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Configuring the landscape: Roman mining in the conventus Asturum (NW Hispania)

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Abstract
The conventus Iuridicus Asturum (mainly, though not only, modern Asturias and León provinces in Spain) was created after the Cantabrian Wars carried out by Augustus himself, which finished in 19 BC. Even though the NW quadrant of the Iberian Peninsula was rich in gold, the C. Asturum concentrated the greatest deposits in the western ends of both Asturias and León. The exploitation of gold was a strategic need for Augustus’ new Imperial coin, the aureus. Those areas with rich pre-Roman goldwork were systematically prospected and mined during the first two centuries of the Christian Era. As a consequence, local populations were subjected to a special form of imperialist policy directed at ensuring the maximum output of minerals. Settlement form and function was radically changed and a tributary system was put in place, thereby changing local society completely.

This policy had a major effect on the landscape in two ways: the mines brought about important geomorphological changes, and the territorial policy changed the rural exploitation of the area with a new landscape management and an increasing importance of cereal cultivation. In this paper these changes are brought forth as what they are: a measure of the impact that Roman gold mining had on the landscape.

Keywords
Roman gold mining; geomorphology; palaeoenvironment; pollen analysis; rural exploitation
GEOMORPHOLOGICAL TRANSFORMATIONS AND FOREST EVOLUTION

In 19 BC the Cantabrian Wars ended. At that moment Roman Asturia was configured as the Conventus Iuridicus Asturum (see Figure 1), thereby becoming incorporated into the Empire. In that area gold had already been exploited at the artisan level (Fernández-Posse de Arnáiz et al. 2004; Sánchez-Palencia Ramos & Fernández-Posse de Arnáiz 1998), generating a rich catalogue of goldwork from the Iron Age (García Vuelta 2007; Montero Ruiz & Rovira Llorens 1991; Diputación Provincial de Lugo, 1996; Perea Caveda & Sánchez-Palencia Ramos 1995). Augustus had designed a new monetary system which consolidated the aureus and the denarius as the gold and silver standards, exhibiting the strength of the imperial treasury (Crawford 1985, 258-260). In order to mint the aurei the amount of gold needed was multiplied, no doubt spurring a massive survey of the sites throughout the region. As a result, a great number of mostly open-cast mines were opened in the 1st century AD.

Geomorphological transformations of the landscape

Three decades of thorough research on Roman gold mining (Domergue 1986; Sánchez-Palencia Ramos 2000; Sánchez-Palencia Ramos et al. 1996) has allowed a better understanding of Pliny the Elder’s description of the techniques used in the peninsular NW: the aurum arrugiae (Nat. 33.71-72). A hydraulic network of channels (corrugi) supplied with water the deposits (piscinae or stagna) which sat at the edge of the mining front. As the front advanced upwards – or receded back up the mountain – the network
had to be redesigned at higher altitudes, thus allowing the exploitation to move from the valleys up the mountain.

The pureness of gold of these sites is low by today’s standards. The amount of earth that needed to be removed to reach the richer levels impressed Pliny (see Table 1). The most spectacular method used was described as the ruina montium (Nat. 33.73). Overall, so much soil was dislodged due to gold mining that the lands of Hispania “advanced into the sea” (Nat. 33.76). Drawing on Pliny, two geomorphological transformations are to be expected as results of gold mining; a) the absence of earth due to the mining extraction, which could use the technique of converging furrows or the ruina montium; b) the landfill created by the tailings which form cones and artificially accelerates the sedimentation of certain areas.

**Table 1. Gold pureness in the NW of Hispania (Pérez García et al. 2000, 226).**

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Earth dislodged (m³)</th>
<th>Gold obtained (t)</th>
<th>Gold pureness (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary fluvial deposits</td>
<td>73</td>
<td>7.3</td>
<td>100</td>
</tr>
<tr>
<td>Quaternary moraines and residual placers</td>
<td>12</td>
<td>1.2</td>
<td>100</td>
</tr>
<tr>
<td>Pliocene fluvial deposits</td>
<td>20</td>
<td>1.8</td>
<td>90</td>
</tr>
<tr>
<td>Miocene fluvial fans</td>
<td>203</td>
<td>10.2</td>
<td>50</td>
</tr>
<tr>
<td>Total placers (Neogene+Quaternary)</td>
<td>308</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>Primary deposits (late Hercynian)</td>
<td>290</td>
<td>170</td>
<td>600</td>
</tr>
</tbody>
</table>

These geomorphological changes are clearly visible using stereoscopic aerial photography or satellite imagery, techniques which are necessary for an adequate interpretation of these structures (see Figure 2). On the ground they are also visible. At Las Médulas, the largest gold mine of the region, the ruina montium altered the morphology of 1100 ha through the extraction of ore in 500 ha and the deposition of tailings...
in another 600 ha. The immense volume of displaced earth that suffocated the valley of Carucedo led to the accidental creation of Carucedo lake – stagnant remains of a long-forgotten activity – and the ensuing sedimentation upstream. Today, that little vale enjoys an unusually flat valley bottom of more than 100 ha.

**Forest evolution**

Even though there is a cliché regarding the need for large-scale logging for the mining activity on behalf of the ‘arid and sterile mountains’ of Hispania (Plin. Nat. 33.67), the fact is that the techniques used had no such requirements. Pliny refers to wood being used only in the following ways:

1. Timber used for shoring in galleries or pits, when the technique is *aurum canalicium* (Nat. 33.68), which is rare in the region (an example near Porto, Domergue 1987, 524-526). Some beams have been found in mining contexts, such as the Boinás site in the Sierra de Begega (Villa Valdés 1998, 170-175).
2. Fuel needed to roast the ore which has been ground and washed in primary deposits, or else to melt the remaining slag (Nat. 33.69). Slag mounds, however, are rare in primary gold-mining sites of the region.
3. The heather (Domergue & Hérail 1978, 285-290) used to retain the gold in the washing channels or *agogae*, which was afterwards burned in order to extract from the ashes the gold particles which had been caught in the branches (Nat. 33.76). Pliny himself, however, said that the *arrugiæ* technique using water did not require a melting down of gold, for it was freed by the washing process itself (Nat. 33.77).

Mining, nonetheless, did have an effect on forests, though perhaps not due directly to mining activity, which can be observed in the pollen sequences analysed. Forests, according to these palaeoenvironmental studies, follow their own evolution. In the pre-Roman period (which is attributed data from approximately 150 BC in all our palynological records) we see a deforestation tendency of upper mountain birch forests in the Ancares mountains (Muñoz Sobrino et al. 1995, 1996, 1997), clearly related to the increase of farming activity. In the Courel mountains this same tendency occurs later, and mainly affecting oak forests, which would be transformed into shrub (Aira Rodríguez 1986; Santos et al. 2000).

In the Roman period (see Figure 3), the oak forests of both the Ancares and Courel mountains suffered greatly from the extension of crop and tree cultivation. Farming pressure and mining activity broke the natural forest cycle in those areas, in contrast with the continuity we can see in the upper Porma river basin (Fombella Blanco et al. 1998; García Antón et al. 1997; Muñoz Sobrino et al. 2003). After the mining activity ceased, the deforestation trend would only increase, possibly echoing steadily growing farming and demographic pressure on mountain areas. The receding forests therefore follow a trend which is not directly affected by mining activity.

From the Iron Age, forests in this region lost ground because of human activity. The cultivation of crops and trees did most of the damage to the Holocene forests remaining, regardless of whether there was or was not gold mining carried out by the Romans.
THE ‘SIDE-EFFECTS’ OF MINING: THE PROVINCIALISATION AND EXPLOITATION OF ROMAN ASTURIA

The mining techniques used in Asturia required an extensive control of a large territory and the population that inhabited it, which would have to provide the workforce necessary to exploit the mine, build and maintain the hydraulic network, and provide the food and tools necessary. In order to achieve this, the Empire sent its imperial bureaucrats (the procuratores metallorum and their officina), and used the technical expertise of the army. By establishing the civitas system, the local population was for the first time
subjected to a tributary system which, more often than not, entailed labour at the mines. Gold, therefore, brought to the region a very specific and thorough form of imperialism.

The territory was completely reorganised, with new settlement patterns and a tendency to develop, as far as possible in Antiquity, a partial specialisation of roles within it. In Las Médulas, certain settlements housed foundries, while others had a purely farming vocation. There are cases where the only role was the maintenance of the hydraulic network, compelling small groups to live in otherwise uninhabitable areas (Sánchez-Palencia Ramos 2000, 270-271). These specialisation trends were completely alien to the pre-Roman society, and they bear witness to the integrated exploitation strategy imposed by Rome in this area.

Figure 4: Absence/presence of cultivated species as attested by pollen records. See also full colour section in this book
The environmental effect of the new territorial and social articulation is important. The presence of cultivated species, including cereals – mainly wheat and barley – and the staple Roman fruit-bearing trees chestnut and walnut bear witness to the impact that the Empire had on how the land was exploited (see Figure 4).

**Cereal**

Cereal pollen tends to travel very little, which is a problem given that most samples used here are taken at high altitudes. Their presence in a sample usually attests local cultivation, or else in very small amounts, which can be interpreted as ‘regional presence’. This low proportion is interpreted here as positive presence of the crop. An overview of the palynological results shows that many areas affected by mining show growing cereal cultivation in their environs, clear proof that settlement patterns favoured nearness to the mines – and high pastures – in detriment to a previous preference for more apt locations.

**Chestnut**

With chestnut trees interpretation is more complicated. *Castanea sativa* pollen was associated directly with human exploitation (Behre 1990; Conedera et al, 2004). This is, however, challenged by the attested presence of relic chestnut forests (Krebs et al. 2004), which compels further studies on local microevolution models in order to distinguish natural from anthropic presence. In our case, however, the clear association between Roman presence and abundant chestnut groves seems to favour their interpretation as serving the purposes of local exploitation. Their cultivation, however, is much greater in the mountain areas surrounding mining exploitation (Courel and Ancares), appearing more rarely in other mountain areas or lowlands.

**Walnut**

*Juglans regia* trees, however, do not follow the footsteps of chestnut trees. Their presence increases slowly with time, and they favour those areas not affected by mining. In many ways, their evolution resembles that of cereal cultivation, but enjoying the moment of maximum impact during the later Roman Empire.

**EL CASTRELÍN AND ORELLÁN AS LOCAL EXAMPLES**

El Castrelín and Orellán are two well known settlements around Las Médulas (recently López-Merino et al, 2010). The first is a pre-Roman hill fort and the second is a Roman-era settlement with a certain metallurgical role within the mining territory. The difference in pollen presence belonging to the three cultivated species mentioned before is clear (see Figure 5). El Castrelín, though it did exploit its territory with very similar types of vegetation, did not do so as thoroughly as Orellán would in Roman times, when the landscape around it was deeply transformed by the mine and a much greater settlement density. Indeed, the pre-Roman settlement has 84 % tree pollen – of which none is cultivated – in contrast to the 40% found at Orellán – of which 51% is cultivated chestnut and walnut trees.

These two settlements also have comparable zooarchaeological studies which have shown a much greater use of ovicaprids in the pre-Roman El Castrelín than in the Roman Orellán where, however, the pieces found are much more often butchered pieces (Sánchez-Palencia Ramos 2000, 275). This phenom-
enon suggests local importation of consumption meat, thus illustrating the previously mentioned specialisation trend of settlements during the mining period.

CONCLUSION: THE IMPACT OF MINING ON THE NATURAL LANDSCAPE

This table summarises the effect of mining on the landscape:

<table>
<thead>
<tr>
<th>Geomorphology</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effects</td>
<td>Direct effects</td>
</tr>
<tr>
<td>Raising of the landscape</td>
<td>Devastation of exploitation areas</td>
</tr>
<tr>
<td>Tailings accumulation</td>
<td></td>
</tr>
<tr>
<td>Indirect effects</td>
<td>Indirect effects</td>
</tr>
<tr>
<td>Alteration of the sedimentation regime</td>
<td>Expansion of cereals and chestnuts</td>
</tr>
<tr>
<td></td>
<td>Deforestation</td>
</tr>
</tbody>
</table>

In this paper many pollen samples have been reviewed in order to assess the effect that Roman gold mining had on a particular region of Hispania. Results have, however, shown very little effect directly attributable to the devastation which this activity caused on the landscape. The nature of the sampling techniques available and the location of these sequences in the high mountains make it impossible to measure this. Notwithstanding, the new territorial articulation which mining stimulated throughout the land proved to be a much more powerful transformation force. It is debatable whether there was a significant demographic increase under the Romans in this area, but there is no doubt that the number of settlements, and how thoroughly the landscape was exploited, saw a great increase. Deforestation was a consequence of this increased agricultural activity.

The end of the mining activity (2nd-3rd century AD transition) did not entail an abandonment which would have meant a return to a pre-Roman status. There seems to be, in fact, a further intensifica-
tion of this exploitation, with the generalisation of the walnut cultivation as an example. Society, and how it made use of the land, had changed for good.

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