Early and Middle Bronze Age and metallic objects or those linked to metallurgy with a specific assigned provenance determined by lead isotope analysis

communities and it would not be more widely used until the Iberian period. The lead isotope analyses (Figure 11.6/ Colour Figure 11.6) have allowed us to conclude that the galena mined in that period in the MBF basin was sent to the south of the Iberian Peninsula, where it has been documented at various Tartessian archaeological sites (Murillo-Barroso *et al.* 2016). At that time, intensive silver mining is documented in the Tartessian area. The silver was obtained mainly from jarositic minerals with large percentages of silver, but no lead. To attract the silver during the cupellation process they had to add lead obtained from other mining basins (Hunt 2005), including the MBF basin (Figure 11.7). Galena mining in this northeastern basin was, therefore, clearly for trading purposes and not for local consumption. The archaeological evidence from the county's settlements shows that the galena mining was structured and managed by the local populations. These were organised around two main settlements, Calvari del Molar and El Puig Roig del Masroig. However, the evidence also clearly indicates that this activity was an initiative fostered

by trading intermediaries in contact with the Phoenicians and their associated demand for lead (Rafel 2012). Thus, during the indicated period, the people living in the southern Priorat completely or almost completely abandoned copper mining to concentrate on the exploitation of galena to place on the Phoenician-fostered trade networks. In return, they had access to the products – mainly wine and other goods (*e.g.* decorated fabrics) – that reached the coasts of the north-east via those networks. For the local peoples these were exotic, prestige goods that contributed to an intensification of the processes leading to inequality.

Intensive lead mining continued in the MBF basin until the 1970s. This profoundly transformed the landscape of the archaeological mining sites, meaning that, unlike in the northern Priorat, we have as yet been unable to document directly any prehistoric workings. The mines of this basin have been analysed using an indirect methodology based essentially on lead isotope analyses (Montero-Ruiz *et al.* 2010). As a consequence, we do not have any direct data on the material and socioeconomic conditions of the mines.

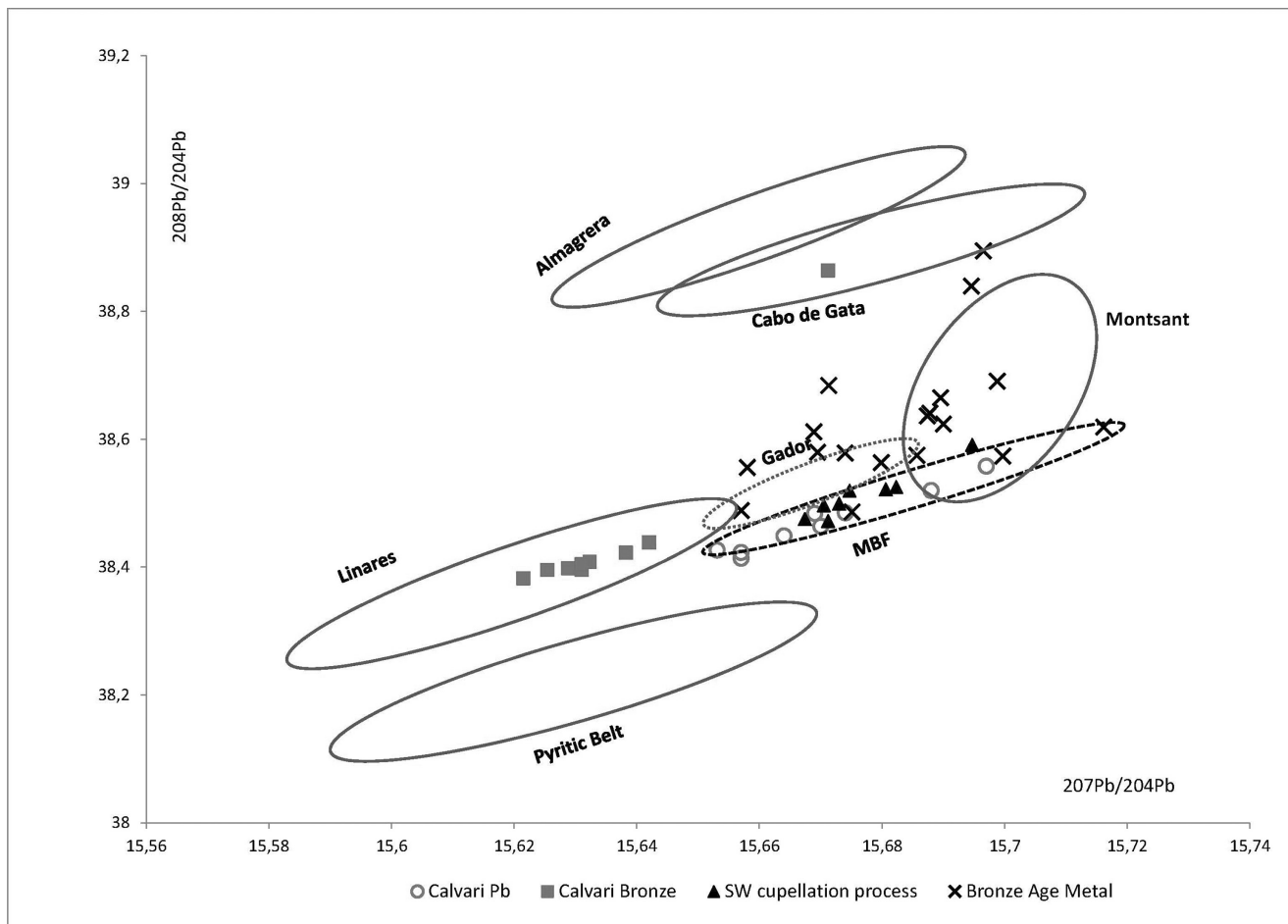


Figure 11.6 Bronze items from the settlement of El Calvari (First Iron Age), items from the Priorat datable to the Late Chalcolithic and the Early and Middle Bronze Age and cupellation remains from the south-west of the Iberian Peninsula in relation to the isotopic fields of Sierra Almagra, Cabo de Gata, Linares, Gador, Montsant, MBF and the Faja Pirítica

However, the indirect evidence coming from the habitats points to a greater specialisation and probably control over production by elites or incipient personal powers. In the settlement of Calvari there appears to have been an area devoted to metallurgical production, as well as a singular building of almost 100 m<sup>2</sup>. This contrasts with the usual houses at the site that are smaller, have a single room and no indication of hierarchical differentiation. This picture is observed in the whole northeastern Iberian Peninsula in earlier and contemporary chronological horizons.

In around 550, coinciding with major geopolitical changes in the whole of the western Mediterranean, a crisis struck the Phoenician mercantile structure on the Iberian Peninsula (Aubet 2009, 344–48) and Phoenician trade with the lower Ebro Valley collapsed. At the same time, the settlements in the southern Priorat were abandoned in what appears to have been a general crisis in northeastern Iberia. There was a population vacuum until, much later, in the 3rd century BC, a new territorial organisation emerged led by the nearby Iberian town of Castellet de Banyoles

(Tivissa). It is at this time that we document a small partial reoccupation of Calvari on the ruins of the earlier habitat, possibly an outpost used by Castellet de Banyoles to supervise and control mining, which now came under that town's jurisdiction. Nevertheless, during those centuries of population vacuum, galena from the Priorat is found in the Greco-Phocaean colony of Emporion (L'Escala, Girona), a fact that we interpret as evidence of direct control of the exploitation by the Greek colony itself. It must be pointed out that at this stage the galena from the Priorat is only documented in Emporion and its hinterland (Rafel 2012).

#### By way of conclusion: metal and power in the Priorat

##### *Late Chalcolithic (2600–2300 cal BC) and Early and Middle Bronze Age (2300–1300 cal BC)*

The amount of metal circulating in those long periods was not very high, but it was of major social significance. The number of metal items documented in the territory reveals



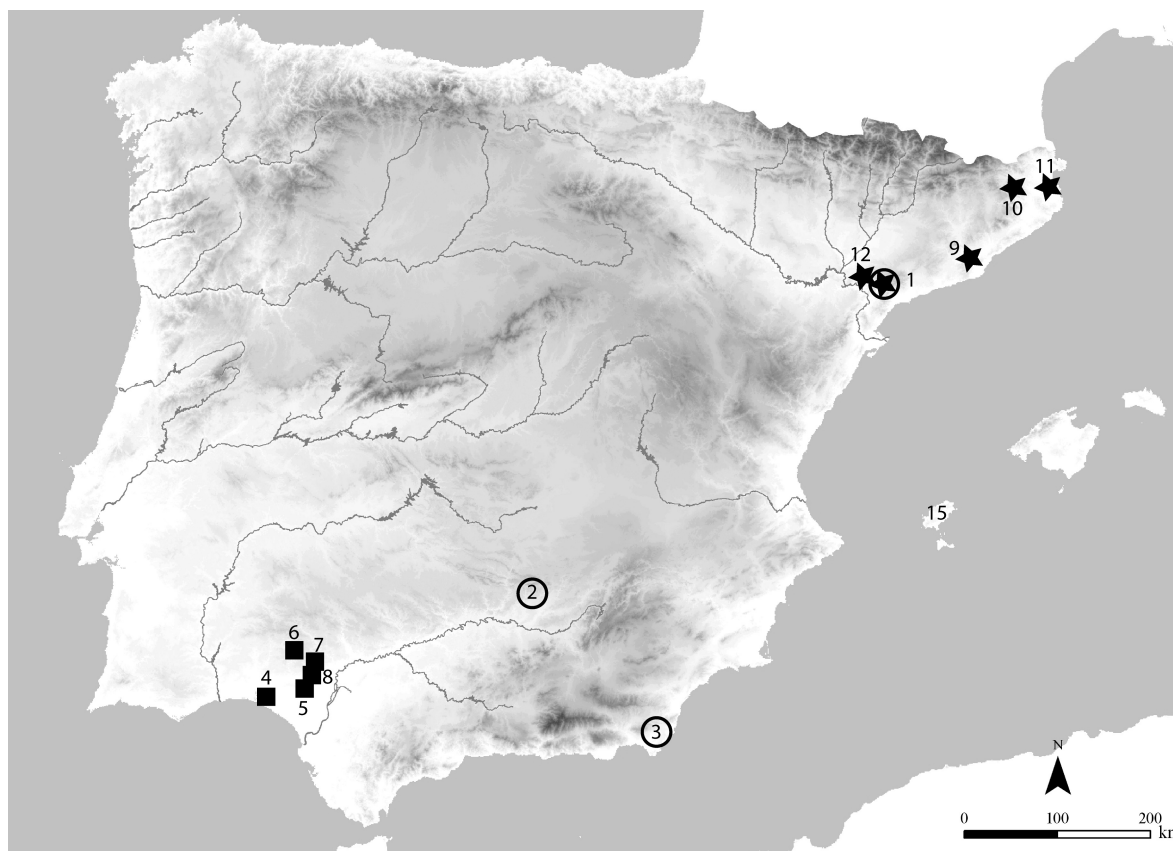


Figure 11.7 The distribution of copper from Linares and the south-east and of lead from the Priorat (MBF). Mining basins (circles): 1. Priorat; 2. Linares; 3. SE (esp. Gálor and Cartagena). Lead from the Priorat in Western Andalusia (squares): 4. Calle del Puerto (Huelva); 5. Tejada la Vieja (Escacena del Campo, Huelva); 6. Cerro de las Tres Águilas (Minas de Riotinto, Huelva); 7. Cortijo José Fernández (Castillo de las Guardas, Seville); 8. Torre del Viento (Aznalcóllar, Seville). Copper from Linares in archaeological sites of the north-east (stars): 1. Calvari (El Molar, Tarragona); 9. Can Roqueta (Sabadell, Barcelona); 10. Vilanera (L'Escala, Girona); 11. Can Xac (Argelaguer, Girona), 12. Sebes (Flix, Tarragona)

a metallurgy with a limited economic weight and the characteristic technology of the Iberian Peninsula based on reduction vessels (Rovira and Montero-Ruiz 2013). Metal was of little importance in productive life, in which most of the tools used were still made of stone. As we have already said, the pattern of consumption was local and minerals were only distributed over a small area, probably in exchange for flint. The dispersion of local raw materials shows a pattern of trade based in inter-group cooperation and direct contacts. In short, although in this period the social function of metal became an important aspect of group identity, its economic importance was limited.

Based on the contextual data at our disposal, to which we have referred briefly, mining appears to have been organised on the basis of groups of part-time miners. These miners formed part of the economic workforce in the group's agricultural-based economy, in other words, they would have been farmworker-miners. However, they probably had a specific status, as not all members of the community would have participated directly in the mining, but rather

only those who were strong and/or agile enough and had the necessary empirical knowledge and skills. The mineral processing tasks were no doubt also subject to similar conditions. However, in neither case did this situation lead to the formalisation of personal powers. As has been proposed for other contexts based on different types of evidence (Rowlands 1976; Ottaway 2001), miners would not have been a differentiated group, but part of general society. Nevertheless, given the archaeological invisibility of the mine agents, we cannot go beyond inferring hypotheses regarding their status based on indirect data.

In summary, we lean towards considering the data available to us as symptomatic of a cooperative maximisation of resources and a distribution confined to local and immediately adjoining territories, though not the product of communities of specialist miners. None of the archaeological data we have justify a hierarchical structure organised around these activities; rather they seem to suggest a panorama of small-scale communities, self-organised into networks, probably with informal and specific powers that



formed an intrinsic part of the network and cooperated in its collective organisation, although without any development of institutionalised powers.

### **First Iron Age (800–500 BC)**

We currently have no data on mining in the Late Bronze Age, except for the find of local copper oxide in a settlement in the southern Priorat, dated to the 10th–9th centuries (Armada *et al.* 2013). As we have seen, we have a solid empirical base for the First Iron Age. In one hand the nuclear area was now situated in the MBF basin. On the other hand social framework is completely different from the earlier developments linked to the Montsant basin.

This period is characterised by an organised population structure in the southern Priorat that controlled the MBF mining basin and was centred on two proto-urban habitats, Puig Roig and Calvari, the latter of which appears to have been the focal point from a hierarchical perspective. Other smaller settlements were dependent on them, with the whole forming a social territory. Metal use, now bronze, is seen to be consolidated, although some stone tool making continued. Mining became more intensive, but continued to be carried out on a part-time basis. This was the norm in European prehistory, except in some large mining areas such as Mitterberg (O'Brien 2015, 248). Nevertheless, in contrast to the earlier period, mining and metallurgy now played an economic role, in addition to a social one. They became an important part of the territory's economy, although that continued to be based on agriculture. The concentration of the population and the appearance of signs of differentiation in the architecture of the settlement of Calvari combine to indicate the probable development of an incipient system of hierarchisation in the organisation of mining as well as the trade in minerals and metals that were generated.

This is a process that was rooted in the preceding developments, as attested by the fact that the stable settlement with stone buildings began to appear at the end of the Late Bronze Age (10th–9th centuries). There was also a basic continuity in some of the movable artefact traditions associated with the same horizon. However, the developments of the First Iron Age also received an undoubted stimulus from the Phoenician trading presence. The Phoenicians were already well established in southern Iberia when the trade linked to them expanded towards the north-east. Their colonial hinterland encompassed the main mining resources of the Iberian Peninsula, including lead, which was particularly abundant in the southeast and the Linares mining basin (Jaén province). The fact that lead minerals flowed from the Priorat to southern Iberia attests the opportunistic nature of that trade, which arose from a search for new markets of interest to those southern societies. Whatever the case may be, the colonial phenomenon led the local population to give more weight

to mining, emphasising from that time the exploitation of galena for the market created by the new trade networks. Minerals and metals now moved over great distances, no longer forming part of a reciprocal system of exchange, but of a true market-based trading network, at least as far as the Phoenicians were concerned. Without doubt, this also resulted in the increased economic role of mining and its consequent conversion into an activity subject to a certain control by nascent formal powers. These new elites had an interest in mineral and metallurgical production as a way of obtaining goods and establishing contacts that would, in the long run, consolidate their status.

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