

Tailings oxidation and mineralogy of Haveri Au-Cu mine, SW Finland – Preliminary results

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The Haveri Au-Cu deposit, situated in SW Finland, composes mainly of pyrrhotite, chalcopyrite and pyrite with accessory Fe-Co-Ni sulfoarsenides, sphalerite, molybdenite, iron oxides and native gold (Mäkelä, 1980). The tailings were piled during the active mining period from 1942 to 1961 covering ca. 18.5 ha and having an average depth of 7 meters.

In May 2006, a total of 40 profiles were drilled. Three profiles, and 17 tailings samples at intervals of one meter, were selected for mineralogical feasibility study. They were studied by optical reflected-light microscopy and by scanning electron microscope (SEM-EDS). Furthermore, the samples will be examined by X-ray diffraction (XRD), and geochemical analyses from selective leachates are planned.

The tailings are exposed to air, rainwater and meltwater which oxidize the primary sulfides remaining from the ore processing. Consequently, the tailings present zoning with oxidized vadose layer closest to the surface and unoxidized water-saturated layer below 3 to 4 meters. The uppermost vadose layer (from 0.9 to 2.0 m in thickness) contains primary iron oxides and scarce remnant sulfides, and abundant secondary Fe precipitates giving the characteristic ochreous color. Pyrrhotite and pyrite are the first sulfide minerals to oxidize and to dissolve. The geochemical processes within the surface layer of the impoundment produce acid mine drainage, in other words, acidic and heavy metal-rich waters. The secondary Fe precipitates (e.g. jarosite) form from the resulting solutions.

Deeper layers are under reducing and anoxic conditions presenting grayish black color. Here the major sulfides, pyrrhotite and pyrite, and minor chalcopyrite exhibit angular forms and no sign of alteration.

The oxidation process will continue for decades or even hundreds of years until reaching the groundwater surface.

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Reference

Mäkelä, K. (1980), *Bulletin of Geological Survey of Finland* **310** 5-75.

Chemical weathering of basaltic rocks in the tropical environment

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The chemical weathering of basaltic rocks under tropical conditions was marked with the generation of moderate to highly alkaline and reducing hot spring. Only a few similar occurrences has been reported in the Philippines where most of the hot springs are highly acidic and volcanic in nature. In Sira-an hot spring along the coast of Antique province, flammable gas (i.e. CH_{4(g)}) accompanies the hot springs waters. Its pH, redox state, temperature, and dissolved constituents are considerably different from a nearby groundwater well and seawater such that it can be considered an anomaly. The mineral assemblage of the fracture fill materials comprises calcium-aluminum-silica-hydrate (CASH) phases, zeolites, and chlorite suggesting highly alkaline conditions.

The local hydrogeology of the area is responsible in the formation of the alkaline and reducing hot spring (Figure 1). Limestones at elevated areas dissolve to form dissolved calcium and carbonate enriched groundwater which percolates through the fractured basaltic rocks. Dissolution of minerals in the basaltic rock under anoxic conditions generates a highly reduced and alkaline aqueous conditions which converts the dissolved carbonate to methane. The dissolved components (i.e. Ca, Si, Fe, Al, Mg) in turn precipitates into CASH phases, zeolites and chlorite.

Figure 1. A schematic presentation of the alkaline and reducing Siraan hot springs, Antique, Philippines.

