

Geochemical processes affecting cations and anions in metal-rich acid streams of Colorado and Tennessee, USA.

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Streams draining bedrock basins where sulfide minerals are exposed to oxidation are characterized by a low pH and elevated concentrations of sulfate as well as of Fe, Al, and other metals. When such waters are neutralized, ferric hydroxide and, in some cases, aluminum hydroxide precipitate. These solid compounds sorb anions at low pH and cations at near neutral pH. The sorption is selective and is inversely proportional to the hydrated radii of the ions. Consequently, the chemical composition of the water changes as the pH increases from strongly acidic to near neutral. The result is that potentially toxic cations are removed from the water by sorption, whereas equally toxic anions are released into solution. This process detoxifies the water by removal of cations from solution, but causes metal-rich sediment to accumulate in ponds and reservoirs within the drainage basin. The metal-rich sediment is a potential public-health hazard because the sorbed metals are released selectively in cases where the water is later acidified and because the metal-rich sediment may require remediation before it can be safely disposed of in case the reservoirs must be dredged.