Geochemical characterisation of topsoils, surface waters and efflorescences in a historic-metal mining area in SE, Spain

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Acid mine drainage (AMD) from sulphide-rich waste-dumps exposed to weathering processes is an important focus of environmental impact, generally due to their low pH, high salinity and high potentially toxic element (PTE) content. The present study represents a contribution to the knowledge of the mineralogy and geochemistry of the solid phases and surface waters formed in the AMD setting of the Sierra Minera (SE, Spain) and their environmental significance. In addition, the exposure of the population to arsenic and the associated risk were assessed.

A total of ten topsoils and surface waters and 11 efflorescences affected to varying degrees by mining activities were studied. The total PTE content (As, Cd, Cu, Fe, Pb and Zn) was determined. In addition, the mineralogical composition of solid samples was determined by X-ray diffraction and some efflorescences were also analysed using a scanning electron microscopy-energy dispersive X-ray spectrometer. Finally, an arsenic-intake risk assessment was carried out, both as regards carcinogenic and non-carcinogenic effects and considering the total and the bioaccesible As content.

The study area is heavily polluted as a result of historical mining and processing activities, during which time great amounts of wastes were produced, characterised by a high PTE content, acidic pH and minerals resulting from supergene alteration, including soluble metal-salts, mainly sulphates, iron-hydroxysulphates and iron-oxyhydroxides, all of which form ochreous precipitates. Topsoil samples showed risk values and hazard quotients higher than the reference levels, particularly for children. In the efflorescences these values were lower but still unacceptable.