ARSENIC IRON CRUST DEVELOPED WITHIN FORMER METALLIC MINE TAILINGS

COURTIN, A., BRIL, H. & NEEL, C. (LASEH, UMR6532 CNRS, Limoges, France)

Oxidation of sulfides in mining environments is an important problem regarding the acid drainage it induces (ALPERS et al., 1994) and the release of potentially toxic elements such as metals or arsenic, which frequently occur as by-products of 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 other mineral grains proceeding from the ore gangue. They are well developed in the gullies recently (< 20 years) created by the runoff of drainage waters.

We aimed at characterizing this material in order to understand its formation and to forecast its potential to release its arsenic content under 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 optical microscopy observations determinations with SEM + EDX system, and with microprobe (WDX) 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 explained by the fact that a few sulfide 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 that 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 (2.8 and 481 mV, respectively). 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

ALPERS, C.N., BLOWES, D.W., NORDSTROM, D.K. & JAMBOR, J.L. (1994). Secondary minerals and acid mine water chemistry. 247–270. in: JAMBOR, J.L. & BLOWES, D.W. (eds.) Environmental geochemistry of sulfide mine-wastes. Mineralogical Association of Canada, Short Course Handbook (vol. 22).

DAUS, B., WEISS, H. & WENRICH, R. (1998). Talanta, **46:** 867–873.

PIERCE, M. & MOORE, C. (1982). Water Res., **16:** 1247-1253.