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### A bit of history

After the end of the Carthaginian domination of Iberia after being defeated in the war, Rome supplanted the Punic power in the Iberian Peninsula, gradually and systematically incorporating the various peoples and lands present in the territory as a consequence of its expansionist policy, in a process that would last for about two centuries. In the regulation and planning of the territory, then under its domain or to be conquered, the still Roman Republic, initially established two geographical areas clearly differentiated based on the respective areas of operations of the two active armies present in Hispania during the war with Carthage. Thus, around 197 BCE., a first structural organization was established with the administrative division of the territory into two provincial units called *Citerior* and *Uterior*.

The two circumscriptions of *Hispania Citerior* (in definition the closest to Rome), and *Hispania Uterior* (the most distant) would remain as a geopolitical reference, annexing new territories until the complete conquest of the last peninsular territories during the times of Augustus' Principate. With Augustus and around the year 27 BCE, a new reorganization of the Hispanic provinces was to be carried out, where the old *Citerior* province would be renamed *Citerior Tarraconense*, taking its name from its capital, the city of Tarraco, while the *Uterior* province would end up being subdivided into two, giving rise to two new administrative entities, called *Baetica* and *Lusitania* (Fig. 1).



Figure 1. Map of Hispania in times of Augustus with its provincial subdivisions into senatorial and imperial provinces. The two areas of exploitation of *lapis specularis* mining in Roman times are also shown. Illustration: Juan Carlos Guisado di Monti.

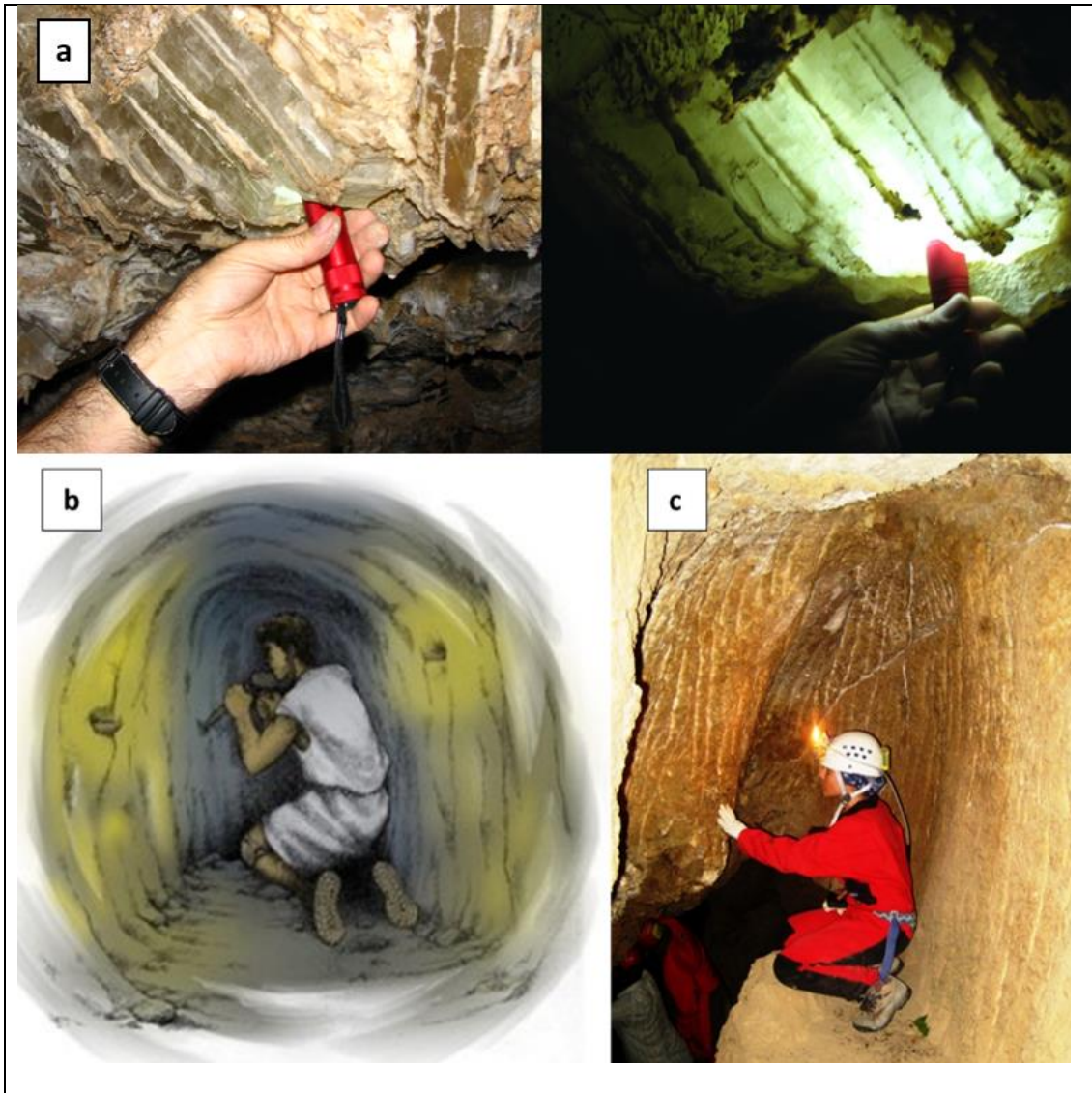
This redivision into three new provincial units was motivated by the profound transformation and categorization imposed by Augustus, with the establishment of a classificatory differentiation between senatorial and imperial provinces, according to their system and management model. The senatorial provinces, as in the case of *Baetica*, were governed by senatorial magistrates dependent and elected by the Senate, while in those of imperial influence, their administration and management were directly in the hands of the emperor—were directly/fell directly within the competence of the emperor.

During the reign of Augustus, another new organizational restructuring of the Hispanic territory would be carried out. This new policy consisted of qualitative separations and annexations to the *Citerior Tarraconense* of important mining areas that formerly belonged to the senatorial province. The restructuring undoubtedly responded to a personal, political and socioeconomic interest, to control and regulate these mining resources by the emperor himself to incorporate them as productive assets to the Imperial Treasury. In this regard, the mines of *lapis specularis*, which began their activity in Hispania in the time of Emperor Augustus, are in line with these structural reforms that, in the case of the selenitic gypsum mines of the region of Andalusia, would undergo a transcendental change. They would no longer belong to the senatorial *Baetic* province legally and administratively, but to the imperial *Citerior*, together with areas rich in other mineral resources also existing in the northern area of Almeria. This intervention of the provincial land would entail the change of ascription to the new imperial territory in which they remained integrated, and whose purpose was none other than to achieve, with the new reorganization, the optimization of the mining exploitation and its greater profitability on the basis of taxation criteria.

*Lapis specularis* mining was already being referred to by the Roman author and naturalist Pliny the Elder (Caius Plinius Secundus: 23 AD. – 79 AD. This type of exploitation would be developed in Hispania in the province *Citerior Tarraconense*, basically in two different and distant geographical areas within the same imperial province. On the one hand, the area of reference defined in the Plinian narrative of the *Naturalis Historia*, comprised around "One hundred thousand steps around the city of Segobriga", in the region or autonomous community of Castilla-La Mancha. On the other hand, it also included another mining area recently identified and yet to be defined in its dimension and research in the current autonomous community of Andalusia. The result of this economic model was the revitalization of the mining regions as areas that would generate wealth and the necessary fiscal resources for the empire.

The mining activity generated in Roman times in Hispania as a provincial area subjected to exploitation had numerous and varied mining resources in the territory, both for metals and minerals. Among the latter, a stony mineral of singular transparency, quality, beauty and easy to work with due to its characteristics, became the constructive and versatile material known as *lapis specularis* (**Fig. 2**).

*Lapis specularis*, or specular gypsum, is a selenitic gypsum that occurs in nature in the form of large crystalline and transparent masses. Its laminar structure allowed to obtain with its exfoliation different hyaline sheets that, in Roman times, were used after their elaboration preferably for the enclosure and glazing of windows and openings, similarly to our modern glasses.



**Figure 2. (a) Detail of the laminar structure and of the mining work on the selenitic gypsum glass inside a roman *lapis specularis* mine; (b) Graphic illustration of a mining work figurative scene in the *lapis specularis* mines of Hispania. Drawing by: Lapis Specularis Research Team; (c) Researcher studying the marks present in the surface of a gallery from a Roman mine in El Alquían (Almería).**

In the autonomous community of Andalusia, Roman specular gypsum mining was carried out in the neogenic basins of Almería-Níjar, Sorbas and Vera (**Fig. 3**). These basins are located between the mountain ranges that conform the Baetic Ranges, to the southeast of the Iberian Peninsula, and were formed during the uplift of this mountainous system, when the connection between the Mediterranean Sea and the Atlantic Ocean was closed. These basins are filled with 700 m of sediments from the Middle Miocene to the Pleistocene. Gypsum that emerge in these basins, of Messinian age, constitute the *Yesares* member of the *Caños* formation and have a thickness of 130 m (Braga & Martín, 1992). These gypsums, of marine origin (Braga et al., 2006), are selenitic, and constitute part of the stratigraphic sequences formed, from lowest to the uppermost strata by: limestone, massive selenite, banded selenite, branched selenite and clay (Lugli et al., 2010).



Figure 3. Location of the basins from: (1) Loranca, (2) Almería-Níjar, (3) Sorbas and (4) Vera. A. Almería; C. Cuenca; M. Madrid.

In the mining landscape of Hispania, *lapis specularis* would become one of the most significant and unique mining resources of the *Citerior Tarraconense* province. Despite being a stony mineral, in Roman times its benefit would be carried out through underground mining. They would be supplying, at a time and basically during the first and second centuries, the crystallized gypsum that would serve and be used as the "Crystal of the Empire".

The most significant consequence of the development of Roman *lapis specularis* mining in Hispania was the existence/creation of numerous mining complexes spread throughout the territory where the exploitation and processing of the mineral would be carried out. These mining complexes were made up of sets of mines of greater or lesser entity, grouped in specific and continuous areas of variable dimensions that had in common different infrastructures generated as a consequence of the mining activity (Fig. 4). Thus, at the present, it is possible to verify an archaeological network associated with it.

The mining of *lapis specularis* in Hispania was carried out by underground mining using the technical method of chambers and pillars; with rooms of exploitation and distribution, from which the mining galleries would depart from. Underground, the megacrystalline or selenitic gypsum can be found located in geological blocks of great purity and transparency, embedded in turn within other stratified and microcrystalline gypsum. In search of the beneficial ore of *lapis specularis*, the mining work reached up to forty or fifty meters deep, developing in several floors or levels.



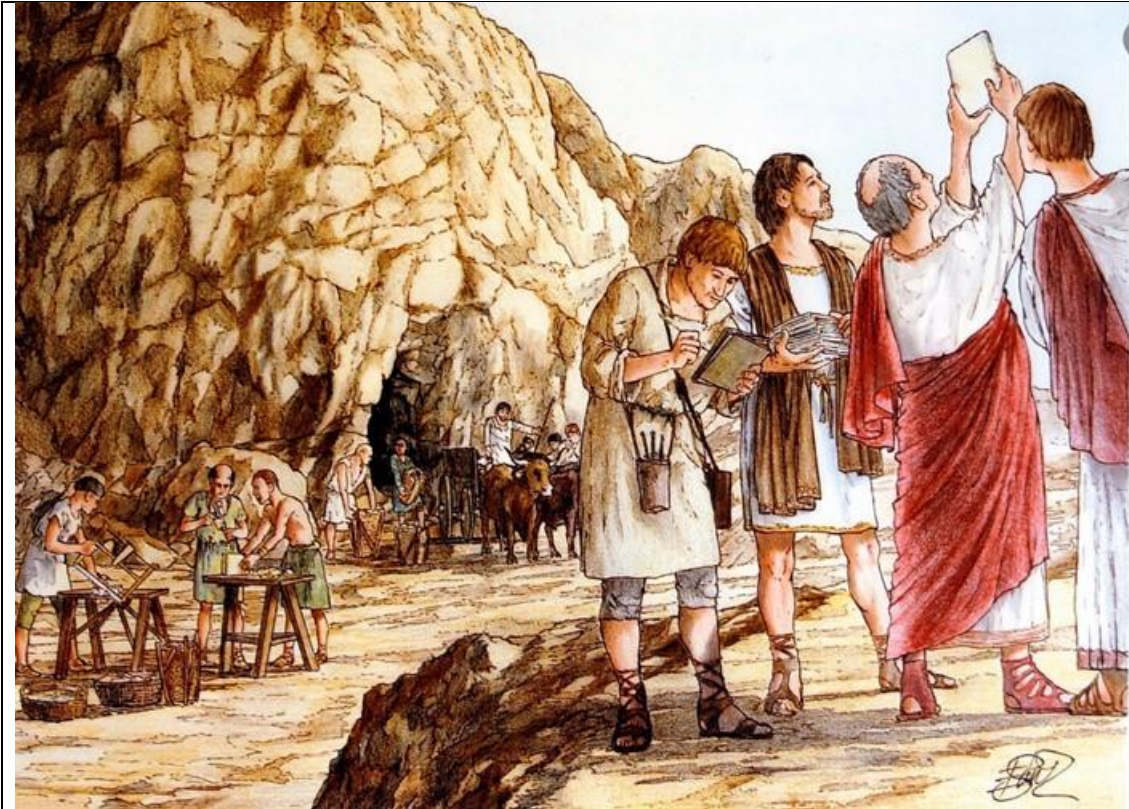


Figure 4. Figurative illustration of the mining work in the *lapis specularis* mine of *El Espejuelo* in Arboleas (Almeria). Drawing by: Emilio Sánchez Guillermo

To extract the mineral, numerous mining wells that connected the surface with the underground interior of the work were used. Mining wells constitute the basic unit of exploitation around which mining facilities are distributed and organized. Their archaeological identification allows to verify the sectorized use of exploitation areas and work areas within the mining complexes. The auxiliary facilities of the mines are located on the surface of the mining area, among which the treatment and processing centres of mineral stand out, as well as other facilities that assist in the mining process (warehouses, furnaces and metallurgical forges, etc.).

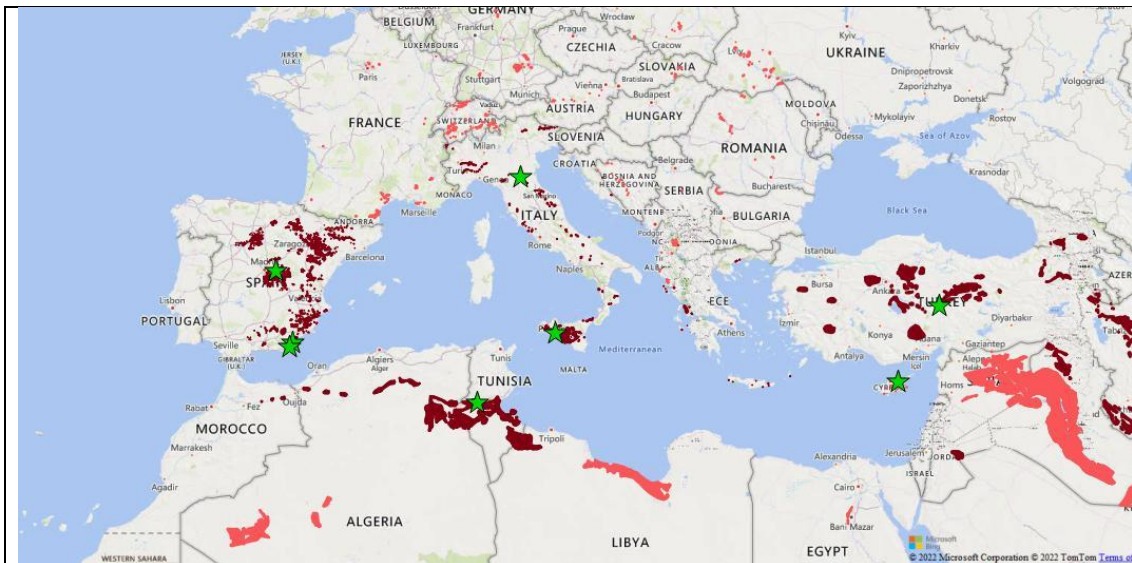
Likewise, in the Hispanic mining of *lapis specularis*, the existence of an organization at the macro spatial level of the mining complexes is worth highlighting, as well as those infrastructures designed for the systematic exploitation of the mining reserves. Among these infrastructures, Roman roads will act as communication routes and as the economic engine of the mines. In the case of the roads in the Castilian-La Mancha area, the road *via del esparto* or *lapis specularis* (the official route in the network of the Empire's roads) will enable the terrestrial commercialization of the mining resource.

### ***Lapis specularis* in the Mediterranean and Andalusia**

Given the peculiar characteristics of the Almeria territory, the so-called "ramblas" or "cañadas" were used as communication arteries through which to transport the mineral. The ramblas constitute ideal and in many cases, unique paths through which the mineral carts could run, as occasional riverbeds in a semi-desert landscape given the poorly permeable nature of their loamy and gypsic materials, as well as the compaction due to long droughts. Thus, they

overcame the geographical accidents and communicated the mining areas with the port areas. In the case of the Arboleas mines, it is the Almanzora river *rambla* that will make it possible to transport the *lapis specularis* to the strategic mining port of Baria in Villaricos (Almeria). Although the Iberian *lapis specularis*' quality and quantity made its extraction profitable, *lapis specularis* was extracted in different locations in the Mediterranean basin (Fig. 5).

Among the former imperial exploitations of this mineral, Hispanic mining would be the main and most dynamic mining district of the Empire, due to its importance. Its end would go hand in hand with the development and the widespread use and acceptance of glass, as a cheaper material than the expensive *lapis specularis*. With the consequent cessation of mining activity, Hispania would lose a unique industry that, after its closure, would not be reactivated.



**Figure 5.** Map of the Mediterranean basin indicating the outcrops of Miocene age gypsum and the places from which *lapis specularis* was extracted (stars). The map does not show the outcrops in Poland, Ukraine and Romania (Based in Lugli et al., 2015).

The Andalusian Roman mining complex of *lapis specularis* has been one of the most important findings of Roman mining archaeology in Spain in recent years. Its recent discovery in the province of Almeria (Fig. 6) has allowed to add a new and significant historical area of Roman exploitation, about which we lacked any information from the classical sources and that had gone unnoticed, despite its entity, in the research and archaeological documentation of the region. So far, the identification of this new mining reality is yet to be defined in its true dimensions and in its overall quantification, not ruling out other areas of the Almeria territory also susceptible to have Roman mining of *lapis specularis*.

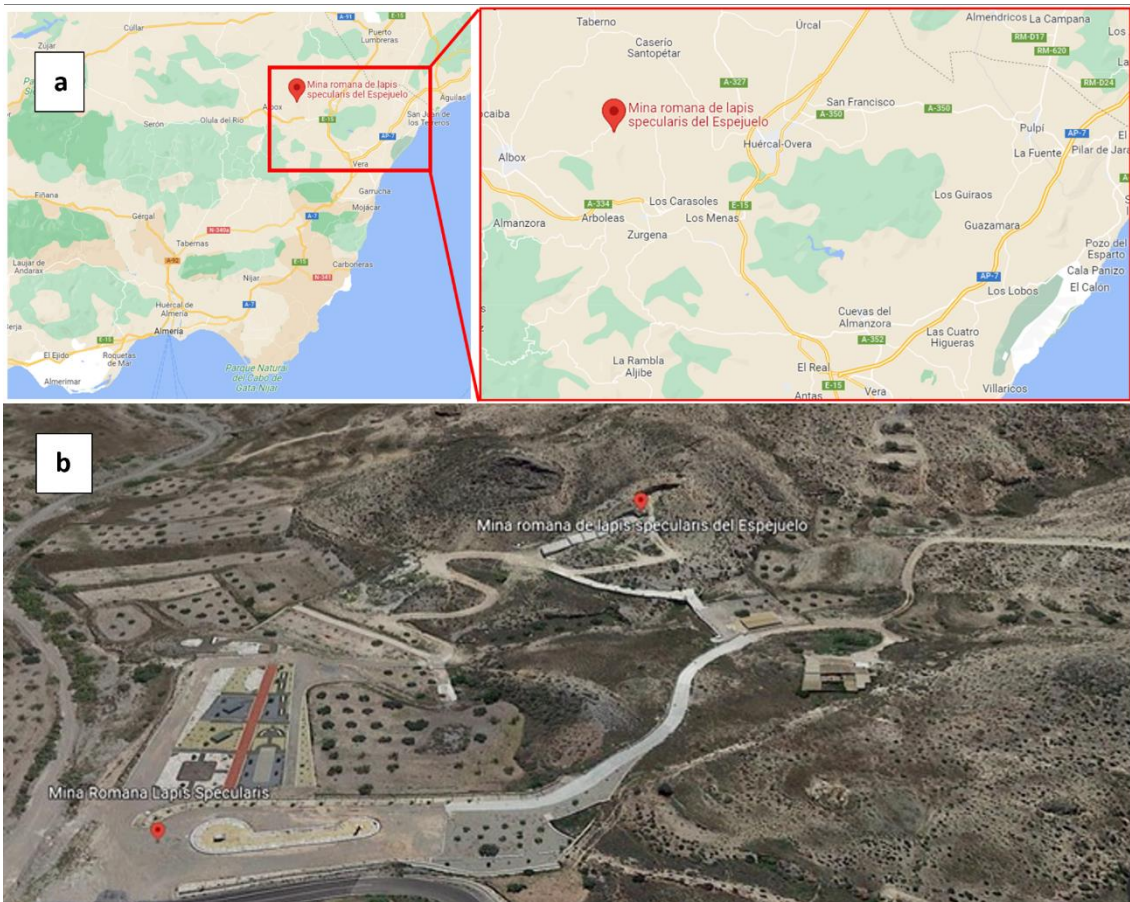


Figura 6.- Municipalities from Almería province that host lapis specularis complexes: 1.- Municipality of Almería (capital): Mining complex of "El Alquian" (AA). 2.- Municipality of Sorbas: Mining complex of "Sorbas" (S). 3.- Municipality of Arboleas: Mining complex of "Arboleas" (AR). Generated from Diaz Alvarez Jose R. (1984) and obtained from Pepe Benavente's unpublished book.

**Mining complex of "Arboleas"**

The Roman mining complex of Arboleas is located in the Almanzora valley. (Fig. 7). It is a mining area of special historical relevance, where the specular gypsum mineralizations of Cerro Limaria, were exploited at the same time as the metallic veins of silver, iron, copper and lead of the mining sites of Herrerias-Sierra Almagrera, Sierra de Almagro and Sierra de los Filabres.

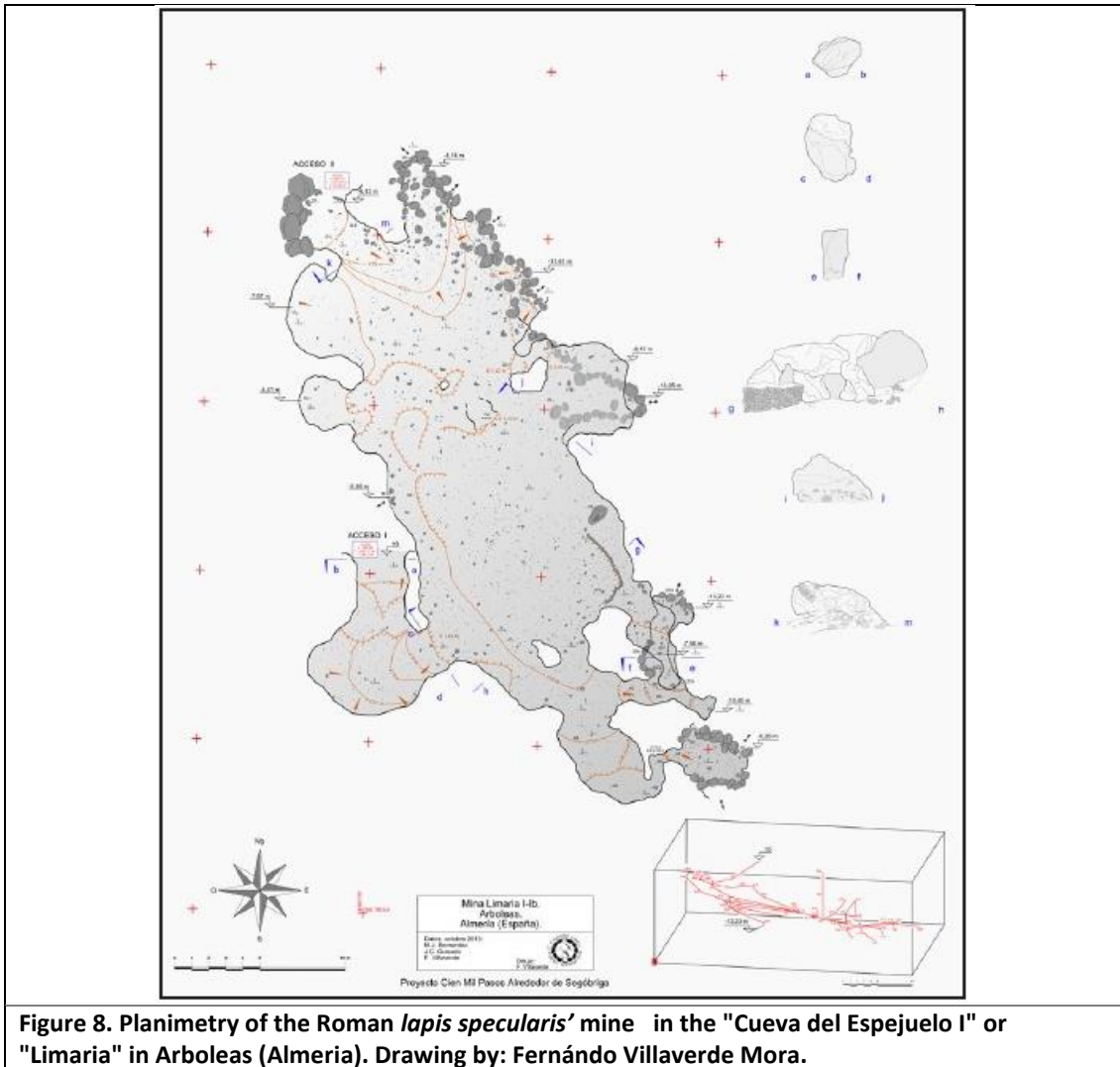




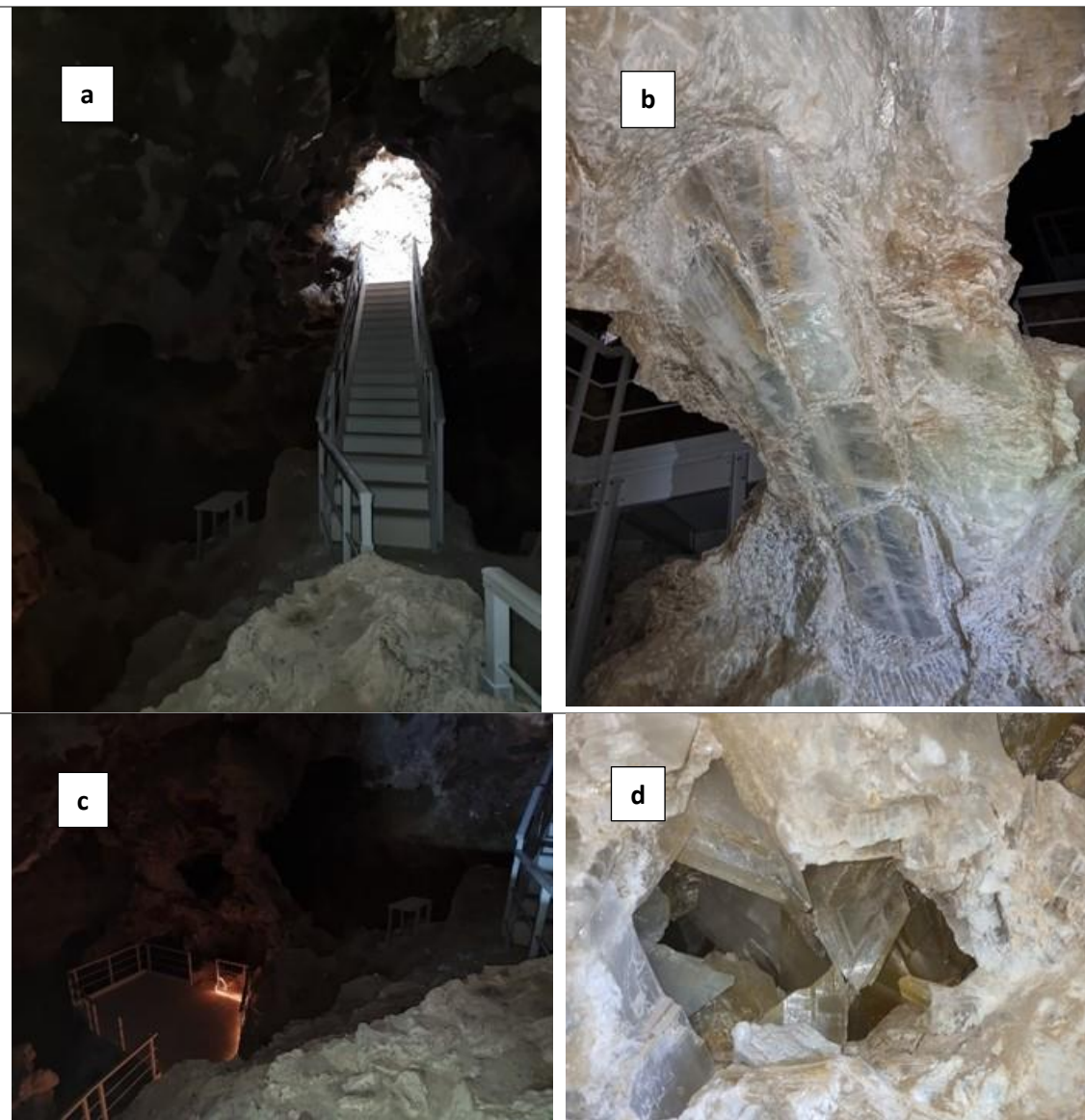
**Figure 7. (a) Location of the mining complex of Arboleas in the province of Almería; (b) Detail of the distribution inside the complex .**

In this complex, in the neighbourhood of Los Higuerales, at the foot of Cerro Limaria and its surroundings, eight not yet fully explored mines of *lapis specularis* have been located to date. The main ones are: the cave-mine *El Angel* or mine *de los Espejos*, the *Sima del Perro* and, most importantly, the mine *del Espejuelo* (Fig. 8). The transport of the *lapis specularis* extracted from this mine was carried out by the Romans through the Surbo River, currently called the Almanzora River, to the Roman Baria, the present village of Villaricos, where the ships waited to transport it to Cartagonova and from there to Imperial Rome itself.





Currently, in the mine del *Espejuelo*, equipment and conditioning work is being done to allow for its touristic use. Works are very advanced, and it is expected to be inaugurated in the present year, 2022 (Fig. 9). This will be the first Roman *mine of lapis specularis* to be used for tourism, not only in Almeria, but throughout the autonomous community of Andalusia as well.



**Figure 9. Details of the interior of the mine. (a) Access ladder to the main chamber; (b) Columnar crystalline formation; (c) Lower floor of the main gallery; (d) detail of the work front for ore extraction.**

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