

Trace element and isotopic signatures of Secondary and Tertiary minerals in Mine Waste

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The chemical alteration of sulfide minerals in natural and anthropogenic environments leads to production of more stable secondary phases. The minerals will control the mobility of metals and metalloids in both solid and aqueous environments. Often, many of the elements focused on for environmental concerns do not form discrete phases but rather occur as trace elements within other secondary minerals. As such their attenuation and later dissolution potential is masked from traditional numerical predictive approach. This is further complicated when the secondary minerals breakdown and form tertiary minerals.

In order to evaluate the mobilization of trace elements within mine waste in-situ tracking of these elements and where possible isotopes has been used to determine the fate, speciation and attenuation of several common elements of concern. On the basis of compositional chemistry a stoichiometric solid for the phase can be determined. Utilizing thermodynamic databases solubility constants can be derived for the derived mass balanced phases that incorporates the trace elements and used to track geochemical behaviour in predictive modelling. Comparison of this approach to actual water chemistry for porphyry copper associated pit lake and mine waste discharge from an abandoned base metal mine indicates improved similarities between actual and modelled results by this approach. This suggests, ensuring trace element speciation is reflected in the inputs to geochemical calculations will improve overall calibration. Use of stable isotopes can be used to track element attenuation especially in tertiary minerals to develop a better understanding of source and fate and used to constrain the mineral reactions incorporated to numerical predictions.