

A Topographical and Archaeological Survey of the Remains of 19th Century Lead Mining and Ore Treatment at La Gamberra (Bedar), Andalusia, Spain

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Introduction

During ten days in May of 2008 a survey was made of an area of intense lead (and iron) mining which is part of the larger Bedar mining district in Andalusia, southern Spain. The area was chosen because of the presence of a variety of ore treatment installations and the relative good condition of preservation of the area. DGPS mapping of all extant features and finds resulted in a map which allows to deduce information concerning spatial organisation and technological adaptation inside a nineteenth century industrial setting.

Landscape and Geology

The site, known as *la Gamberra*, is located on an uneven plateau surrounded on all but the west side by steep sided valleys. The main valley on the northern and north eastern side, the *Rambla de las Norias*, has the highest and steepest sides, with several mine adits visible in the near vertical faces. On the southern side, the *Barranco de Gato* separates the site from the former mining settlement El Pinar, which is now being redeveloped for holiday/retirement homes. To the east, the plateau more gradually goes over into the plains carrying the Rio Aguas to the Mediterranean. The western side, finally, marks the continuation of higher ground into the Sierra de Bedar, flanked on the north west by a third valley, the *Rincones de los Mancos*.

The bedrock in the study area was made up of limestone, with the exception of the northern most tip of the plateau which was made up of a mica rich metamorphic gneiss-like formation. The limestone contained area's of dispersed, well formed crystals of galena (lead sulphide), and, at the very south west corner of the site, pockets of siderite (iron carbonate).

Methodology

As a first step the limits of the study area where defined by a combination of the topography of the terrain and the extent of the material remains. This led to the delineation of an area of about 300 m by 300 m.

The area was consequently thoroughly scanned for structures and finds which were then plotted using a hand held Magellan Mobile Mapper using Differential Global Positioning System (DGPS) technology. Also the whole terrain was plotted in to create a background topographical map.

All structures and finds where subsequently photographed and described. All built structures were

recorded by a drawing of the feature in plan and, where necessary, in section.

All this information was combined using various software programs and published online, with the information grouped into several pages and accompanied by an interactive map. The results are visible at www.timespaces.eu/Spain/Bedar.html.

The Mines

There are 46 mine entrances in the study area. The most intense mining activity occurred at the eastern side of the study area, with three mine entrances with interconnecting adits forming a maze of tunnels. For safety reasons, the mines were not studied as to the mode of exploitation.

Two mines further to the west were exceptional as they were built as vertical shafts, 4.5 metres and more than 21 metres deep respectively. They both have horse-shoe shaped spoilheaps around the shafts containing galena bearing limestone, indicating these must have functioned as mines. In fact, a large area of additional spoilheaps seem to be connected to these mines, indicating a high level of production from these 'shaft mines'.

In the south western corner of the site, two iron mines were encountered, the spoilheaps of which contained siderite and not galena. These mines form part of a larger complex of mines found throughout the surrounding area.

At the northern edge of the study area, a single 'mine' was encountered which was opened into the mica-rich gneiss-like rock without reaching the limestone. It is unclear if this represents a trial mine or if it had a different function.

Ore Treatment

1. Ore crushing and selection

Very striking throughout the site were the heaps of graded spoil, which represent the result of ore crushing by hand and subsequent selection. A fine example was located in the south east corner of the site where three spoilheaps belonging to the same mine showed the spoil size decreasing from 5 to 20 cm, over 1 to 5 cm, to less than 1 cm as the heaps lay further removed from the mine.

2. Ore Sieving

Towards the north of the site a stone built sieving installation was found. The structure was a horse-shoe shaped dry-stone wall (about 1 m diameter, preserved height: 40 cm) built into a heap of finely sorted ore. The base of the interior was filled with compacted fine sand. At the edge of this structure two iron square-headed bolts (8 cm long, 0.6 mm diameter) were found. A fragment of an iron sieve, found further to the west, had two holes at the side with a diameter of also 0.6 cm.

3. Ore Calcination

Due to the nature of the ore, finely dispersed galena in limestone, calcination kilns were employed to reduce the weight of the ore by calcining the limestone into lime, while at the same time

converting the lead sulphide into lead oxide.

The kilns at La Gamberra are circular in shape, built from local limestone blocks set in mortar and are dug into the slightly sloping bedrock. The outer diameter of the kilns varies between 3.40 and 3.70 m., the inner diameter between 1.90 and 2.40 m. The height from the top of the rim to the base of the bowl measures between 2.80 and 3.10 m. The inside diameter decreases towards the bottom making it slightly conical. In front of the opening at the base a channel is cut out of the bedrock to let in air and remove the calcined ore. Three out of the four kilns also had stone platforms built at one side, undoubtedly for adding fuel and ore.

Several heaps of limestone blocks and a patch of lime found near the kilns, probably represent material left over from the building of the kilns.

Three of the kilns were placed at the top of a valley with the opening pointing towards the lower lying land, presumably to take advantage of wind rising up these valleys. The fourth kiln was built at the side of one of these valleys, but was constructed pointing across this valley. This last kiln, however, was built above, and forming the continuation of, the entrance to an abandoned mine. In this case the kiln was using the wind coming up the valley combined with a stream of draught created by the old mine. This draught can still be observed today. Possibly the mine provided a more steady air current than the rising winds.

The calcination kilns at La Gamberra were very similar in size and construction to local lime kilns, one of which was observed about two kilometres north of Bedar [at the house where we stayed, toponym?].

4. Ore adulteration?

Seven of the spoilheaps with lead-bearing limestone also contained fragments of natural iron oxide. These fragments were always the same size as the surrounding lead ore fragments, suggesting they were broken up, selected and/or sieved together. The iron oxide is identical to pieces found, together with (iron ?) slag, at the Barranco San Marcos, about a kilometre south west, on the other side of El Pinar village and no other iron oxides were seen at the site. It is unclear why the oxide would be mixed with the lead ore, but adulteration is a possibility.

5. Platforms with unknown function

Two well built stone platforms were found, each having a crudely built circular stone setting constructed on top. One of the platforms overlooks a steep valley and could have had a transport function. The same platform was also surrounded by graded spoil which could have masked finer sand, pointing towards a sieving function. But the other platform could neither have had a transport function, nor was there any fine spoil in the vicinity. The function of these platforms remains unknown.

Transport

Several larger tracks on the site, leading to and terminating at partially or fully removed spoilheaps, can be connected to the quarrying of these spoilheaps for gravel. These tracks could mask older tracks connected with the mines. One remaining smaller track in the south west of the site connects several mines and spoilheaps with a partially buried building. Sections of another smaller track lead

from the main mining area towards the east. This would be towards the coast and away from the mining settlement El Pinar

Shelter

The only substantial building in the study area was almost completely buried by the main access track to the site. Two other structures, located around the main mining area, consisted of low dry stone walls combined with small mortared pillars of stone. They are probably the remnants of crude structures functioning as temporary resting or sleeping places for the miners and their animals. The structures could also have functioned as storage spaces for tools and/or lead ore.

Fragments of pottery were found near to these buildings, but also elsewhere. The majority of the pottery fragments originated from jugs, but also pieces from plates and pots were found.

Blacksmithing

Next to two of the kilns, areas containing iron smithing slag were encountered. One of these areas also contained several fragments of worked iron. These are undoubtedly the remains of the blacksmithing being carried out connected with the mining, probably mainly tool repair and possibly the manufacture of iron objects. Why these areas seem to be connected with the kilns, rather than the mines, remains unclear.

Hunting

Several structures were encountered which are related to recent partridge hunting activity. These are represented by circular dry stone built hunting booths providing camouflage for the hunter. Additionally heaps of stone in the vicinity of these booths were constructed as decoy stands. A cage with a female partridge placed on the stone heaps would attract males, which could subsequently be shot.

Conclusions

We hope to have shown that this project, within a short time-frame and using limited resources, has provided valuable insights into a little studied type of industrial landscape. Remnants of the whole chain of production (mining – ore crushing – sieving – calcination – transport) were recorded, next to the remains of housing, storage and blacksmithing.

The calcination kilns represent a potentially unique testimony to the adaptation of an established local technology (lime calcination) to ore processing, using rising winds and even, in one case, the draught created by an abandoned mine.

Some questions remain: the function of the stone platforms, the iron oxide mixed in with the lead ore and the exact nature of the two deep shaft mines all deserve further study.

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