Проблемы археометаллургии

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EARLY COPPER MINING IN THE IBERIAN PENINSULA: STATE OF THE ART

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The metallogenetic characteristics of the Iberian Peninsula are somewhat peculiar due to the availability of numerous small open-cast oxidic copper ore mineralisations exploited until recent times. Their study in relation to prehistoric metallurgy has a long tradition that is reflected in the archaeological literature. However, it is in recent decades that research has begun to provide precise data of great interest relating the geochemistry of the ores to archaeological metallurgical evidence by means of lead isotope analysis, all within the chronological framework provided by C14 dating of both mines and excavated prehistoric settlements. The data reported here present in an orderly fashion all available information covering the Peninsula (Spain and Portugal) and the Balearic Islands, but it should be noted that there are a number of mine excavation projects underway which will hopefully provide more information when completed.

Keywords: early copper mining, Iberian Peninsula, lead isotope analysis, radiocarbon dating, Chalcolithic, Bronze Age.

РАННЯЯ ДОБЫЧА МЕДИ НА ПИРЕНЕЙСКОМ ПОЛУОСТРОВЕ: УРОВЕНЬ РАЗВИТИЯ

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Своеобразие металлогенетических характеристик Пиренейского полуострова обусловлено наличием множества небольших открытых месторождений окисленных медных руд, разработка которых продолжалась до недавнего времени. Их изучение в связи с доисторической металлургией имеет давние традиции, которые отражены в археологической литературе. Однако именно в последние десятилетия в результате исследований были получены представляющие большой интерес точные данные, связывающие геохимию руд с археологическими сведениями о металлургии, основанные на анализе изотопов свинца и относящиеся к хронологическим рамкам, обусловленным радиоуглеродным датированием (С14) как месторождений, так и обнаруженных при раскопках доисторических поселений. Представленные в статье данные систематизируют всю имеющуюся информацию о полуострове (Испания и Португалия) и Балеарских островах, но следует отметить, что в настоящее время осуществляется ряд проектов по разработке месторождений, по завершении которых, как ожидается, будут получены дополнительные сведения.

Ключевые слова: археология, ранняя добыча меди, Пиренейский полуостров, изотопный анализ свинца, радиоуглеродное датирование, энеолит, бронзовый век.

Introduction

The mineral wealth of the Iberian Peninsula is one of the factors frequently mentioned to explain the historical trajectory and justify the interest of Phoenicians, Punics and Romans in this territory. The extraction and trade of minerals both motivated and encouraged the arrival of colonisers, in the case of the Phoenicians and Punics, and integration into the Empire in the case of Rome. However, the exploitation of these mineral resources began at an earlier date during the Recent Prehistory or Metal Ages.

The mineral wealth covers most of the metals used in antiquity (copper, lead, tin, silver, gold, iron), but in this work we will focus on copper mining, the main metal in the metallurgical production of this period, since lead and iron were practically not used until the beginning of the first millennium BC by influence of Phoenician contact. Tin and gold were mainly mined by panning sediments, the archaeological trace of which is almost non-existent. Although silver was extracted in the Bronze Age from minerals such as native silver and kerargyrite, there is hardly any specific research on its mining beyond identifying the specific areas where this type of mineral appears (Murillo-Barroso and Montero Ruiz, 2014).

The research scenario has changed significantly in the last 30 years as it has in most Western European countries, where a large number of mines have been excavated and dated

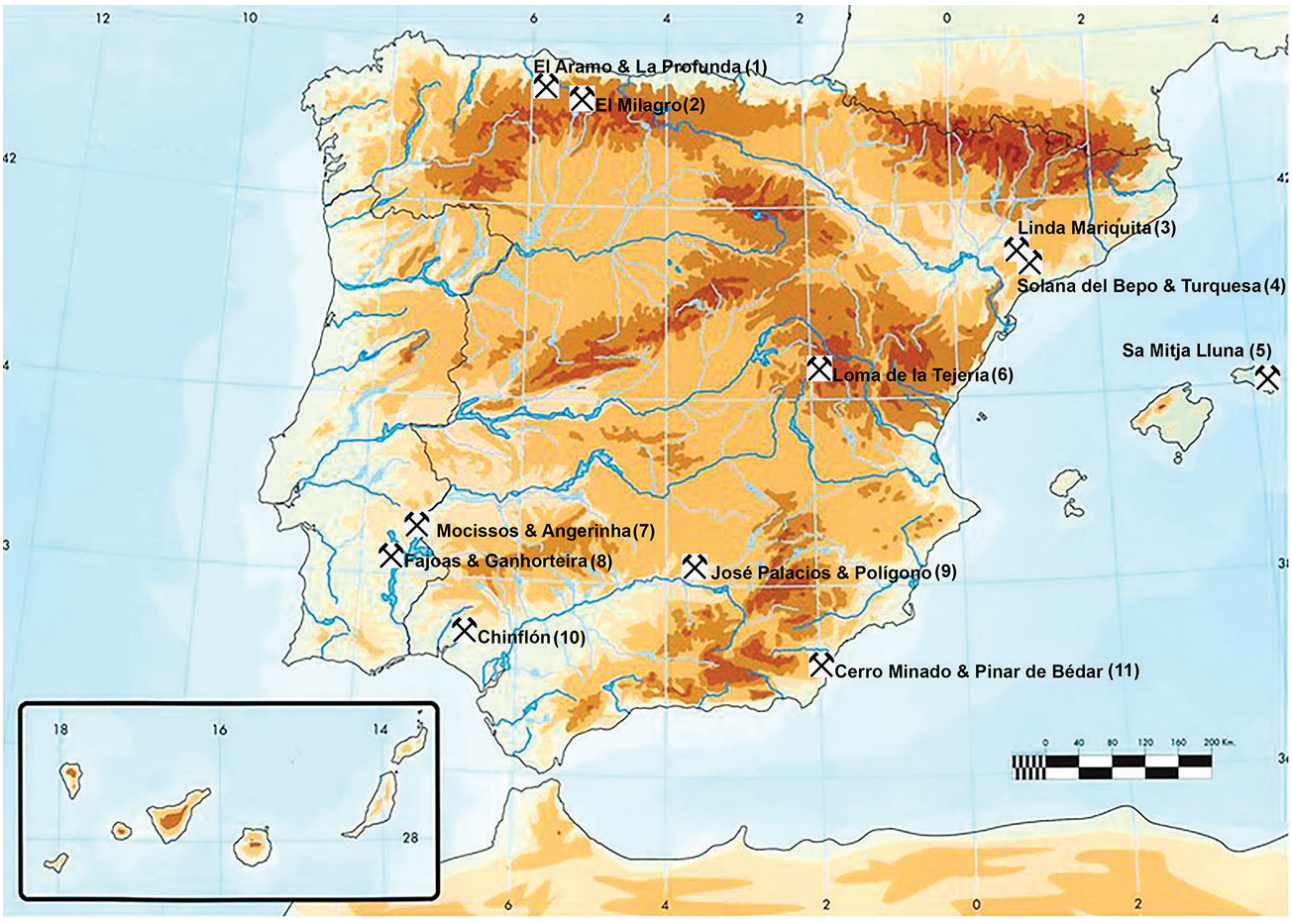

Fig. 1. Location Map of the main prehistoric copper mines in Iberia.
Рис. 1. Карта основных доисторических медных шахт в Иберии.

(see a synthesis in O'Brien, 2015). In the Iberian Peninsula most of the dates have been obtained in recent years and are not detailed in the O´Brien´s book, or in the review published years earlier by Montero Ruiz and Rodríguez de la Esperanza (2004). Therefore, we believe this tribute to Serguei Vladimirovich Kuzminykh is a good opportunity to present an updated overview of this information (Fig. 1), although we are aware that new works that are underway will add soon new data to those compiled here.

To these dated mines we can add some cases in which the information has been indirectly obtained through the results provided by lead isotopes that suggest that they were in use at the times to which the archaeological materials linked to them belong. Lead isotope analyses reveal that during the Chalcolithic and Bronze Age there were several mineral resources in use (Montero Ruiz, 2017), many more than the mines currently dated and, in some cases, we cannot yet link them to specific mines due to the lack of geological reference data.

Finally, there are many mines that can be classified as prehistoric due to the occurrence of lithic tools (hammer stones), but without being able to determine the specific period of exploitation. Many of these mines are situated in Andalusia, Extremadura and southern Portugal. A synthesis of the prehistoric mines of Sierra Morena was published in Mark Hunt's PhD thesis (Hunt-Ortiz, 2003), and Arboledas et al. (2017) have added new mines from the Jándula and Yeguas valleys in the province of Jaén, which are clear evidence of the research potential that remains to be developed and on which some ongoing projects are focusing.

Mines in the Asturias-León region

These mines deserve special mention as they are the ones where the most complete and continuous research has been carried out. Known since the mid to late 19th century, we refer to three mines: El Milagro (Onís), La Profunda (Cármenes) and El Aramo (Riosa). Miguel Angel de Blas has spent decades researching and publishing both specific and synthesis articles on lithic and bone tools, the development of the galleries and the dating of bone tools and human remains (de Blas, 1989, de Blas et al., 2013). In addition, archaeological work has been carried out outside El Aramo, identifying ore reduction activities and Bell-Beaker pottery (de Blas et al., 2013).

The El Aramo mines (de Blas et al., 2013) were mainly exploited between 2500-2100 cal

BC if we consider the dating of the tools found in the galleries (Fig. 2). However, the remains from the exterior suggest an earlier start (from 2700 cal BC) and later use during the Early Bronze Age up to 1500 cal BC, with a less frequent exploitation in the Late Bronze Age (around 1200 cal BC) (see tab.1).

El Milagro mine displays a similar chronological range, although the number of radiocarbon dates is smaller, starting before 2500 cal BC and lasting until 1600/1500 cal BC (de Blas, 2007-2008). At La Profunda mine only three datings are available, starting around 2700 cal BC and covering up to 2300 cal BC (de Blas, Suarez, 2009) (see Tab. 1).

These three mines have been well characterised by lead isotopes and present a very characteristic range with extremely radiogenic values that make them quite unique among European mineralisations. Comparative results indicate that the metal obtained from their ores was widely used in the Bell-Beaker period, probably being identified in some pieces from England (Montero Ruiz, 2017) and especially in the French Chalcolithic linked to Palmela points and tanged daggers (Labaune, 2016). It is also possible to trace metals with provenance in these Astur-Leonese mines in central Portugal and central Spain (Montero, 2017), and its arrival in southern Portugal has also recently been suggested (Soares et al., 2020).

The preparation of the monograph on the excavations at El Aramo, which is about to be published, will provide a great deal of data on the prehistoric workings in these mines.

Southwest mines

An important aspect to take into account is the possibility of a mine having several periods of intensive exploitation. In the Astur-Leonese mines, the dates are mostly grouped in a specific period, but they show a certain continuity, without clear interruptions. When the number of C14 dates is small (one or two) there is a risk of considering only one of these periods. This is perhaps the case of Chinflón Mine 3 (Huelva), where, in addition, some of the dates have a wide margin of error. The dating from the bottom of the excavation is linked to the Late Bronze Age (1500-900 cal BC), as is the nearby mining camp (Hunt-Ortiz, 2003: 71-72); another dating from Mine 2, affected by the Hallstatt plateau, points to its use in the Early Iron Age (700-330 cal BC) (see Tab. 1). However, it cannot be ruled out that some of the Chinflón mines began to be exploited in the Chalcolithic, as originally proposed (Blanco, Rothenberg, 1981).

Fig. 2. View of a gallery inside El Aramo mine. Some stone and bone tools have been found in this area. Photo courtesy of M.A. de Blas.
Рис. 2. Вид на галерею в шахте Эль Арамо. В этом районе был найден ряд каменных и костяных орудий. Фото М.А. де Бласа.

The mines of Monte da Angerinha and Mocissos in southern Portugal have been archaeologically investigated, but the information have not been fully published, although the radiocarbon dates are included in IDEARQ database (http://www.idearqueologia.org/). Both mines have various periods of exploitation, with Mocissos dating back to the end of the 4th millennium cal BC (Tab. 1, KIA-30550) being the oldest mine so far documented (Fig. 3). We reproduce a paragraph referring to these mines in Hanning et al. (2010: 289): "*The mine from Angerinha was dominated by Roman activity, but both Bronze Age and Islamic dates recovered from the backfill of the mining trench point to both earlier and later periods of activity. Additionally at the base of the stratigraphy, two Chalcolithic radiocarbon dates could be obtained from beneath the first mining dump. The excavations at the mine of Mocissos were more successful in locating early signs of mining activity. According to the stratified 14C-dates, the multiphase mining activities could be determined from the 4th mill. BC up to the Early Iron Age; modern remains (19th and early 20th century) were identified as*

Fig. 3. Mocissos mine (Portugal). Part of the large trench after exploitation in modern times. In the background, the Guadiana river. Photo by S. Rovira-Llorens.
Рис. 3. Шахта Мокиссос (Португалия). Часть большой траншеи после использования в наше время. На заднем плане – река Гвадиана. Фото С. Ровиры-Льоренса.

well. In the younger prehistoric strata (Early Iron Age/Middle Bronze Age), a large quantity of stone hammers made out of quartzite pebbles from the nearby Guadiana River occur together with pottery. Excavations of the older strata, i.e. from the Early Bronze Age to Chalcolithic, brought to light two stone axes made of amphibolite and a few crucible fragments related to a copper ore smelting process (Goldenberg and Hanning in press)".

Recently, some survey results have been published including lead isotope sampling from the Barrancos area (to which Angheriha and Mocissos, mentioned above, also belong to). In the Fajoas and Ganhoteira mines, pottery, remains of metallurgical workings and associated materials, as well as hammer stones have been recovered, suggesting a Chalcolithic chronology (2700-2200 cal BC) (Soares et al., 2020) (see Tab. 1). Lead isotope analyses confirm that metals from nearby settlements (< 30 km far from mines) are related to them, although it is not possible to individualise which one due to the low number of geological samples available from each mine (≤ 5) to define a precise isotopic field. We would have at least four potentially exploited mines, three of them in the Chalcolithic, although there are more mines in the area that only have lithic material identified on the surface (for example, Minancos and Rui Gomes mines) (Soares et al., 2020).

Northeast mines

Two mines were known in this area and have been recurrently cited. One of them, known as Riner or Forat de la Tuta, has been discarded as it corresponds to the burial site of a metallurgist with moulds and remains of ore, and there are no traces of mining work (Soriano, 2011). The second of these, known as Solana del Bepo (Vilaseca and Vilaseca, 1957), is in the Montsant area and has had an extensive record of picks and hammer stones. Excavations have been carried out to identify the vein and all the preserved lithic material has been studied in detail. The Solana del Bepo macrolithic assemblage has no clear parallels in the known panorama of European prehistoric mining (Fig. 4). The implements, mainly picks, were made from local rock that were easily obtained in the immediate surroundings. They are noteworthy for their high degree of

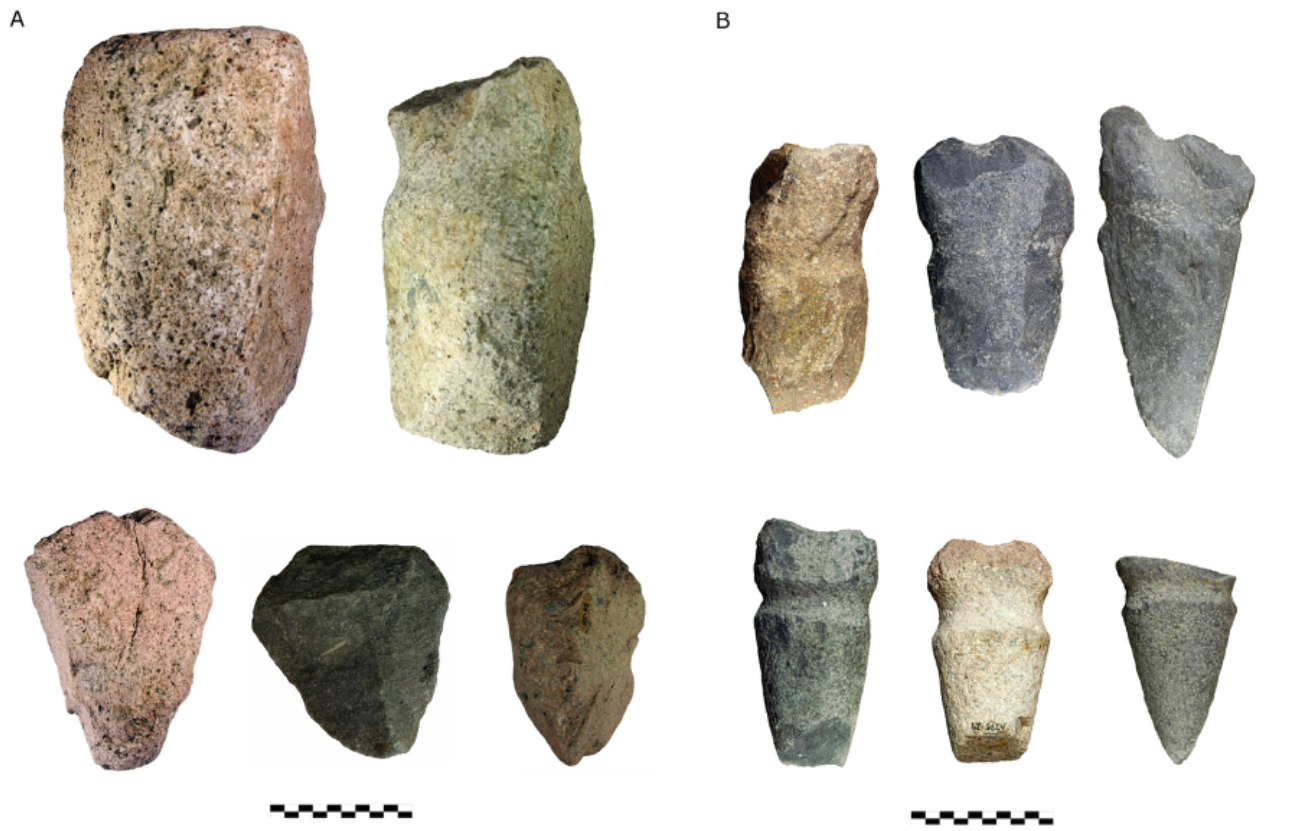

Fig. 4. Comparative view of stone tools found in Mina Turquesa (A) and Solana del Bepo (B), the last one with high degree of modification and complex hafting devices. Photo courtesy of N. Rafel.

Рис. 4. Сравнение каменных орудий, найденных в Мина Туркеса (A) и Солана Дель Бепо (B), последний пример отличается высокой степенью модификации и наличием сложных приспособлений. Фото Н. Рафеля.

modification, both in terms of the preparation of their passive faces and active fronts and the fact that a very high percentage of them have relatively complex hafting devices, among which are those that have the diverse types of T-shaped handles (Rafel et al., 2017, p. 85). The dates obtained confirm Bronze Age exploitation in at least two periods separated by a stage of abandonment, the first between 1900-1800 cal BC and the second between 1700 and 1600 cal BC (Rafel et al., 2019) (see Tab. 1). A third dating, obtained from the organic sediment of the lower level, with a date of the second half of the 4th millennium cal BC (Tab. 1, Beta-447530) could indicate frequentation of the site at that early time, but the authors maintain their reservations about its validity. Lead isotope analyses of some pieces had already suggested before the dating was obtained that an Early Bronze Age chronology was likely at this mine (Montero, 2017).

The Turquesa or Mas de les Moreres mine belongs to the Montsant area and is located about 10 km from Solana del Bepo. It has also been excavated, and remains of fire-setting works (Fig. 5) and hammer stones have been identified (Rafel et al., 2018). It has been studied from a geochemical and lead isotope point of view, being the only mine in the Montsant area that presents the association of copper with arsenic. Although excavations have not yielded C14 dates except for the 6th-8th century AD period, lead isotopes have linked the provenance of some metals with arsenic to this mine (Montero, 2018). In all cases, these are materials assigned to the Chalcolithic and Bell-Beaker periods.

We must also mention in the province of Tarragona, but in the area of Molar-Bellmunt-Falset (MBF) the Linda Mariquita mine. Although lead predominates in this district, there are copper mineralisations consisting of tennantite-tetrahedrite series minerals. There is no direct evidence of its exploitation in prehistoric times but lead isotope analyses link to these minerals the metal of some Chalcolithic and also Iron Age artefacts from surrounding sites (Montero Ruiz, 2017; Rafel et al., 2021).

In the case of the minerals reduced in the Bell-Beaker site of Bauma del Serrat del Pont (Girona) links by lead isotope analysis have been established with the mines of Montsant (Turquesa and Solana del Bepo) but also with other mines closer by (18 km), such as Les Ferreres, which so far only had evidence of exploitation from the Roman period (Montes-Landa et al., 2021).

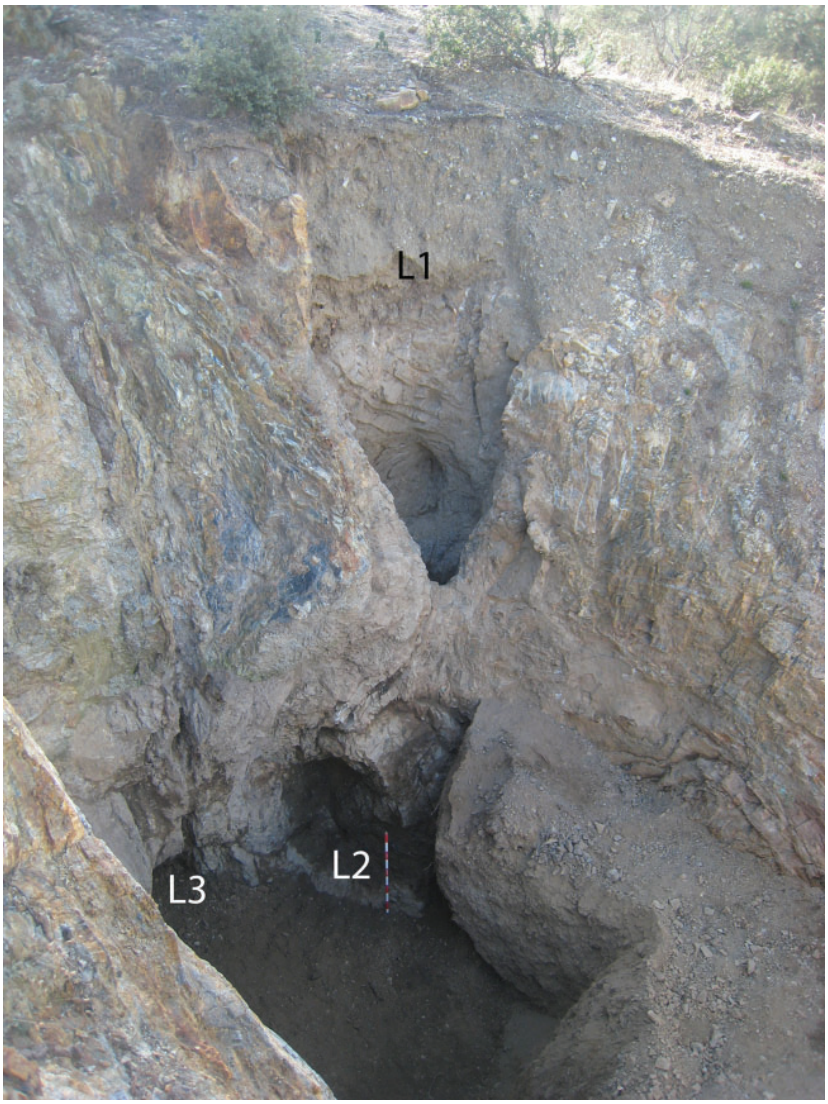

Fig. 5. Mina Turquesa after archaeological works in 2016. Fire-setting evidence has been identified in the walls of some shafts (L). Photo courtesy of N. Rafel.

Рис. 5. Мина Туркеса после археологических работ в 2016 году. На стенах некоторых шатхных стволов обнаружены следы огневых работ (L). Фото Н. Рафеля.

Finally, in this area we should mention Loma de la Tejería (Teruel). This is a small mining camp next to a small copper mineralisation, where some remains were recovered linked to the processing of the mineral and its reduction to metal. Although we do not have radiocarbon dates for the site, the entire archaeological record belongs to a Bell-Beaker/Chalcolithic period (Montero-Ruiz, Rodríguez de la Esperanza, 2008).

The Loma de la Tejería, as the most extreme example, confirms the exploitation of small mineral resources within a reduced scale of production, as was the case in the Chalcolithic period. Neither the Turquesa Mine nor Solana del Bepo can be considered large mines like those documented at El Aramo or El Milagro. On the contrary, they are mineralisations that have lacked interest in more recent times due to their low yield or small volume, and therefore have hardly been affected by modern industrial workings, except for some exploration pits.

Mines of the Southeast

Despite being the best-known metallurgical area (Montero Ruiz 1994) since the work of the Siret brothers (1890) at the end of the 19th century, and despite the fact that the Millares (Chalcolithic) and El Argar (Early Bronze Age) cultures have been studied by various teams, little concrete information on mining has been obtained until recent years. Only two mines, Cerro Minado (Almería) and Mina José Martín Palacios (Jaén), has been dated by C14.

Cerro Minado has only one dating and the associated lithic tools show low rates of modification, making their identification difficult until the research by Escanilla (2016). The chronology obtained on charcoal from a dump

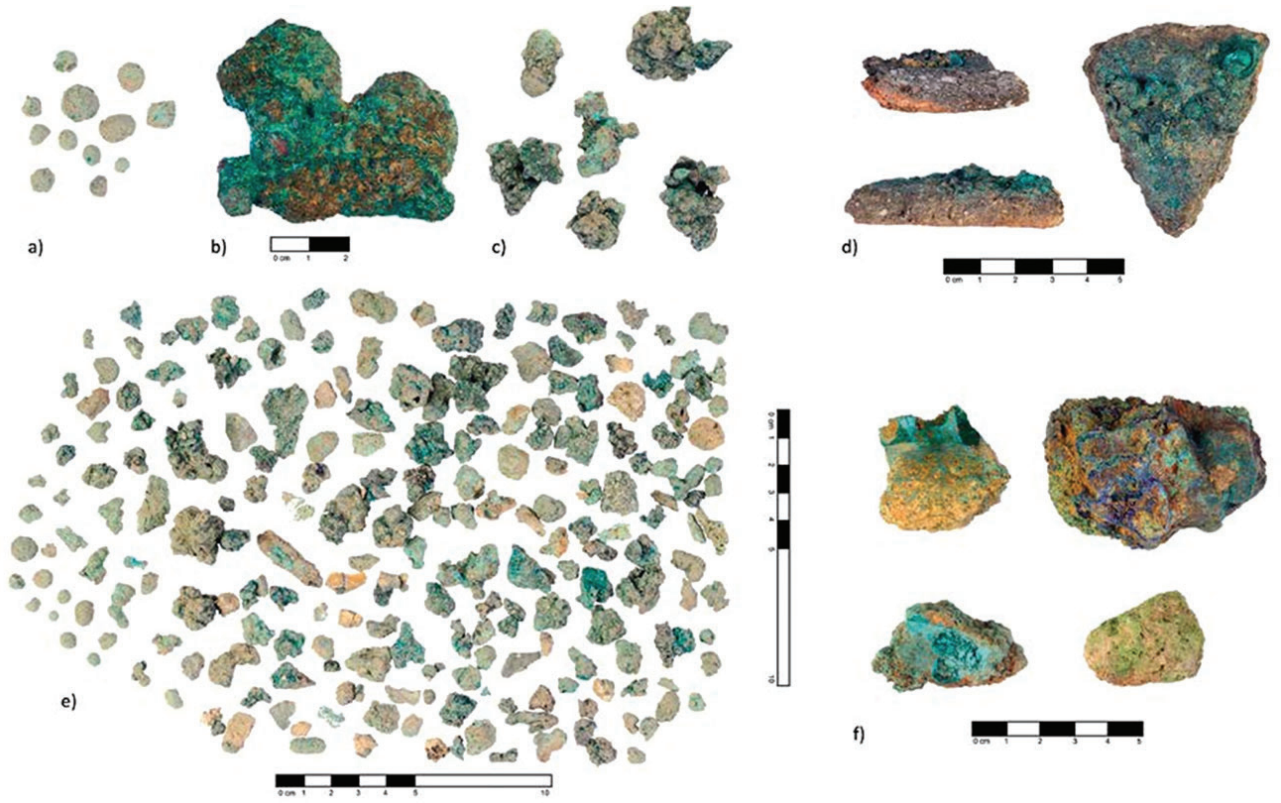

Fig. 6. Chalcolithic metallurgical remains from Almizaraque (Almeria). Most of the copper ores and copper prills are related to Cerro Minado mine by lead isotopes analysis. Photo courtesy of M. Murillo-Barroso.
Рис. 6. Свидетельства металлургического производства медно-каменного века из Альмизарака (Альмерия). По результатам анализа изотопов свинца большинство медных руд и самородков связаны с шахтой Серро Минадо. Фото М. Мурильо-Барросо.

places the mining works in the Chalcolithic 2500-2300 cal BC (Escanilla, Delgado-Rack, 2015) (see Tab. 1). Lead isotopes confirm the relationship of the metallurgical remains found in the Chalcolithic sites of Santa Barbara (1 km from the mine) and Almizaraque (20 km away) (Fig. 6) (Murillo-Barroso et al. 2020). There are also objects from the following period (El Argar) that can be linked to the Cerro Minado ores, which would support their exploitation at different times (Montero-Ruiz, Murillo-Barroso, 2021).

Lead isotopes also allow us to consider the Pinar de Bedar mine (located 10 km from the previous one) as a Chalcolithic mine, which has a geochemistry distinct from Cerro Minado. The archaeometallurgical record (ore, slag and smelting remains) of the Chalcolithic site of Las Pilas (Mojácar, Almería) is associated with this mine (Murillo-Barroso et al., 2020), although no evidence of lithic tools has been found there. No material from El Argar analysed so far shows any relationship with this mine, as was the case with

Table. 1. Radiocarbon dates from prehistoric mines in Iberia and Balearic Islands. Most of these information can be downloaded online from the IDEArq C14, the Spatial Data Infrastructure for the online publication of repertories of georeferenced archaeological information (http://www.idearqueologia.org/c14/?ln=en)
Таблица. 1. Радиоуглеродные датировки доисторическуих шахт в Иберии и на Балеарских островах. Большая часть представленных сведений может быть загружена онлайн из IDEArq C14, инфраструктуры пространственной передачи данных для онлайн-публикации каталогов географической археологической информации (http://www.idearqueologia.org/c14/?ln=en).

Nº in fig 1	Site	Reference	C14 date	Stdev.	Material sampled
1	El Aramo	OxA-1833	4090	70	Bone
1	El Aramo	Ua-37452	4045	40	Charcoal
1	El Aramo	Ua-33691	4000	40	Bone
1	El Aramo	OxA-6789	3995	50	Bone

1	El Aramo	Ua-33695	3945	40	Bone
1	El Aramo	Ua-39331	3942	32	Charcoal
1	El Aramo	Ua-18633	3940	60	Bone
1	El Aramo	Ua-33690	3920	40	Bone
1	El Aramo	Ua-33700	3915	40	Bone
1	El Aramo	Ua-33694	3905	45	Bone
1	El Aramo	OxA-3007	3900	90	Bone
1	El Aramo	Ua-377446[sic]	3840	40	Charcoal
1	El Aramo	Ua-35378	3840	35	Bone
1	El Aramo	Ua-33699	3840	40	Bone
1	El Aramo	Ua-18632	3825	60	Bone
1	El Aramo	Ua-33703	3825	40	Bone
1	El Aramo	Ua-35375	3815	35	Bone
1	El Aramo	OxA-1926	3810	70	Bone
1	El Aramo	Ua-33697	3780	40	Bone
1	El Aramo	Ua-18629	3775	65	Bone
1	El Aramo	Ua-33698	3730	60	Bone
1	El Aramo	Ua-35377	3725	35	Bone
1	El Aramo	Ua-39330	3723	32	Charcoal
1	El Aramo	Ua-33689	3700	40	Bone
1	El Aramo	Ua-24542	3650	40	Bone
1	El Aramo	Ua-33687	3515	35	Charcoal
1	El Aramo	Ua-37451	3490	40	Charcoal
1	El Aramo	Ua-39329	3474	34	Charcoal
1	El Aramo	Ua-33682	3440	30	Charcoal
1	El Aramo	Ua-33683	3415	30	Charcoal
1	El Aramo	Ua-33693	3410	60	Bone
1	El Aramo	Ua-33688	3400	30	Charcoal
1	El Aramo	Ua-33686	3370	35	Charcoal
1	El Aramo	Ua-18630	3365	60	Bone
1	El Aramo	Ua-33685	3345	30	Charcoal
1	El Aramo	Ua-33684	3315	30	Charcoal
1	El Aramo	Ua-37450	3315	40	Charcoal
1	El Aramo	Ua-41113	3314	32	Charcoal
1	El Aramo	Ua-18631	3310	65	Bone
1	El Aramo	Ua-35374	3270	35	Bone
1	El Aramo	Ua-35376	3225	35	Bone
1	El Aramo	Ua-33696	3220	40	Bone
1	El Aramo	Ua-41112	3217	30	Charcoal
1	El Aramo	Ua-18634	3215	55	Bone
2	El Aramo	Ua-33692	3150	45	Bone
2	El Milagro	OxA-3005	3990	90	Bone
2	El Milagro	OxA-3006	3850	90	Bone
2	El Milagro	Ua-33207	3785	35	Bone
2	El Milagro	Ua-33209	3775	35	Bone
2	El Milagro	Ua-24538	3630	40	Bone
2	El Milagro	Ua-24537	3520	40	no reference
2	El Milagro	Ua-24550	3355	55	Bone
2	El Milagro	Ua-33206	3285	35	Bone
2	El Milagro	Ua-33208	2100		Bone

1	La Profunda	Ua-35780	4075	35	Bone
1	La Profunda	Ua-35779	3950	35	Bone
1	La Profunda	Ua-35778	3865	35	Bone
10	Chinflón	BM-1529	3320	130	Charcoal
10	Chinflón	BM-1600	2890	50	Charcoal
10	Chinflón	BM-1599	2830	50	Charcoal
10	Chinflón	BM-1528	2650	60	Charcoal
7	Mocissos	KIA-30550	4620	29	no reference
7	Mocissos	KIA-31370	4509	29	no reference
7	Mocissos	KIA-30549	4485	25	no reference
7	Mocissos	KIA-30552	4006	24	no reference
7	Mocissos	KIA-31372	3581	31	no reference
7	Mocissos	KIA-31371	3456	31	no reference
7	Mocissos	KIA-30547	3314	23	no reference
7	Mocissos	KIA-30548	3083	25	no reference
7	Mocissos	KIA-31369	2630	27	no reference
7	Mocissos	KIA-31368	2561	27	no reference
7	Monte da Angerinha	KIA-33229	4158	31	no reference
7	Monte da Angerinha	KIA-33227	4130	26	no reference
7	Monte da Angerinha	KIA-33232	2230	27	no reference
7	Monte da Angerinha	KIA-33231	2212	28	no reference
7	Monte da Angerinha	KIA-33228	2168	31	no reference
7	Monte da Angerinha	KIA-33230	2157	27	no reference
7	Monte da Angerinha	KIA-33225	2107	22	no reference
7	Monte da Angerinha	KIA-33226	1991	26	no reference
7	Monte da Angerinha	KIA-33223	1231	28	no reference
7	Monte da Angerinha	KIA-33224	1164	33	no reference
4	Solana del Bepo	Beta-447530	4570	30	Organic sediment
4	Solana del Bepo	Beta-447528	3540	30	Charcoal
4	Solana del Bepo	Beta-447529	3360	30	Charcoal
11	Cerro Minado	MAMS-18508	3905	21	Charcoal
9	Mina José Martín Palacios	CNA-1004	3726	31	Charcoal
9	Mina José Martín Palacios	CNA-4006	2695	32	Charcoal
9	Mina José Martín Palacios	CNA-1017	2359	41	Charcoal
5	Sa Mitja Luna	KIA-48275	3420	35	Charcoal
5	Sa Mitja Luna	KIA-48274	3095	35	Charcoal
5	Sa Mitja Luna	KIA-48273	3045	35	Charcoal

Cerro Minado. The earliest historical data come from the 16th century and the recent urbanisation of the area has led to the disappearance of most of the mining remains, so it will be impossible to search for the missing archaeological evidence.

The José Martín Palacios Mine in the district of Linares (Jaén) was excavated in 2013 (Arboledas et al., 2015). Previously, its exploitation in the Bronze Age had been suggested (Arboledas et al. 2006) through lead isotope analysis of materials from the nearby site (2 km) of Peñalosa (Moreno Onorato et al., 2010). The excavations in the mine achieved better documentation, not only by obtaining C14 dates, but also with the recovery of some metallurgical and Bronze Age pottery. The three dates obtained place a first period of work at the beginning of the Bronze Age (between 2200-2000 cal BC) and two periods in the Late Bronze Age (900-800 cal BC) and in the Early Iron Age (600-400 cal BC) (see Tab. 1).

The studies of the Peñalosa site also identify other types of minerals which, both from a geochemical and lead isotope point of view, are related to the Polígono mine (1 km from the site). It is interesting to note the exploitation of two mines with different characteristics at the same site, although most of the metallurgical remains seem to be linked to this second (Moreno et al., 2010), as yet undated, mine.

Balearic Islands

Copper mineral resources are concentrated in Mallorca and Menorca, but only in Menorca have

prehistoric mining remains been identified in the area of Sa Mitja Lluna (Menorca). Excavations by Hunt et al. (2014) in the waste dumps recovered some prehistoric ceramic material, lithic tools, and organic material to allow obtaining three C14 dates that show at least two periods of exploitation. The first would span the period between 1800-1630 cal BC and the second between 1400-1200 cal BC (see Tab. 1).

Thanks to the isotopic and elemental characterisation of its minerals, studies have been carried out on local metals finding probable coincidences with this mine at Sa Mitja Lluna (Sureda, 2019) from early stages (1800-1500 cal BC). It is also observed that trade circuits in the Late Bronze Age changed the supply of metal, and local exploitation remained on a reduced scale (Sureda, 2020).

Conclusion

The wealth of copper ores scattered throughout the different territories of the Iberian Peninsula and the Balearic Islands was exploited throughout prehistoric times. Regardless of their size and the quality of the ore, there were many mines that were worked in the first moments of metallurgical production, with local exploitations being developed due to a reduced scale of production and a scarce social value of the metal during the Chalcolithic and Early Bronze Age (Murillo-Barroso, Montero Ruiz, 2017). During the Late Bronze Age there was an intensification of copper-based metallurgy and although the lead isotopes show that some areas achieved a greater weight in the circulation of the metal (such as the district of Linares in Jaén), there is still a diversity of mines in use throughout the geographical area of the Iberian Peninsula. The potential for mining research is very great and both the presence of lithic tools and the indirect evidence provided by lead isotopes allow us to plan more detailed studies to understand the changes that took place in mining and its relationship with metallurgical activity in each of the periods covered by Recent Prehistory.

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