Geophysical Research Abstracts
Vol. 15, EGU2013-8084, 2013
EGU General Assembly 2013

Impact of Acid Mine Drainage on the hydrogeological system at Sia, Cyprus

Stephen Ng and John Malpas
Department of Earth Sciences, University of Hong Kong, Hong Kong (ng.stephen@hku.hk)

Discontinued mining of the volcanogenic massive sulphide ore bodies of Cyprus has left significant environmental concerns including Acid Mine Drainage. Remnant sulphide ore and tailings in waste dumps react with oxygenated rainwater to produce sulphuric acid, a process which is multiplied when metal-loving acidophilic bacteria are present. Given that Cyprus has a Mediterranean climate, characterized by its warm and dry summers and cool and wet winters, the low pH effluent with high levels of trace elements, particularly metals, is leached out of the waste tips particularly during the wet season.

The Sia site includes an open mine-pit lake, waste rock and tailings dumps, a river leading to a downstream dam-lake, and a localised groundwater system. The study intends to: identify the point source and nature of contamination; analyze the mechanism and results of local acid generation; and understand how the hydrogeological system responds to seasonal variations.

During two sampling campaigns, in the wet and dry seasons of 2011, water samples were collected from the mine pit lake, from upstream of the adjacent river down to the dam catchment, and from various boreholes close to the sulphide mine. The concentration of ions in waters varies between wet and dry seasons but, in both, relative amounts are directly related to pH. In the mine-pit lake, Fe, Mn, Mg, Cu, Pb, Zn, Ni, Co and Cd are found in higher concentrations in the dry season, as a result of substantial evaporation of water. The Sia River runs continuously in the wet season, and waters collected close to the waste tips have pH as low as 2.5 and higher concentrations of Al, Cu, Fe and Zn. Further downstream there is a significant decrease in trace metal contents with a concomitant rise of pH. Al and Fe dominate total cation content when pH is lower than 4. Al is derived from the weathering of clay minerals, especially during the wet season. Fe is derived from the oxidation of pyrite. Once pH's exceed 4, a white precipitate of gibbsite (Al(OH)3) settles to the stream bed removing Al from the water. This is finely laminated together with orange-brown layers of similarly precipitated Fe(OH)3.

During the dry season the Sia River dries up and the mine-pit lake is greatly reduced in surface area leading to the crystallisation of a variety of multi-coloured salts, which form on the muddy substrate through capillary action. These include large amounts of gypsum and hexahydrite, and lesser amounts of chalcanthite, jarosite, wupatkiite, halotrichite, malachite, etc. These are ephemeral in nature being quickly dissolved by early rains of the wet season that, in the stream waters, produces short-lived toxic concentrations of metals.

Groundwaters sampled directly at the mine site show the influence of drainage from the waste tips. Elsewhere, apart from sporadic high Boron concentrations, there is no evidence of contamination from the mine workings. The origin of Boron is a problem that arises at a number of sites throughout Cyprus, especially on the Mesaoria Plain and in the Troodos Complex.