Trace Element uptake in Aluminium Hydroxysulfates: Implications for Mining-affected Environments

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Aluminium (Al) sulfates such as felsobanyaite (basaluminite) $[Al_4(SO_4)(OH)_{10}\cdot 4H_2O]$ and hydrobasaluminite $[Al_4(SO_4)(OH)_{10}\cdot 15H_2O]$ form as a result of the dissolution of aluminosilicates or aluminium oxides in the presence of sulfate at pH above 5 [1, 2]. Whereas the role of trace element uptake by common Fe-bearing sulfates such as jarosite and schwertmannite has already been extensively studied [3], much less is known about the role of Al-hydroxysulfates in these processes. Poorly crystalline Al hydroxysulfates may scavenge trace metals from mine waste and natural waters, and such processes are particularly effective at pH values above 6 [4, 5]. However, the structural position of the trace metals in the Al precipitates and their behaviour during the progressive transformation into more crystalline minerals with ageing remain unknown. Answering both questions is important for assessing the possible role of Al hydroxysulfates as temporary or permanents sinks for trace elements in natural environments or treatment systems.

To clarify these questions, Al hydroxysulfates were synthesized under laboratory-controlled conditions similar to those encountered during the neutralization of acid mine or soil waters, and these were co-precipitated with trace amounts of As, Cu, Ni, Pb and Zn. The results show that, for pH values higher than 6, more than 90% of the As, Cu, Ni, Pb and Zn were scavenged by the Al precipitates. By contrast, less than 30% of these elements are associated with the precipitated phases at pH values below 4.5. The ageing of precipitates for 15 weeks does not seem to have any effect on the release or scavenging of any of the studied elements. We therefore propose that Al hydroxysulfates could be used to remediate neutral to basic mine waste waters.

[1] Jambor *et al.* (2000) *Rev. Min. Geochem.* **40**, pp. 303-350. [2] Bigham & Nordstrom (2000) *Rev. Min. Geochem.* **40**, pp. 351-403. [3] Nordstrom (2011) *Appl. Geochem.* **26**, 1777-1791. [4] Lee *et al.* (2002) *Appl. Geochem.* **17**, 569-581. [5] Munk *et al.* (2002) *Appl. Geochem.* **17**, 421-430.