The medieval mine from Dealul Crucii (Baia Mare, Romania)

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Abstract

Grota din Dealul Crucii (The Smoke Gallery) is the largest known medieval mine in the Baia Mare mining area. The mine was started before the 1500's to exploit an Au-Ag ore deposit, and its greatest extent was reached seemingly in the 2nd half of the XVth century. In order to document the actual state of the old gallery, we resurveyed its medieval part and performed mineralogical studies on the secondary deposits and observations on the techniques used for extraction and the mining technology. The main gallery is 5-15 m high and up to 10 m wide and descends ~40 m from the horizontal entrance following the limit of the mineralization. The main exploitation technique was fire-setting, with the ore sorted on site, as proven by the underground tailings. Wooden beams and as well as pillars made of stacked boulders can still be seen in place. Present day secondary mineral deposits consist of "limonite" stalactites and flowstones, gypsum crusts and crystals, jarosite and melanterite.

1. Brief history of mining in Dealul Crucii

The medieval gallery from Dealul Crucii (hereafter Cross Hill), or the Smoke Gallery (450 m a.s.l.), represents the uppermost level of an extended networks of tunnels and shafts at the northern city limit of Baia Mare (Fig. 1). The Cross Hill (Kerszthegy [hu], Kreuzberg [de]) received its actual name in the XVII-XVIII centuries (SZIRMAI 1809, BRADOFKA 1896). Mining was centered upon the extraction of the “main lode” (major vein), which outcrops at the top of the hill and is oriented NE-SW, dipping at 75^0 NW (BRADOFKA 1896, ISTVAN & MINGHIRAŞ 2004). The main lode is 1 - 8 m thick, with an actual exploited length of 800 – 900 m and with numerous branches, gold- and silver-rich at the top (gold mineralization extending vertically over 600 m) and an increasing Pb-Zn character with depth (GRANCEA et al., 2002; ISTVAN & MINGHIRAŞ 2004). The ore is developed in Pannonian quartz andesites with variable degres of alteration (GRANCEA et al., 2002). Although it is argued by some authors that mining in the general area debuted during the Roman empire (PAGET 1839, SZELLEMY 1894), certain proof of mining activities exists since the XIII-XIVth centuries (PAULINYI 1936, BALOGH 2011). A first period of blooming of the mining activities (gold and silver) is in the 2nd half of the XVth century, when the most extensive mine in the Cross Hill was the “Great mine of the King” (”Kiralyi-Nagy Banya” [hu]), also known as ”Nagy-Verem” (SZIRMAI 1809). According to reports to Ferdinand I of Hungary between 1550-1553 (BALOGH 2011), at the end of the XVth century and the beginning of the XVIth century, seven mining adits were active in the Cross Hill, of which the most extensive was ‘*the large grotto*” (Nagyverem [hu], Grosse Gruben [de]), a complex system consisting of a base gallery (*lat. ”Cuniculus haereditarius”* - SZIRMAI 1809) or ”Erbstollen” [de], (PAULINYI 1936), about 1280 m long, at 345 m a.s.l., which served for evacuating minewater, four ore (and minewater) extraction shafts, lateral galleries, and galleries under the base gallery, and various others at higher altitudes, used for air circulation and smoke exhaustion (SZIRMAI 1809, PAULINYI 1936). The depth reached before 1500 was 152m below the Săsar river (78 m a.s.l.) (SZIRMAI 1809, BRADOFKA 1896) leading to flooding and stagnation of the ore extraction. In 1505 the Thurzós were granted a concession on the mines and their minewater extraction system reached a maximum depth of 265 m below the base gallery (80 m a.s.l.) (PAULINYI 1936, 1978). The interval between the 2nd half of the XVIth century and the first half of the XVIIIth century was marked by stagnations and/or regress, due to unstable political conditions, lack of funds for investment and of technological advances to remove the minewater (PAULINYI 1936). Between 1765 and 1795 a new base gallery was dug at at the lowest possible elevation above the Săsar river flood plain (232 m a.s.l.). Initially named “Saint Cross”, it was later renamed “Lobkovitz”. In 1845, to gain access deeper in the main lode, the Werner shaft was dug at 1062 m from the entrance of this gallery (KOSZTKA 1869), starting from 241 m a.s.l. (BRADOFKA 1896). Through the Werner shaft, old, flooded horizons were reopened and new ones were opened further down. Until 1938-1939 9 horizons were opened, reaching 395 m below the Lobkovitz gallery (BARON 2011), respectively -154 m altitude (b.s.l.). Ore extraction was performed manually until 1939 (BARON, 2011). Mining in the Cross Hill was abandoned in 1948 and restarted in the ’70s with two new horizons (X and XI) (KACSO 2011). By 2007, mining operations were closed down in the whole region (KOVACS & FÜLÖP 2009).

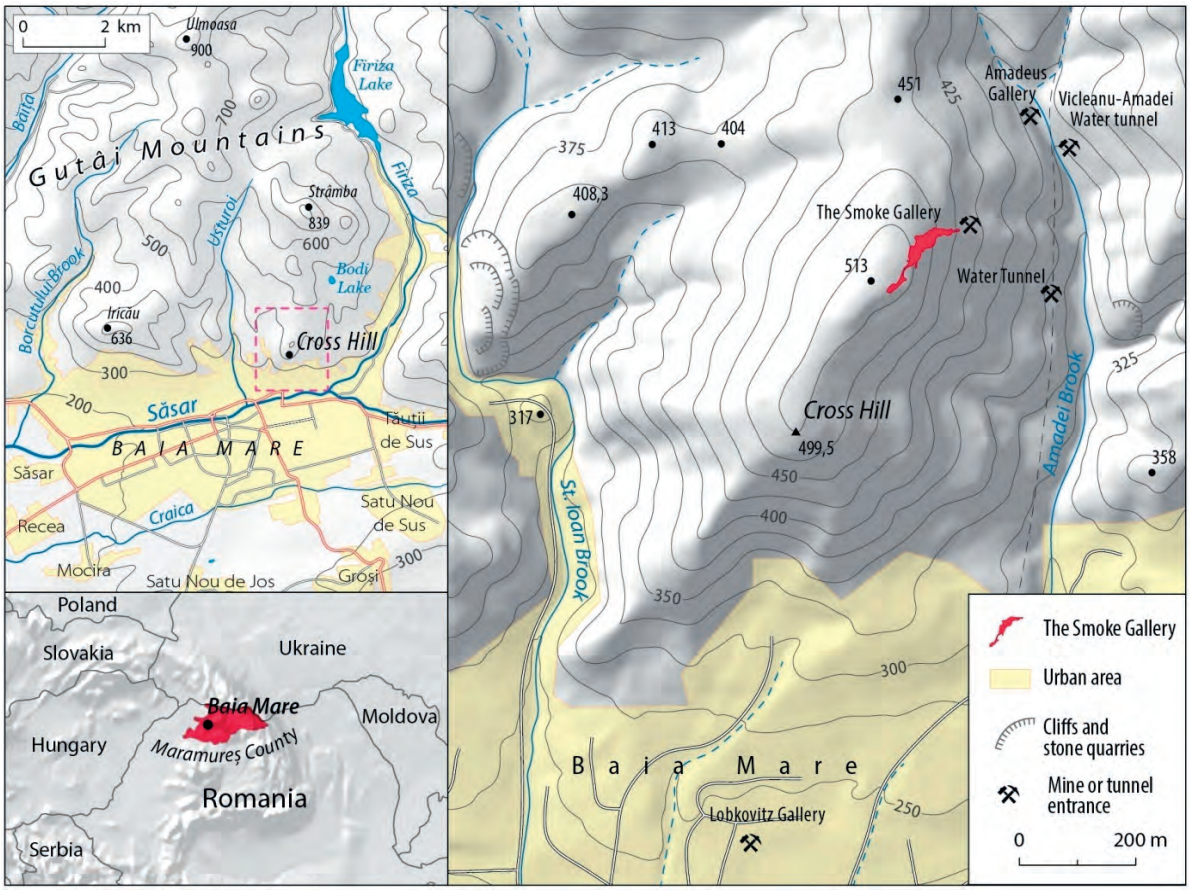

Figure 1: Location of the Smoke gallery in the Cross Hill north of Baia Mare, and of the base galleries mentioned in text.

2. Gallery description

The mine was surveyed with a theodolite and using a balloon to measure heights, with later additional DistoX measurements. The Smoke Gallery, 409.2 m long, at 450 m a.s.l. (Fig. 2, 3) represents the largest underground cavity preserved at least from the medieval ore exploitation. The gallery presently has 5 open entrances, one horizontal and 4 rectangular shafts connected to the largest chamber of the cavity, oriented E-W, which is encountered shortly after the entrance. For morphological reasons, the cavity can be divided in two parts. On the first 80 m, it has the aspect of a chamber with impressive dimensions, with an average width of 5 - 15 m (max. 30 m), and heights of 10-15 m. It is this part mostly where the ore was extracted by fire fire-setting, with the 4 shafts above this section serving as exhaustion chimneys for the smoke as well as for extraction. According to references inventoried by KACSÓ (2011), fire setting was used in the area until the late XIXth century. These shafts were dug initally in vein quartz and then follow the limit between the vein quartz and the Au-Ag mineralization (IŞTVAN & MINGHIRAŞ 2004). How far downwards this chamber went is at present impossible to determine. However, correlating historical data with our measurements, the best estimate of its maximum depth is of ca. 370 m (down to 80 m a.s.l.) at the time when the Thurzós took over the exploitation (1505).

The ore was most likely sorted on site (Fig. 2), taking account that no tailings were identified at the surface in the vicinity

Figure 2: The chamber at the entrance of the Smoke Gallery.

of the entrance (IŞTVAN & MINGHIRAŞ 2004). In the second part of the cavity, further on from the chamber, the gallery descends from -42 to -67 m towards the SW, intersecting several short lateral branches. This sector has the shape of a canyon and contains sectors over 20 m high where wooden beams are still present in places. Its development downwards is also blocked by tailings, but by its final part it connects to a shaft towards the surface (C14 in Fig. 3) and to another one at -63m probably connecting downwards to the Lobkovitz gallery. This latter part, ca. 60 m long, dates from the late XVIIIth century when the Lobkovitz gallery was dug from 232 m a.s.l. and the "Smoke shaft" connected the new base gallery to the surface. The few lateral galleries, oriented N-S, are well preserved and contain pillars made of stacked blocks, tailings and various secondary mineral deposits (Fig. 4).

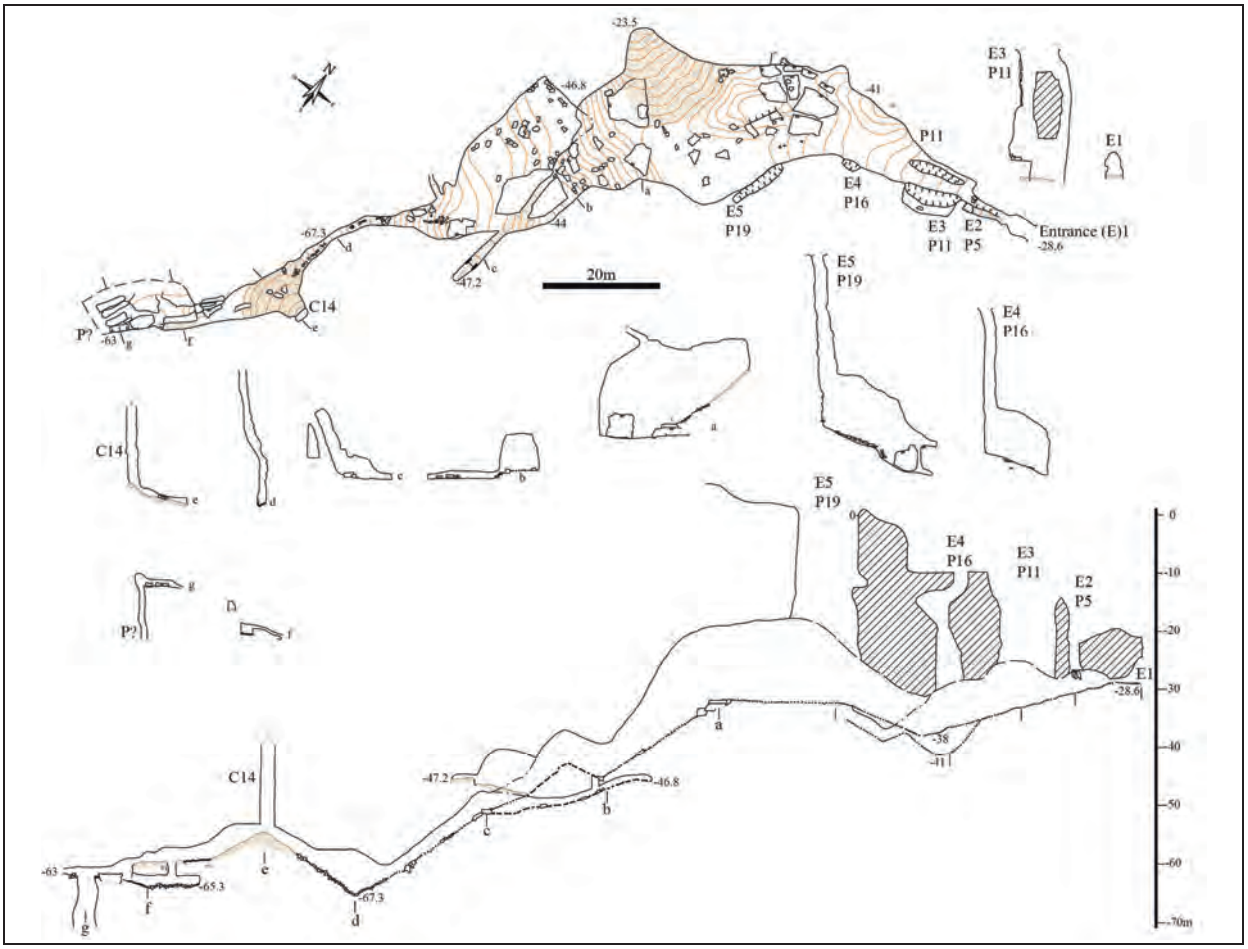

Figure 3: Map of the Smoke gallery.

3. Mineralogy

A preliminary mineralogical study on samples collected throughout the mine was done through X-ray diffraction (XRD), scanning electron microscopy and energy dispersive spectroscopy (EDS). Goethite is by far the most frequently encountered mineral in the Smoke gallery, forming various deposits such as stalactites, stalagmites and flowstones especially in the 2nd sector of the mine and in the lateral branches. Gypsum occurs as monocrystals, crystal aggregates, and crusts. Jarosite group minerals were found in yellow dusty crusts and belong to two mineral species, jarosite and hydronium jarosite Finally, millimetric green transparent crystals of melanterite were recently noticed in a few locations along the chamber near the entrance. All these minerals, resulting from sulfide oxidation are common for such mine adits.

4. Outlook

This paper gives an outlook of our ongoing research in the Smoke Gallery, the oldest medieval mine in the Cross Hill near Baia Mare, Romania. We have attempted to correlate historical data available with our survey data (underground and surface) in order to better represent the extent of the galleries at the end of the 15th century and possibly earlier. Cartographic data has served in figuring out morphological characteristics of the gallery, as well as to try and position various findings related to the exploitation techniques and features that are still in place. Mineralogical analyses also

have provided a few additions to the inventory of this old adit. Further work in progress, including a 3D model and surveys in the other galleries will hopefully give a better overall picture of the network of medieval galleries and shafts from the Cross Hill.

Figure 4: Lateral galleries with pillars made of stacked boulders and goethite stalactites and flowstones.

Acknowledgments

We thank the members of the Montana Caving club for their help in gathering data for this paper. The paper is dedicated to the memory of geologist Dumitru Iştvan (1947-2011), founder of the Montana Caving Club and long-time caver, mentor and friend.

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