HOLIDAY GEOLOGY

Las Medulas gold mines, Spain

Away in the northwestern corner of Spain, Las Medulas lies about midway between the famed cathedral cities of Leon and Santiago de Compostela, and is tucked in between the wine region of the Sil valley and Spain's main belt of slate quarries along the Sierra de la Cabrera. It offers unusual geological interest.

Placer gold, probably derived from Variscan hydrothermal veins, was worked more than 2000 years ago at many sites along the southern slopes of the Cantabrian Mountains, but at Las Medulas the Roman occupiers introduced mining on a larger scale. Locally worked placer workings drew them to the site around 27 BC, and over the next 150 years or so, it was the most important source of gold for Imperial Rome

Neogene alluvial conglomerates more than 30 metres thick form faulted outliers on hilltops, locally beneath sandstone caps, over an area of about 10 square kilometres, and these include Neogene placer deposits of native gold. Within the lowest 5 metres of the conglomerate, gold values reach about 0.3 grams per cubic metre, and there are records of nuggets up to 3 kg in weight from the site. Palaeozoic slates and quartzites constitute the local basement, in which veins were the likely source of the gold, though no single large mother lode has ever been found.

The Romans employed a type of hydraulic mining that involved large-scale removal of the hillsides using the erosive power of water. They gathered water from streams off the Sierra de la Cabrera (where the mountain rainfall is higher), and hand-dug canals (with gradients of 0.3%) almost contoured the hillsides for distances of up to 100 km to feed reservoirs above Las Medulas.

Coarse alluvial debris that yielded the highest gold values, in the lower part of the Neogene conglomerate sequence exposed within one of the mine galleries.

Gold was distributed unevenly within the ore field, because its highest values were spread along palaeo-channels, in the same way that pay streaks within alluvium are found and followed by modern placer miners. Once a rich zone had been located by sampling, multiple levels of galleries were hand-dug through the conglomerates. Then torrents of water were released from the high-level reservoirs to erode and enlarge the stacked mine levels, to the point that a whole zone of the hillside collapsed between almost vertical walls. The water and debris swept down the low-level valleys, and at the same time sorted the sediment to create new placer deposits containing the heavy gold, while barren sediment was washed yet further down the valley. It was an early equivalent of the hushing used by lead miners in the northern Pennines, except that the Pennine miners only directed their erosive water along the vein outcrops, whereas the Romans also directed their water power underground. As an early form of hydraulic mining, Las Medulas was a classic (Bird, 2004).

The spectacular view from the Mirador de Orellan across the pinnacled terrain left by the Roman mining at Las Medulas.

The largest surviving mine gallery that was not unroofed by the hushing process.

Newly-formed zones with high gold values in the sediment down-valley were then re-worked with riffle tables to allow collection of the gold, again using the water from the canal systems. The whole process was known as *ruina montium* (wrecking of the mountains), and was comprehensively described by Pliny the Elder. He was for some years the local procurator (a powerful official figure) for the Roman province, before returning home and then being killed by a pyroclastic surge during the Vesuvius eruption of AD 79.

The scale of the mining at Las Medulas can be estimated from the volume of waste in the now-forested dumps; they contain over 80M cubic metres of debris. It is thought that this had yielded between 4 and 5 tonnes of gold during well over a century of extraction at a site worked by up to 10,000 miners. Perhaps they could not be labelled as slaves, but these were local folk given little choice in where to work when controlled and guarded by Roman soldiers. Pliny recorded the awful working conditions, particularly for those who excavated the mine tunnels.

Mining at this scale changed the landscape dramatically, and the scene today is largely what the Romans left behind. It is a spectacular, though artificial, landscape of red cones and towers that rise up to 30 metres from the lush green of the wooded slopes. These red hills are merely residuals left between the areas of working, and many have very steep walls that were created by water erosion within the stacked levels. Surviving within the remnant hills, a handful of mine galleries are up to 20 metres tall, with bare walls beneath reasonably stable arches formed in the poorly bedded conglomerates.

Las Medulas is easily found sone 25 km southwest of the small town of Ponferrada. The mine site extends over an area about a kilometre in diameter, with trails that provide gentle walking around the scenic bits and past the largest of the surviving mine galleries. It is now popular with visitors, and a walk through the canyons and into the mines gives some impression of the sheer scale of Roman activity in their yearning for gold. Also not to be missed is the circuitous loop road round the eastern flank, which takes in the Mirador de Orellan with its spectacular view over the old mines.

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Reference

Bird, D., 2004. Pliny's arrugia: water power in Roman gold-mining. *Mining History* (PDMHS), **15**, 58-63.

Towers of red conglomerate are remnants where gold values in the basal ore beds were too low to be worth working; their vertical walls were created by the multi-level mining.