

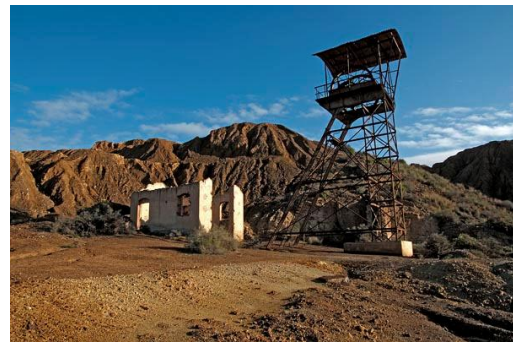


**Notes on the Mazarrón mining area.**

by

**Rob Vernon**

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On behalf of the Friends of La Union Mines

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## 1. Introduction

The Southeastern part of Spain is amongst the most intensely mineralised regions of Europe, with a great variety of ore-forming environments containing primarily Pb-Zn-Ag ores. The most important economic districts from north to south are: Sierra de Cartagena (La Union), Mazarrón, Aguilas and Sierra Almagrera. Mining in some of these Pb-Zn-Ag deposits was economically very important as long ago as the pre-Roman period.

The Mazarrón zinc-lead silver deposit is located in the Murcia Region of SE Spain, 25km from Cartagena. Production peaked in the period 1860-1940 with more than 2,000 people employed. Exploitation was largely by underground selective mining of individual high-grade lead-silver veins down to depths of 600 metres. Total historic production is estimated at 2.5 million tonnes of direct shipping lead ore grading 15% lead and 150g/t silver. The zinc-rich ore in the uppermost part of the vein system (25-100 metres depth) was left largely untouched. Partial mining of this ore type was undertaken from 1950 to 1966 when flotation techniques became available to separate the lead and zinc sulphides. A total of one million tonnes of ore grading 5% zinc, 3% lead and 115g/t silver was extracted during this period from large open stopes in near-surface stockwork zones. Mining ceased in 1966 as a consequence of deteriorating mine conditions and declining metal prices.

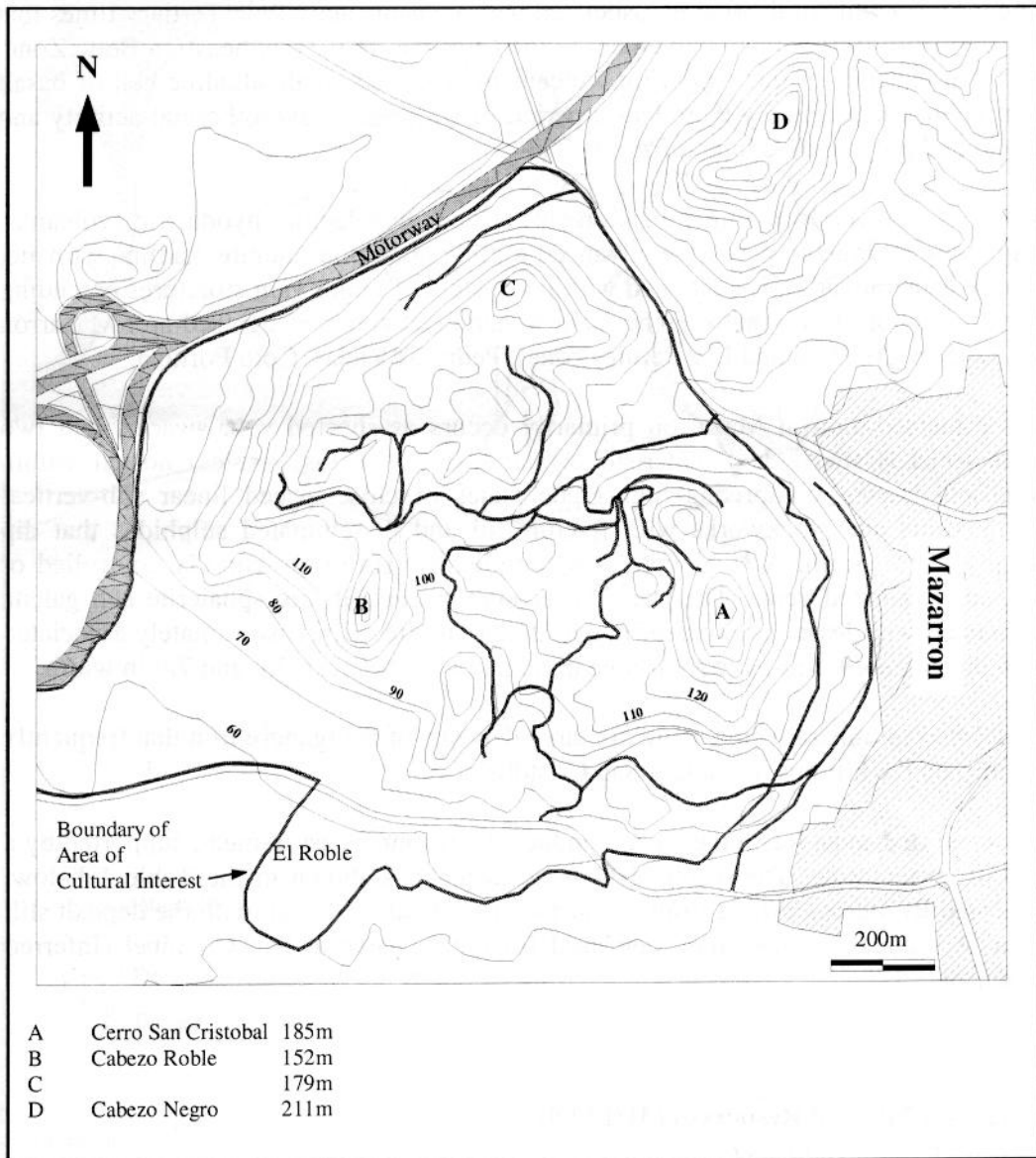
## 2. Setting and Topography

The principal ore deposits occur in the upland area immediately to the west of Mazarrón town, dominated by the hill of San Cristobel rising to a height of 185m ASL. (See Figure 1)

The area is characterised by the presence of many rich colours derived from the minerals in the subsoil (limonite, haematite and manganese oxides), resulting in sterile rocks and contaminated water. A full range of mining activity can be seen virtually everywhere on the hill: deep wide open shafts, headgears, magazines, spoil tips, ore dressing plants, tailing lagoons, offices and workshops. The whole hillside is criss-crossed by tracks allowing easy access across the whole area. Recently the west side of the mining area has been disturbed by the construction of the Cartagena-vera motorway, although this appears to have had minimal impact on mining remains in the area.

In 2005, the whole of the mining area was defined by the Murcian Regional government as being of cultural interest and has been designated as a historical site. The boundary of the area of historical interest is shown in Figure 1.

There are two other areas with significant mining remains at Mazarrón. (i) Coto Fortuna about 2km to the West has an equally long mining history, but is now the backcloth to the local waste disposal point. Workings of Roman origin are present; the san Carlos shaft headgear dominates the site. (ii) Luisito mine about 3km to the north has also been classified as a historical site, and consists of a self-contained group of mine buildings with a fine wooden headgear.



**Figure 1. Mazarrón: Topographical map showing contours and roads.**

### 3. Regional Geology and Mineralisation

The Mazarrón-Águilas mining district is situated in southeastern Spain, in the eastern part of the Cordillera Bética (Betic Mountains or Betic Range). Geologically the region is known as the Betic Zone, a complex structural framework created by the relative movements of the African and European plates since the late Mesozoic. It forms a part of the Alpine fold belt and in the Mazarrón area is typified by intensely deformed and metamorphosed sediments of the Permo-Triassic age.

The lead-zinc mineralization is associated with volcanic activity in Tertiary times that resulted from further plate movement in the Miocene. In the southeastern Betic Zone, as a consequence of this extension, volcanism produced a calc-alkaline belt of basalt to rhyolite rocks. Finally there was a period of widespread hydrothermal activity and associated polymetallic mineralisation.

Most of the known mineralisation is hosted by dacitic-rhyodacitic volcanics displaying strong and pervasive advanced argillic alteration (alunite, kaolinite, jarosite, silica). Mineralization is contained within a system of major vein structures extending down to a depth of 600 metres. The main mineralised zones recognised are: Mazarrón centre (San Cristóbal and Los Perules zone), Pedreras Viejas, Coto Fortuna.

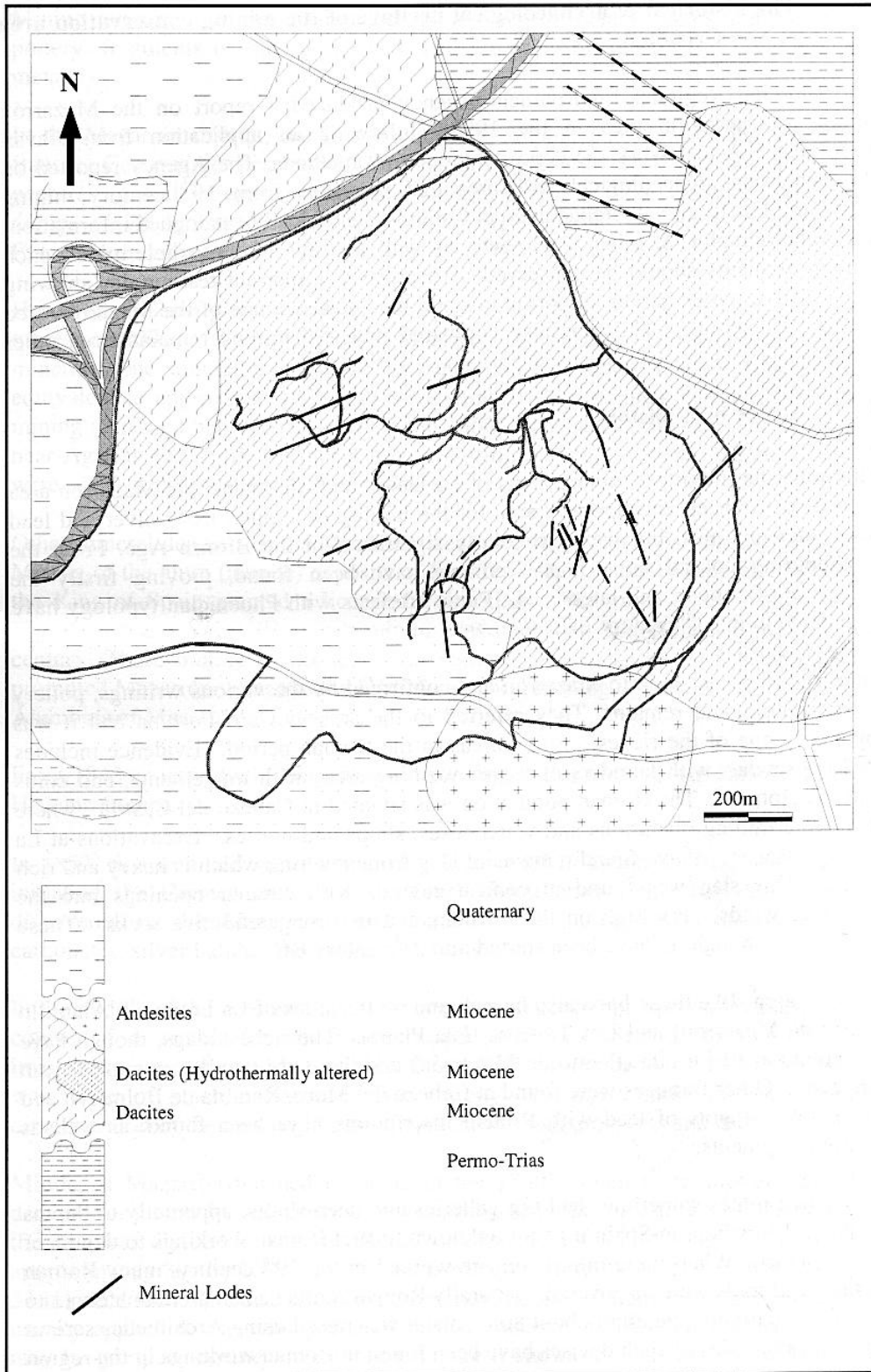
The mineralization at Mazarrón primarily occurs as sheeted vein swarms and two stockworks (Cabezo de San Cristóbal and Cabezo de los Perules) hosted within silicified dacites, comprising high-grade zones of close-spaced linear sub-vertical major veins and stockworks with fracture-fill and disseminated sulphides that dip steeply to the north. A stockwork is a complex system of structurally controlled or randomly oriented veins. The principal economic minerals are sphalerite and galena associated with lesser amounts of marcasite and pyrite. Silver is intimately associated with the galena. Veins have a variable trend and vary between 2m and 7m in width.

In addition to mineral veins, there are large deposits of manganese iron that frequently outcrop on the hilltops, including San Cristóbal.

In the 1990s Navan Resources S.A. conducted a resources assessment, supported by a drilling program. The result of their assessment is shown in the Table 1 below. Indicated Resources extend from the surface to a depth of 120m, with the deposit still open. A manual estimate has been used for the resource at San Cristóbal (Inferred Resource).

<b>Mazarrón Mineral Resources (31/12/99)</b>		
Measured	Indicated	Inferred
	10.7Mt, 2.7%Zn	15.0Mt, 2.0%Zn
	0.6%Pb, 16.6g/t Ag	0.5%Pb, 12.0g/t Ag

Table 1: Ore resources assessment by Navan Resources S.A. in the 1990s



**Figure 2. Mazarrón: Geological plan**

#### **4. The historical & archaeological heritage of the mining conservation area of San Cristobal.**

The Murcian Regional Environment Agency produced a report on the Mazarrón mining conservation area in the 1990s, following an application from the Navam Resouces S.A. to rework the deposit by open-pit methods. He agency reported on the numerous archaeological structures that remained from 19<sup>th</sup> century mining activities. The Regional Archaeological Centre systematically catalogued information, data, photographic & other documents, as well as mine plans to determine which mining elements should be conserved. These were important testimonies showing economic activities, labour opportunities and the social climate of the Mazarrón areain the 19<sup>th</sup> century. This was also compared with old mining remains from other areas.

##### **4.1 A very brief history.**

Adjoining the important mining areas of La Union and Cartagena, the Mazarrón area of Murcia has been an important area for the mining of copper, iron, silver and lead since ancient times, but was particularly significant in the bronze age. From the neighbouring coastal area, many remains have been found, proving firstly the extraction of copper, and later, lead. Punic artefacts with Phoenician typology have been dated to the 3<sup>rd</sup> century BC.

Later, the Romans came to Mazarrón and confirmed by the various writings, pottery and archaeological remains. They referred to the area as Coto Fortuna and it was apparently one of the richest mining areas of the Roman period. Evidence includes drainage ditches with launders of wood, washing areas with implements, and coins with inscriptions. The Romans population was situated in Cabezo del Castillo, where there were mining operations and warehouses, shops and houses. Excavations at La Loma de Herrerias have found remains of slag from smelting which is heavy and rich in lead. This slag was found in conical cavities with circular openings into the prevailing winds, very high on the hillsides and in strong refractive rocks. These practises are thought to ave been started mid 2<sup>nd</sup> century BC.

Smelting area like those have been found on the sides of La Loma del Alamillo (Puerto de Mazarrón ) and Los Tinteros (Isla Plana). The richest slags, though have been found at El Florida (Puerto de Mazarrón) and there are parallel examples fromCartagena. Other furnaces were found at cabezo del Moro, Rambla de Bolnuevo and La Cinuela. Ingots of lead with Roman inscriptions have been found, as well as amphora fragments.

The Roman mines sometimes had big galleries and deep shafts, apparently to depths of 300m. (Elsewhere in Spain it is not unknown to find Roman workings to depths of at least 200m) When these mines were re-worked in the 19<sup>th</sup> century, many Roman artefacts and tools were discovered. Generally Roman shafts had small diameters (1 to 2m), and usually to a depth of about 80m. Water was raised using Archimedes screws and many examples of such devices have been found in Roman workings in the region af Andalucia.

Mining remains from the Islamic occupation period include lamps and explosives, pottery, fragments of blue-grey glass, and lamps using manganese with reflective metal.

In the Mazarrón district, the first documented mining dates from 1587 when Juan Bautista Genoves got permission from the government to work several argentiferous pedreras (gravel dumps) in Mazarrón village; probably these were ancient Roman dumps of Pb-Ag ores or slags. A century later in 1688, the king of Spain gave Francisco de Leiva permission to work a silver mine at Mazarrón.

However, the area gained significance in the nineteenth century; in 1840 there were more than 200 shafts and galleries at Mazarrón, and in 1843 40,670 quintales of lead minerals (one quintal is about 46 kg) and 96,849 marks of silver (one mark is equivalent to approximately 230g) were shipped from Aguilas harbour. Silver-lead mining increased between these times and 1860, especially in the lomo de bas mines near Aguilas and in the Mazarrón mines. During this period these lead/zinc deposits were some of the most productive in Spain.

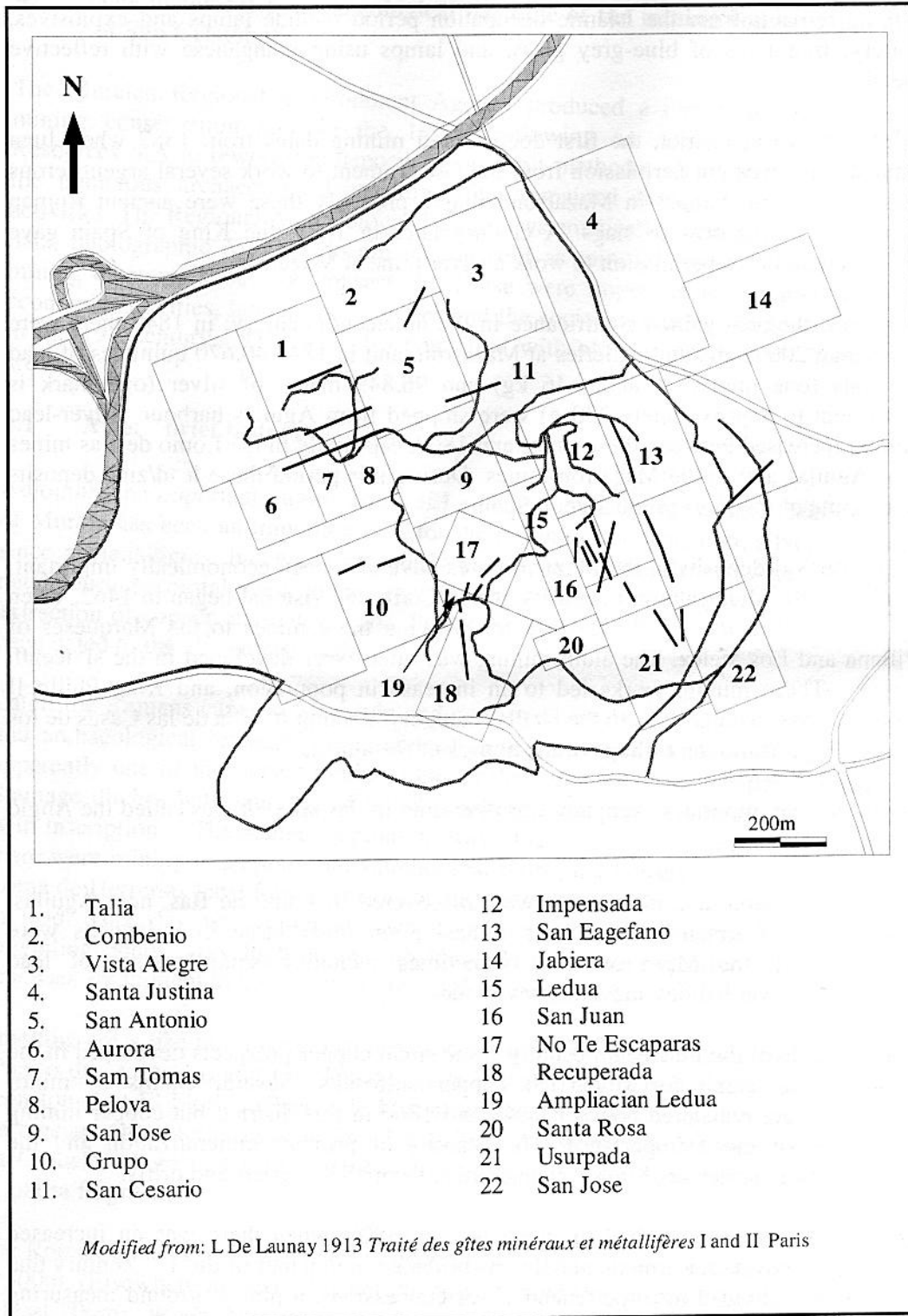
Other mineral deposits in the Mazarrón area have also been economically important. Mining of the alum (alunite) deposits of San Cerro de Cristobal began in 1462, when the king of Spain granted a license for working these mines to the Marquesas of Villena and Los Velez. The alum mining was intensively developed in the sixteenth century. These mining works led to an increase in population, and King Philip II promoted Mazarrón village to the "Villa" category, naming it Villa de las Casas do los Alumbres of Mazarrón (village of the houses of the alum).

From 1843 an important Company was operating in this area. It was called the Anglo Hispana Company.

In 1853, rich iron and silver veins were discovered in Lomo de bas, near Aguilas, initiating the Carmen and La Cruz mines. Soon other large iron deposits were discovered in the Mazarrón area, sometimes including small masses of lead carbonates, silver halides and antimony oxides.

In the middle of the nineteenth century some small copper prospects developed in the course of a search for silver-rich copper sulfosalts. Several claims of minor importance are registered between 1842 and 1860 in this district, but copper mining was never of much importance. The scarcity of primary mineralization and the dissemination of the ores limited development to small prospects and drifts.

Mining at Mazarrón reached its acme in the late 1880s when there was an increased demand for metals for armaments. It was probable in this half of the 19<sup>th</sup> century that the area was divided into 'pertenencias' or concessions, a plot of ground measuring approximately 300 by 200 varas (A vara is sometimes referred to as the Spanish yard = 33 imperial inches). Concessions are often named after a Saint, and the name is also usually applied to the principal shaft of that concession. Through time concessions may be grouped together or extended. Figure 3 shows the concessions at Mazarrón about 1905.



**Figure 3. Mazarrón: Mining concessions c1905**

The French Company, Compañia d'Aguilas (see share certificate on the front cover), founded in 1881 by the Rothschild Bank in Paris, worked the deposit as part of their campaign to contrao metal production in southeast Spain. They were able to achieve much higher output by improving ventilation and mines drainage, and

introducing electricity in the late 1890s for pumping, winding etc. The company also established a steam tramway to the Port.

In 1885 the Comania Metalurgica de Mazarrón stimulated production by establishing the successful Santa Elisa smelting works, and in 1886 six big calcining furnaces were constructed. Traces of the Fundicion Santa Elisa can still be seen, predominantly on the west side of the Cabezo del Faro, at Puerto Mazarrón.

In the late 19<sup>th</sup> century several British based companies attempted to work mines in the Mazarrón area. These included the Coto Fortuna mining Co Ltd (formed in 1874); Cervantes Silver Mines Ltd (formed in 1884); and the Mazarrón Manganese Iron Ore Co (formed in 1891). However none of these companies survived very long.

One of the main problems encountered in the workings was the presence of Carbonic Acid. Not only was it corrosive, it could make working conditions very unpleasant and even fatal. In February 1893 for example, in the Impensada mine 27 miners were suffocated by the accumulation of poisonous gases. The accumulation of gases was such that it was sometime before the bodies could be recovered.

By the late 1920's the most important mine was San Jose, which provided 20% of Murcia's total lead output and 60% of Mazarrón's.

In 1931 the Compañia de Mineros de Mazarrón was formed, which shared the same Mining Engineer/Director as Compañia de las Minas de Hierro de Bedar and increased the wages of the workers.

From 1951 - 1962 the Empresa Minerales No Ferricas S.A. (later called Minas de Cartes) re-opened more old workings and established a new system of ore dressing using flotation principles.

Since 1972 the Compañias Asarco, Billiton Espanola S.A. and Navan S.A. have set up feasibility studies and made various attempts at re-working the mines.

By the beginning of the twentieth century, iron mining had stopped. The alumina mines were definitively closed in 1953, and mining activities in the lead-zinc deposits of Mazarrón had stopped in 1969.

In July 1991 Navan Resources plc wholly owned subsidiary, Navan S.A. paid \$US22,000 for an option for 100% interest in the ground holdings of Minerales no Ferricos SA (Minofer) and Mazarrón. The option was for over a period of 90 years and exercisable at a cost of \$135,000 plus a 3% net smelter return to Minofer.

An initial feasibility study supported by a drilling programme was completed in the mid-1990s and this was followed by applications for relevant permits required for mining. However Navan Resources plc went into receivership in 2002 and no mining work was undertaken.

## 4.2 Mining remains.

Resolution 20299 issued by the Comunidad Autonoma de la Region de Murcia on the 9<sup>th</sup> November 2005 lists 76 structures spread across 15 concession at Mazarrón that are of historic interest. Some of the principal structures with their locations identified on Figure 4 are:-

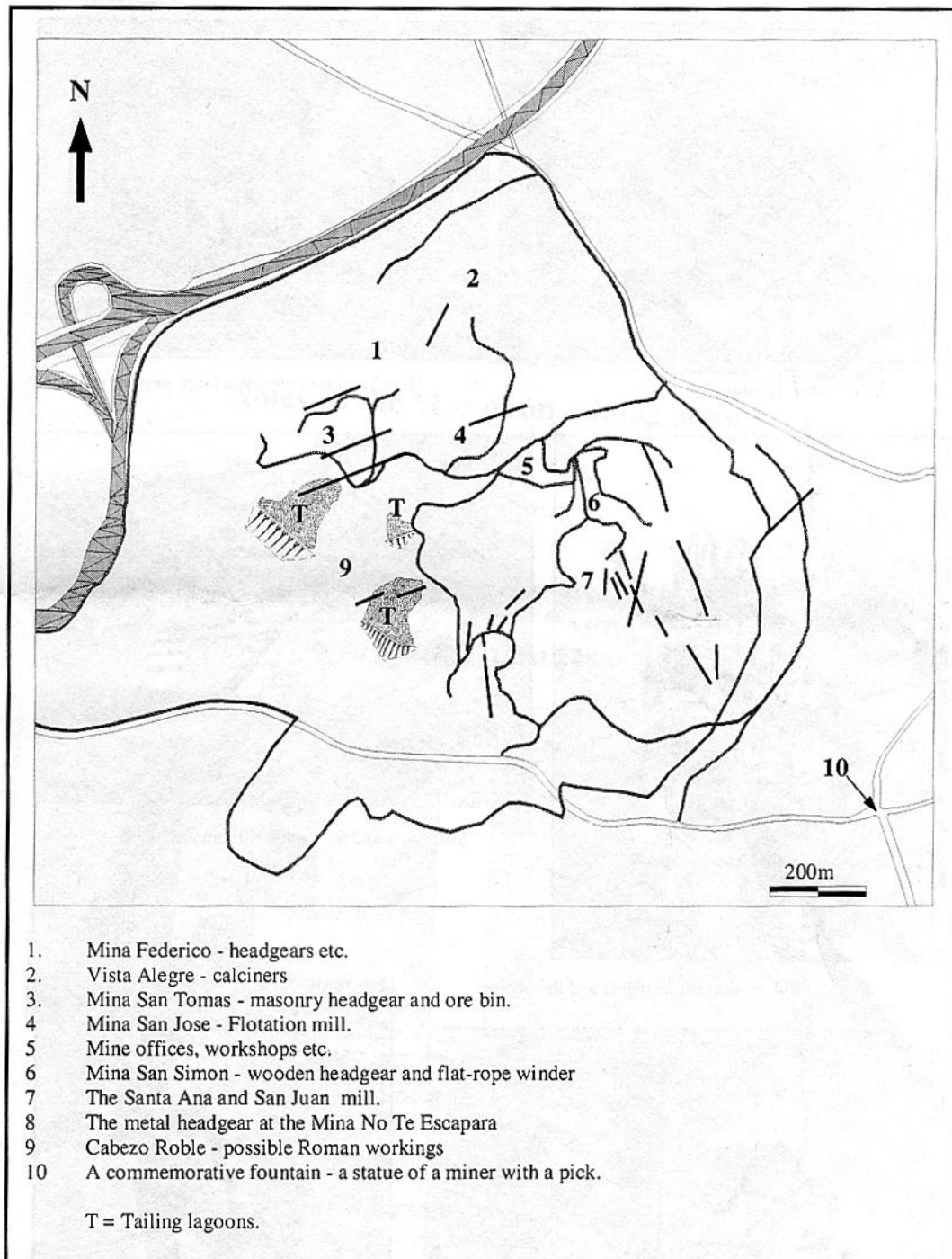
- 1) Mina Federico (Concession San Antonio) at the northern end of the area contains the remains of a metal headgear and winding engine house as well as a powder magazine. There are also possible Roman mining trenches.
- 2) Concession Vista Alegre contains two calciners.
- 3) Mina San Tomas (Concession San Tomas) contains a masonry headgear and ore bins.
- 4) Mina San Jose (Concession San Jose) contains a large stepped mill. There is a major winding shaft at the top of the structure. A short blocked adit is presumed to connect with the shaft. This is probably the most recent structure on the site and was probably constructed by the Empresa Minerales No Ferricos SA in the 1950s to house their flotation plant. Three major tailing lagoons lie to the south and west of this structure.
- 5) East of the San Jose Mill there are a series of mine offices and workshops. Some of these buildings may have been constructed by the Compañia d'Aguilas in the late 1800s and reused or modified by later mining companies.
- 6) Mina San Simon (Concession Ledua) contains a fine wooden headgear and the remains of a flat-rope winder complete with reels and rope. The winding engine was housed in a wooden 'shed' type construction that has collapsed. There is a long masonry building next to the shaft.
- 7) The sprawling mill of Santa Ana and San Juan contains numerous features including calciners, an incline and setting tanks. It was probably constructed by the Compañia d'Aguilas in the late 1800s.
- 8) The metal headgear at the Mina No Te Escapara can be found south of San Jose Mill.
- 9) Cabezo Roble - possible Roman workings.
- 10) In the town of Mazarrón there is a commemorative fountain to the mining that is topped by a statue of a miner with a pick.

## 5. Comments

The Mazarrón hill is riddled with mine workings and contains many more features than those listed above. The majority of shafts have been walled off. However with such a long history the hill can still have a few surprises. So as with any mining area care is required when walking the tracks. In the glare of the sun open unprotected shafts can easily get concealed in the shadows!

The information above has been compiled from numerous sources to be found on the internet, that includes company reports on the operations of Navan Resources, various mineralogical papers and archaeological reports.

Also a thank you to Boo Vernon for translating the archaeological reports.



**Figure 4. Mazarrón: Some of the areas of interest.**

Mazarrón: Some of the mining remains.



3. Mina San Tomas



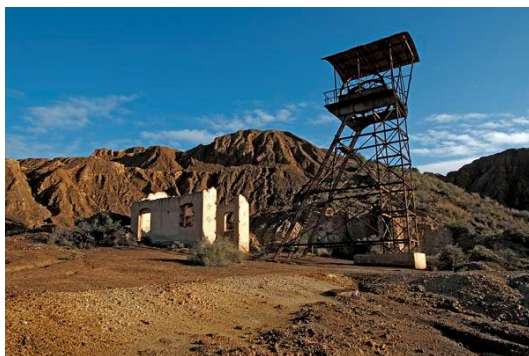
4. Mina San Jose contains a large stepped mill



6. Mina San Simon wooden headgear



Flat Rope Winder



8. Mina No Te Escapara headgear

