

TRACE METALS REMOBILIZATION DURING RESUSPENSION OF CONTAMINATED SEDIMENT FROM A DAM RESERVOIR.

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Introduction

Dam reservoirs sediments are generally resuspended during operations required for safety and maintenance, when the water level is rapidly lowered by opening discharge equipment. There is a risk for the environment when these sediments are polluted by metals, because of the remobilization of particles and of the possible increase of dissolved metal concentrations, more bioavailable for biota. Indeed, sediment resuspension leads to a sharp change of chemical conditions surrounding solid particles promoting the release in the dissolved phase of adsorbed or co-precipitated metals (Caille et al., 2003; Vink, 2009; Kalnejais et al., 2010; Superville et al., 2014). Laboratory resuspension experiment is a good method to understand and predict such evolution. We carried out such experiments on sediments from a reservoir contaminated by As, Cd, Pb and Zn, all issued from old mine tailings.

Methods

Aliquots of the sediment (slightly anoxic) were added in a 3L reactor filled with the filtrated reservoir water. Three experiments were conducted with dry masses equivalent to suspended solid concentrations ranging between the regulation values and the highest values observed during dam management operations (around 3, 5 and 9 g/L). The reactor was aerated and stirred for 120h, and 30ml of water were regularly collected for the analyses of trace metals and major ions concentrations, measured by ICP-MS and capillary electrophoresis. pH, Eh, dissolved O₂ and temperature were continuously monitored within the reactor. The sediment was characterized for major mineralogical components, particle size, total organic carbon content and total metal content. A sequential extraction scheme adapted from BCR and Tessier procedures (Quevauviller, 2007; Tessier et al., 1979) was also conducted to assess the metal fractionation in sediment.

Results and discussion

Trends in dissolved concentrations were very similar for the three experiments, whatever the mass of sediment used in the reactor (fig.1). The small differences observed are probably related to the grain-size variations found in the aliquots.

These trends reflect the release and removal kinetic processes between solid and dissolved phases. Ca, Mg and HCO_3^- increased up to the end of the experiments, in agreement with the undersaturated index calculated from PHREEQC for calcite and dolomite (major phases observed with XRD analyses). As and Al also increased continuously, attesting of another dissolution process. Fe, Mn, Pb and Co increased rapidly at the beginning of the experiments, then started to decrease after few minutes up to 5 hours. This must be associated to precipitation (and adsorption) of Fe/Mn-oxides or hydroxides. Cu, Zn and V exhibited a different trend with a very fast decrease within the first few minutes, then more or less stable values. The major risk of contamination should thus be associated to As, the more mobile element during the resuspension. Results of sequential extractions are still being analysed to better interpret the precipitation-dissolution trend of the solid phases.

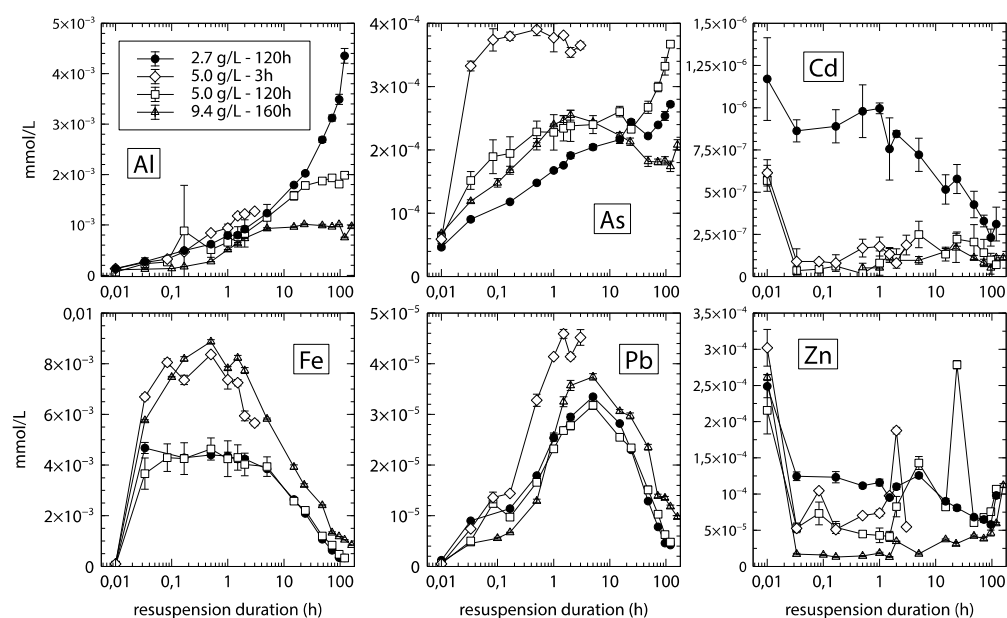


Figure 1. Evolution of metals concentrations in dissolved phase (mmol/L) during the experiments of sediment resuspension (h, log scale); t_0 -points are concentrations in water prior to the addition of sediment. The curves correspond to the various mass of dry sediment used.

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