Integrating geochemical and mineralogical observations in mine-waste investigations

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Predictions of the extent and duration of acidic drainage associated with mine wastes, and the development of new remediation approaches require a comprehensive understanding of the mechanisms controlling the release, transport and attenuation of dissolved constituents. Rates of sulfide oxidation estimated from measurements of pore gas and pore water chemistry were compared to independent mineralogical studies of the waste materials. Identification of secondary minerals and measurements of the masses of these minerals were combined with geochemical speciation modelling to constrain reactive-transport model calculations. These constraints enhance the reliability of predictions made using reactive-transport models. Isolation of secondary mineral sulfides, in conjuction with measurements of concentrations of dissolved sulfide, metals, and nutrients, and characterization of microbiological populations, provides a confirmation of the mechanisms controlling the concentrations of dissolved metals in remediation systems.

The whole Earth geohydrologic cycle

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The conventional hydrologic cycle describes the reservoirs for H_2O in the near surface, and the movement of H_2O between these different reservoirs. These near-surface reservoirs are linked to the deeper georeservoirs through subduction and volcanism. The georeservoirs include continental crust and oceanic crust, the upper and lower mantles, the transition zone, and the core. We present a geohydrologic model that includes the near-surface reservoirs and describes the cycling of H_2O between the near surface and deeper reservoirs on Earth.

The dominant process that cycles H_2O from the near-surface reservoirs into the deep Earth is subduction, and H_2O is returned to the near-surface environment through volcanism. Residence times range from 10^{-2} years (about 10 days) for H_2O in the atmosphere, to several hundred million years for H_2O in the continental and oceanic crust, to several billion years for H_2O in the mantle.

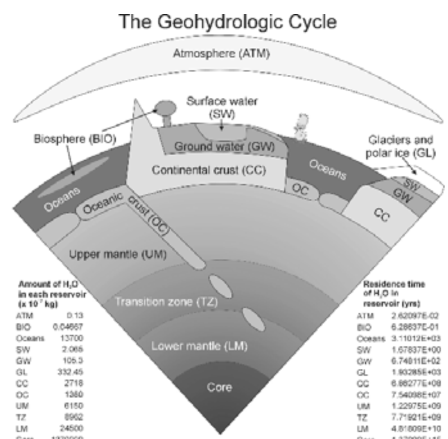

Figure 1: Schematic representation of the 12 reservoirs in the geohydrologic cycle as well as the amount of H_2O contained with each reservoir (lower left) and the calculated residence times for H_2O in each of the 12 reservoirs (lower right).