



## Mineralogical study of stream waters and efflorescent salts in Sierra Minera, SE Spain

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Trace elements contained in the residues from mining and metallurgical operations are often dispersed by wind and/or water after their disposal. These areas have severe erosion problems caused by water run-off in which soil and mine spoil texture, landscape topography and regional and microclimate play an important role.

Water pollution by dissolved metals in mining areas has mainly been associated with the oxidation of sulphide-bearing minerals exposed to weathering conditions, resulting in low quality effluents of acidic pH and containing a high level of dissolved metals.

The studied area, Sierra Minera, is close to the mining region of La Unión (Murcia, SE Spain). This area constituted an important mining centre for more than 2500 years, ceasing activity in 1991. The ore deposits of this zone have iron, lead and zinc as the main metal components. Studied area showed a lot of contaminations sources, formed by mining steriles, waste piles and foundry residues. As a consequence of the long period of mining activity, large volumes of wastes were generated during the mineral concentration and smelting processes. Historically, these wastes were dumped into watercourses, filling riverbeds and contaminating their surroundings. 40 sediment samples were collected from the area affected by mining exploitations, and at increasing distances from the contamination sources in 4 zones

In addition, 36 surficial water samples were collected after a rain episode

The Zn and Fe content was determined by flame atomic absorption spectrometry (FAAS). The Pb and Cd content was determined by electrothermal atomization atomic absorption spectrometry (ETAAS). The As content was measured by atomic fluorescence spectrometry using an automated continuous flow hydride generation spectrometer and Al content was determined by ICP-MS.

Mineralogical composition of the samples was made by X Ray Diffraction (XRD) analysis using Cu-K $\alpha$  radiation with a PW3040 Philips Diffractometer.

Zone A: Water sample collected in A5 is strongly influenced by a tailing dump, and showed high trace element contents. In addition, is influenced by the sea water and then showed high bromide, chloride, sodium and magnesium content, together with a basic pH. The DRX results of evaporate water showed that halite, hexahydrate and gypsum are present: halite corroborates the sea influence and gypsum and hexahydrate the importance of soluble sulphates. A9 water showed acid pH and high trace elements content; is influenced by the tailing dump and also by waters from El Beal gully watercourse, transporting materials from Sierra Minera

Waters affected by secondary contamination are influenced by mining wastes, the sea water and also are affected by agricultural activities (nitrate content). These waters have been mixed with carbonate materials, present in the zone increasing the pH. Some elements have precipitated, such as Cu and Pb, while Cd, Zn and As are soluble. The DRX analysis in the evaporate if A14 showed that halite and gypsum are present: halite confirms the seawater influence and gypsum the relationship between calcium and sulphates

A2 and A6 waters are affected by tertiary contamination and showed basic pH, soluble carbonates and lower trace element content. Only Zn, Cd and Al are present.

Zone B: All waters are strongly affected by mining activities and showed: acid pH, high trace element content and high content of soluble sulphates. The evaporate of B8 and B12 showed the presence of soluble sulphates: gypsum, halite, bianchite, paracoquimbite, halotrichite and siderotil in B8; gypsum, bianchite, paracoquimbite and coquimbite in B12; gypsum, hexahydrate, carnalite, bianchite, copiapite and sideroti in B10 and polihalite, gypsum, bianchite, coquimbite and paracoquimbite in B14.

All the sampling points collected in Zone C are affected by primary contamination, because there are a lot of tailing dumps and sampling points are located close to them.

C1 showed high trace element content because is a reception point of a lot of tailing dumps. Water samples from C3 to C8 also had acid pH and high trace element content, particularly As (remains soluble) and Zn and Cd (high mobility). In addition, they showed high soluble sulphates. C2 water showed neutral pH, soluble carbonate and low trace element content because is influenced by a stabilised tailing dump. However, the As remains soluble.

Zone D: All waters collected in this zone showed acid pH and high trace element content, mainly Zn, Cd and As. Some differences were found from the high and the low part: samples located in the lower part (D2-D7) showed higher As content while Zn is higher in the high part (D8-D13)

The DRX analysis in evaporates suggest that in D4 copiapite, coquimbite, gypsum, bianchite and ferrohexahydrite are formed and in D11 gypsum, bianchite, halotrichite and siderotil.

D1 is affected by secondary contamination, which showed higher pH (still acid) and lower content in soluble salts and trace elements.