Mineralogical controls on mine drainage, Ervedosa mine, Northern Portugal

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At Ervedosa, tin-bearing quartz veins with cassiterite and sulphides cut Silurian schists and quartzites and a Sn-bearing muscovite granite. The veins were exploited at Ervedosa, so-called Tuela mine, for tin (Sn) and arsenic trioxide (As_2O_3), until 1969. The veins fill faults related to the Hercynian movements along a dextral N30°W shear zone and belong to three paragenetic stages separated by faulting. Euhedral to subhedral crystals of cassiterite are generally <10 mm across or associated in round masses with a diameter of 10 cm. The cassiterite shows alternating parallel darker and lighter zones and the darker zones show exsolved columbite, titanian ixiolite, W $\geq$ Ti - ixiolite, niobian rutile and very rare wolframite and ilmenite. Arsenopyrite is the most abundant sulphide and has inclusions of pyrrhotite, bismuth, bismuthinite and matildite. It is replaced by pyrite, chalcopyrite, sphalerite and stannite.

At the tin-bearing quartz veins and their granite and schist walls, there are supergenic solid phases consisting mainly of hydrated sulphates of Al, Fe, Mg and Ca (alunogen, meta-alunogen, aluminocopiapite, copiapite, halotrichite, fibroferrite, pickeringite and gypsum), while oxides, hydroxides, phosphates, arsenates and residual mineral phases (albite, muscovite and quartz) occur in mining tails.

The aim of this study is to compare the acid mine drainage (AMD) with the granitic rock drainage using data collected during winter. The waters at the mining site are toxic and affected by AMD (pH=3.1-3.5), with high condutivity (130-726 µS/cm) and significant metal concentrations (As=3-8µg/l, Cu=410-415µg/l, Zn=1919-8370µg/l, Fe= 922-11200µg/l, Ni= 26-95µg/l and Co= 49-118µg/l), while in the superficial granitic waters outside the mine influence the pH measured is close to neutral (pH=5.5-7), with low condutivity (28-35 µS/cm) and metal concentrations are lower (As=0.3-3µg/l, Cu=7-22 µg/l, Zn=108-147µg/l, Fe=50-411µg/l, Ni=6-9µg/l and Co= 0-3µg/l). Waters associated with mineralised veins should not be used for human consumption and agriculture activities.

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Formation and transformation of schwertmannite in acid-mine-drainage deposits of the Chinkuashih mining area, northern Taiwan

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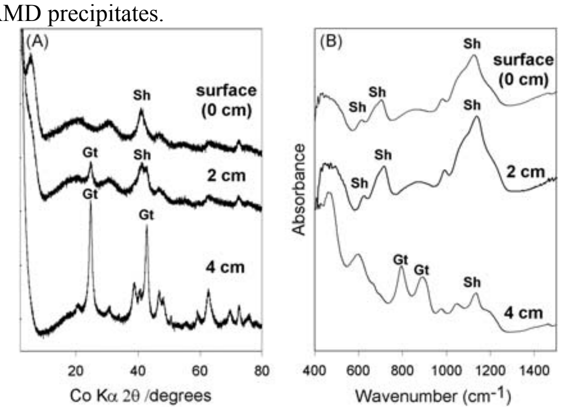
Reddish yellow to reddish brown acid-mine-drainage (AMD, pH = 2.6–3.1) deposits of 20 to 30 cm in thickness occur at Golden Falls and its downstream riverbed in the Chinkuashih gold-copper mining area. Radiating aggregates of schwertmannite nanoparticles have an overall hedgehog morphology and form the principal constituent of the Golden Falls AMD deposit. Goethite starts to present at a depth of 2-3 cm and becomes increasingly abundant with depths, concomittent with a decrease of the schwertmannite content, as evidenced by XRD and IR analyses (Figure 1). The identification of schwertmannite and goethite has also been confirmed by our TEM results.

Figure 1. XRD patterns and IR spectra of the Golden Falls AMD precipitates.



The downstream riverbed rocks are coated by a thin layer of schwertmannite with a microstructure identical to that occurring at Golden Falls. Standardless EDS analyses suggest that the Golden Falls schwertmannite aggregates have iron/sulfur atomic ratios of 5-7 and invariably contain a small amount of arsenic content whereas those occurring in the downstream area do not have a recognizable arsenic constituent and are associated with a much lower arsenic concentration in the riverwater.

The combining effects of precipitation of schwertmannite and its transformation into goethite do not significantly change the pH values and elemental concentrations of the Chinkuashih AMD solution except those of Fe and As.