A multiapproach for solving geoarchaeological problems: inferences from Roman gold mining in the Eria Valley (León)

Un enfoque múltiple para resolver problemas geoarqueológicos: inferencias de la minería de oro romana en el valle del Eria (León)

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ABSTRACT

The Eria River valley exhibits one of the largest gold mining complexes in NW Iberia from Roman Age. In this study, a geoarchaeological work is presented, combining a multiapproach based on airborne LiDAR remote sensing, descriptive geology and radiocarbon dating. The studied area is characterized by the presence of a mining infrastructure comprised of hydraulic canals driving the water at different levels to the mines. Mining works were associated with Plio-Quaternary raña deposits and Quaternary materials consisting of hillside and periglacial deposits, and fluvial terraces. The washing of the gold deposits used the hydraulic force to break up and drag out the sediment, giving rise to three different types of exploitation depending on the characteristics of the different materials. The results shed light on the geological materials exploited and other geo-morphological aspects associated with the exploitation techniques. The work contributes to improving the knowledge about Roman gold mining and its geological context in northwest Iberia.

Key-words: geoarchaeology, roman gold mining, Eria river valley, radiocarbon dating, LiDAR.

Introduction

The most prolific auriferous mining sector in the Iberian Peninsula configures a bent gold belt that extends from the regions of Asturias and Galicia towards the Duero Basin (Fig.1A). This area is interspersed with a large number of mines that dates back to the Roman times (Pérez-García et al., 2000; Sánchez-Palencia and Currás-Refojos, 2014). Despite most of these sectors are well known since the early 70-80s decades (Lewis and Jones, 1970; Domergue, 1970; Sánchez-Palencia, 1980; Bird, 1984), there are fundamental questions concerning the geology of exploited deposits that remain unclear yet. Differentiate between natural landforms or anthropic deposits is not always obvious due to the important landscape transformation that occurred during the past 2,000 years (Fernández-Lozano et al., 2020). Therefore, a more detailed analysis based on the combination of different methods (geomorphological analysis, geochronology, etc.) and techniques (remote sensing from LiDAR and drone data) can shed light into the mining landscape, providing new insights over the nature of the mining deposits (i.e. natural or anthropic) and the location of gold occurrences to historians, archaeologist, and geologist.

This research work explores in detail a small sector of the Eria river valley (León) to describe the Roman gold mining infrastructure and the geomorphological features associated with the exploitation of secondary deposits (Fig. 1B). The implemented multidisciplinary approach relies on geomorphological mapping, stratigraphic analysis, high-resolution LiDAR-derived data (1 m Digital Terrain Models) and geochronology based on radiocarbon dating from a charcoal sample.

Roman hydrologic infrastructure

The mining infrastructure implemented for hushing the auriferous deposits comprised a dense irrigation system of canals and tanks for water collection (Fig. 1B). In the study area, two different types of canals can be recognized according to Sánchez-Palencia (2014): i) supply canals or corruig (numbered c-1, etc.), which bring water from the catchment areas (rivers or springs) or tanks that regulate the volume of water and transport it to the principal mining sectors; and ii) exploitation canals or emissaria (numbered e-1,
etc.), which usually present variable-length showing ramifications from supply channels and tanks and directed to the exploitation fronts. Note that the canal number shown in figure 1B is solely referred to the studied sectors.

Material and Methods

Firstly, a 1:25,000 geological and geomorphological mapping was carried out using 3D images from Junta de Castilla y León Spatial Data Infrastructure-Idecyl service (https://idecyl.jcyl.es). Then, a detailed stratigraphic column of the most controversial deposit (Figs. 2 and 3) and the radiocarbon 14C (tested at the BETA Analytics laboratory) analysis of a piece of charcoal collected from a tree branch fragment found in the interior of the material complemented the interpretation of natural and anthropic landforms related to the mining activity. Moreover, detailed surveying of the mining infrastructure was performed using high-resolution (1 m) LiDAR-derived images from the Spanish Geographical Institute (www.ign.es). Finally, the identification and description of different mining elements were assessed with fieldwork.

Results and discussion

The studied area consists of secondary gold occurrences. Detailed geological mapping pointed out to three main deposits that were exploited by the Romans: i) Plio-Quaternary raña deposits consisting of orange to reddish conglomerates typical of alluvial fans; ii) Quaternary fluvial terraces of the Eria River that comprise up to 4 levels (see Fig. 1, levels T4-T1), and iii) scree deposits. The raña conglomerates were intensively exploited in the valley, but in many areas, their presence has been inferred from the exposed mining tails, locally named muriás (see mining sectors S-2, 5, 6 and 7 in Fig. 1B). The exploitation of these deposits consisted of deep trenches and mining cuts using the hydraulic force. While the fluvial terraces are widespread identified over the valley, the landscape transformation due to agriculture and livestock conceals the mining works. However, the development of hummocky morphologies suggests the presence of gold works. Another outstanding feature is represented by abundant scree with charcoal fragments (Figs. 2A,B) that may resemble deposits originated during the mining works (deposit S-3 in Fig. 1B). To gain insights into the nature of these deposits a detailed stratigraphic section was performed as shown in figure 3. It comprises a symmetric alternance of argillaceous microconglomerates (slate fragments < 1.5 cm) and conglomerates
northwest Iberian Peninsula represents a natural laboratory for unveiling ancient mining landscapes. The identification of large volumes of material and geological formations altered for gold extraction can provide new insights into the large-scale infrastructure developed during the Roman times. The discovery of new elements of the hydraulic system and the geological characterization of auriferous materials improves the knowledge of the Roman gold mining in the Eria River valley (León) and contributes to better understand the technical and methodological mining developments implemented by the Romans in Hispania.

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References


Conclusions

Understanding the geomorphic landforms in a mining context is vital to identify the Roman activity preserved over the landscape successfully. The hydraulic infrastructure conceived by the Romans to benefit these auriferous deposits consisted of a system of canals excavated in slate or volcanoclastic rocks and leads to bring the water to the main mining sectors (Figs. 4A,C,D). Approximately they comprised a network over 3.5 km that collected water from rivers, streams and springs. The water level across these canals there must have been variable, as it has been observed to vary from a few centimetres to 0.35-0.40 m. Also, the canal width shows important variations from 0.4 m to over 1.2 m both differences must account either for the availability of water from the catchment areas and/or the strength of the excavated material (rock or soil) (Fernández-Lozano and Sanz-Abalanedo, 2021). In some cases, these canals were reinforced using nearby resources such as slate to build retaining walls (Fig. 4D).

The striking mine tailings, also known as murias, are widespread in the area (Fig. 4E). They consist of quartzite boulders that were set aside and accumulated during the mining works. Their size and characteristics are compatible with the observed alluvial fan reddish conglomerates of the raña. It is also important to notice the presence of prospection levels, a type of horizontal galleries carried out in the red sediments and often used to control the gold grades before the mine was abandon (Fig. 4F).

Fig. 2.- A) Studied section. B) Coal fragment used for 14C dating. Ver figura en color en la web.

Fig. 2.- A) Sección estudiada. B) Fragmento de carbón sobre el que se ha realizado la datación por 14C. See color figure in the web.

Fig. 3.- Tentative cross-section depicting the stratigraphy of the grèzes litées-type deposit. Ver figura en color en la web.

Fig. 3.- Columna estratigráfica del depósito de tipo grèzes litées. See color figure in the web.
Fig. 4.- A) Supply canal (c-1) collecting water from the Truchillas River. B) Converging grooves used for the extraction of gold in the grèzes litées-like deposit. C) Leat (c-1) from the Valdavido sector. D) Slate tiles used for wall protection of the (c-4) canal in the Valdavido sector. E) Mine tailings (murias) in Las Llamas sector. F) Prospection levels excavated in the raña deposits covered by mine tailings (locally called San Martín Cave). Ver figura en color en la web.