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Arsenic behavior in the AVS-SEM procedure –is there a better way?

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At many mining (and related) sites, cationic metals have historically been the elements of interest, and their chemistry and fate have been studied in many impacted waters and sediments. More recently, it was realized that metalloids like arsenic (As) can also play a significant role in the environmental and human risk assessments at many of those sites. To understand the environmental biogeochemistry of each element of interest in such systems, and any associated risk, their physical and chemical speciation must be studied.

For cationic trace elements, the "acid-volatile sulfide – simultaneously extracted metals" (AVS-SEM) approach, which features extraction of the sediment with hydrochloric acid, has been used frequently to characterize the association of metals with sulfide in (reducing) sediments, and occasionally, metalloids have been included in these studies. However, there is to date no experimental data that test if this approach yields useful information to help us understand the association between As and sulfide in sediments, and the resulting mobility and (eco)toxicity of As. In this study, we have applied the AVS-SEM approach to sediments from an industrially-impacted site, and compared the behavior of As to that of cationic trace elements.

Correlation between As released in the SEM procedure and AVS was weak, and suggested that only a small fraction of As was associated with AVS. If interpreted the traditional way, these results seem to indicate that association between As and sulfide in these sediments is insignificant, and does not influence As mobility and (eco)toxicity in this ecosystem.

However, building on existing knowledge regarding As-sulfide interactions, we showed that an alkaline extraction released more As than the acidic SEM procedure, which resulted in a stronger correlation between released As and AVS, and suggests that a larger fraction of As in these sediments is associated with sulfide than the SEM procedure indicated. As speciation analyses by ion chromatography-inductively coupled plasma-mass spectrometry confirmed that soluble As-sulfide compounds constitute a significant fraction of the As extracted from the sediments under alkaline conditions, and could therefore play important roles in the associated mobilization and (eco)toxicity processes.