MUSLIM MINING IN THE IBERIAN PENINSULA (PART II)

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METAL PRODUCTION IN IBERIA

Gold

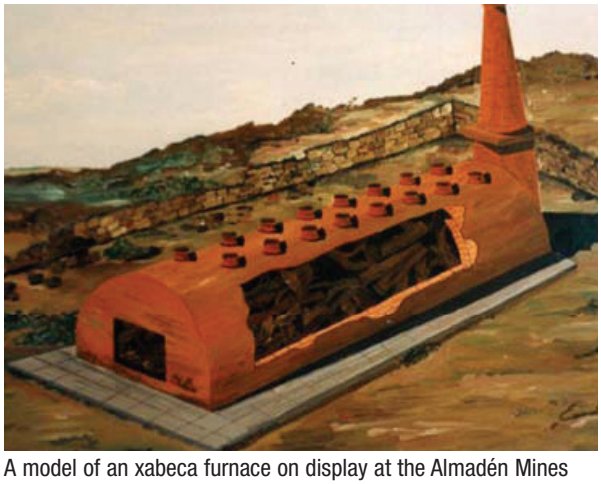
Gold was obtained in the alluvial deposits of rivers scattered through the Iberian Peninsula. Rivers like Segre (Lerida), Darro (Granada), and Tajo (near Lisbon), as mentioned by the chronicler Ahmed Arrazi, the geographer Al Edrisi, and the poet Ibn Hazim. Surface mining was also found in the area of Elvira (Granada) and probably in the village of Navas de Ricomalillo (Toledo), as can be inferred from its closeness to the Muslim mining area of Los Vascos where mining tools were discovered. In addition, gold was imported from Africa and was shipped to Malaga, which was the commercial centre of gold. According to a book on Lapidary, translated from Arabic to Spanish at the time of Alfonso X, we know that borax was used as flux in gold metallurgy. The metal obtained was employed in jewelry, gilding, and textiles, as well as to mint the so-called "dinares" in the Spanish Muslim period. According to Ibn Hawqual, minting—by virtue of its monopoly—was one of the main sources of income for the State.

Silver

Silver was obtained from mines located in the area of Hornachuelos-Posadas (Cordova), Herrerias (Almeria), Loja y Pechina (Granada), Almaden de la Plata y Guadalcanal (Sevilla), and also in the Muslim provinces ('kuras') of Beja and Ocsonoba (Portugal), among others. According to Vallvé Bermejo, at the time of emir Abd Allah in the ninth and tenth centuries, silver mines near the coast of Tudmir in Murcia produced 30 pounds of metallic silver per day. This metal was used in jewelry, decorations, crockery, and also to mint money.

Lead

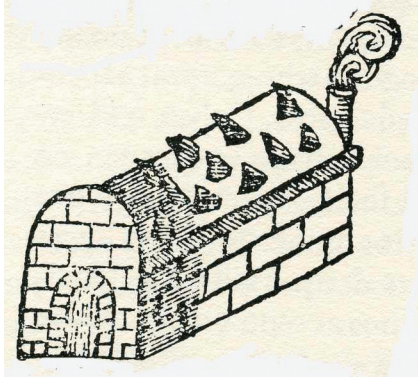
Lead mining is often related to the exploitation of silver-bearing galenas. According to Ibn Hawqal, iron, mercury, and lead mining were abundant in Spain. There were mining works near Cabra, Hornachuelos, and Los Pedroches (Cordova), Baza (Granada), Bellmunt (Tarragona), Sierra de Cartagena (Murcia), among others. According to Vallvé Bermejo (1996), Daysam Ben Ishaq from Murcia extracted a thousand cavalry charges from his mines annually. This lead was used for piping, roofing, and in pottery. Finely ground galena was used as makeup for women, taking advantage of its dark colour.



A model of an xabeca furnace on display at the Almadén Mines

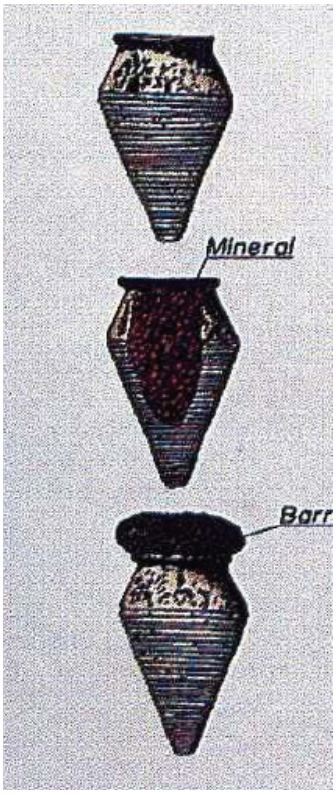
Mercury

Mercury was principally mined in Almaden in Ciudad Real, although there were also mines in other places such as Ovejo (Cordova) and Las Alpujarras (Granada).



Xabeca mercury recovery furnace as illustrated in *Arte de los Metales* (1640)

According to the geographer Al Edrisi, in the 12th century, Almaden's mining site had about 250 webs (420 metres), which most probably made it the deepest mine at that time. A labour force of more than a thousand men was employed in mining, mine water drainage, metallurgy, wood collecting, pot manufacturing, and as master builders (*alarifes*). Mercury was produced from cinnabar in a xabeca (pronounced shabeka, an Arabic word) which is a furnace described by Alvaro Alonso Barba in his book *Arte de los Metales,* published in Madrid in 1640. Ceramic pots were filled with cinnabar, sealed with clay, then placed in the holes in the upper part of the furnace where they were heated from below. A model of this furnace is on dis-



Clay pots, sealed at the top, in which mercury is recovered from cinnabar

play at the Almadén Mines. Mercury was used in gilding by amalgamation, and also in medicine. Ground cinnabar or vermilion was employed as a pigment. Mercury and vermilion were exported to the Mediterranean countries.

Iron

Iron, a necessity in the manufacture of swords and agricultural implements, screws, etc., was exploited in the mountains of the northern valley of the River Guadalquivir, around the areas of Constantina and Cerro del Hierro (Seville), as well as in Alquife (Granada), Sierra Filabres and Sierra Almagrera (Almeria), Otero de Herreros (Segovia), Montes de Toledo, and in many other places. We have not heard of the existence of hydraulic forges, introduced in the Christian territories of northern Spain by Europeans in the 12th century. However, we know about the existence of low furnaces, sometimes half buried, where several layers of iron oxide ores were mixed with charcoal and flux. A natural draft in the mountain, or artificial ventilation, was created by means of bellows. The doughy mass obtained was beaten out (by manual hammering) to remove the iron slag. The iron could then undergo some type of treatment (annealing, quenching, cementing, etc.) to get the desired product.

According to the geographer Az Zuhri, there were Indian steel factories called 'alhinde' in Seville, Spain, that exported this metal all over the world. In the 12th century, Al Idrisi also points to the island of Saltes, near Huelva, as the place where an important iron and copper factory was found. There was also an important armaments industry in Huesca and a siderurgy factory in Malaga, though the most valued steel came from Damascus.

Zinc

In his encyclopedia of Natural Sciences and Geography, Ancari Katobi mentions the mineral 'calamines' in Salobrena (Granada). We do not know if this archaeological site coincides with that of Cerro del Toro mine in Motril, Granada. Brass and other alloys like azofar and ceni were obtained by alloying zinc (atutia) with copper. Brass was probably manufactured near the mines of Riopar (Albacete).

Copper

In 1318, the geographer Al Dimashqui wrote about Spanish copper in El Cairo. Copper was obtained near Rio Tinto (Huelva), Cerro Muriano (Cordova), as well as in Granada, Almeria, the Toledo's mountains, Aljustrel (Portugal), and others. Copper sulphate (blue vitriol, known as 'aceche' by Muslims) and other sulphates, such as 'jebe' (alum = aluminium-potassium sulphate) were also exploited in the Iberian Pyritic Belt. Copper was obtained by smelting oxidized ores in Castilian furnaces, and was used for boiler forge, alloys (brass and bronze, known as wash copper), and manufacturing verdigris for painting. Aceche or blue vitriol had important applications in agriculture.

Other Metals

Tin needed to manufacture bronze came from the Hercynian Massif, the mines of the province of Ocsobona (Portugal), and other mines in Extremadura and Lumbrales (Salamanca) in Spain. According to Arie (1984), Al Andalus exported a great deal of tin and especially copper. On the other hand, high-quality antimony and alum were imported from Morocco. Antimony was exploited in the Muslim province of Lisbon, and according to the geographer Katobi, there was also an antimony mine in Jaén (Spain). ■

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Originally published in *CIM Magazine*, May, 2007
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