ARSENIC IRON CRUST DEVELOPED WITHIN A FORMER METALLIC MINE TAILINGS

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Sulfides oxidation in mining environment is an important problem regarding to the acid drainage it induce (Alpers et al., 1994), and to the release of potentially toxic elements such as metals or arsenic which frequently occur as by-products for various ores.

Located in the southern part of the French Massif Central, the tailings of an arsenopyrite-rich former metallic mine present a local induration by an oxidized cement rich in As and Fe. These "ferri-crusts" are constituted by millimetric to centimetric quartz and others minerals grains proceeding from the ore gangue. They are well developed in the gullies recently (< 20 years) created by runoff of drainage waters.

We aimed at characterizing this material in order to understand its formation and to forecast its potentiality to release its arsenic content in these conditions. The first step was to determine the As-bearing phases. Mineralogical and chemical observations were performed by XRD, ICP/MS and AAS analyses on the whole sample or on mechanically separated cement. Combining microscopic determinations with SEM observations, equipped with an EDS system, and with microprobe analyses, we defined five types of cements: a dark reddish cement (≈ 1.4 wt % As and ≈ 47 wt % Fe) and a red cement (≈ 3 wt % As and ≈ 45 wt % Fe) which both formed collomorph structures, a yellow cement (≈ 1.4 wt % As and ≈ 40 wt % Fe), a resinous As-rich cement (As ≈ 17 wt %, Fe ≈ 23 wt %) and a fleecy cement (As ≈ 5.7 wt %, Fe ≈ 27.5 wt %). Small amounts of sulfur were found which could be explaining by the fact that few sulfides relicts were observed.

The affinity of As with Fe was pointed out in many studies (Daus et al., 1998; Pierce & Moore, 1982). It was also observed in these ferri-crusts, in which the largest quantities of As were found either in association with Fe, as an As-bearing K-jarosite or as an amorphous gel corresponding to the so-called "resinous" cement. The formation of jarosite is consistent with the pH-Eh conditions measured in drainage waters (respectively 2.8 and 481 mV). However, arsenic seems to be mainly trapped by the well-developed amorphous iron hydroxide: no arsenate minerals were observed. It is now important to investigate the long-term stability of these ferri-crusts under variable pH – Eh conditions.

References

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