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Arsenic transport between surface and groundwater in a moderately reducing zone: Geochemical approach

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Arsenic contamination represents a major risk to human health as one of the most prominent environmental causes of cancer mortality. Mining activities, particularly those involving arsenic rich ores have an impact on the environment and on human health that may persist for many decades after mine closure.
The relationships between As released from alluvial aquifer in the vicinity of the sulfide-rich mine dumps was demonstrated with geochemical and isotopic tracers (major and traces elements, 87Sr/86Sr, 18O, 2H). Strontium isotopes were used to trace the transport of As downstream from a As rich tailing dam. Increasing As and Fe concentrations in surface water are explained by As release associated with alluvial groundwater discharge to the stream. This process occurs in a moderately reduced section of the stream downgradient from the sulfide-rich tailing dam. High As, total Fe and low Eh in groundwater confirm the discharge of alluvial groundwater and explain its impact on surface water.
Transport of As between surface and groundwater can be described as follows:
1- Subsurface moderately reducing conditions prevail in groundwater downgradient from the tailing dams. This suggests a flux of reduced water from sulfide-rich tailing dams which is characterized by its high As and Fe content resulting from the reduction of Fe-sulfides.
2- Upon mixing with surface water, oxidizing conditions prevails and precipitate as Fe hydroxide on the stream bed. As and Sr subsequently adsorbed on the Fe –oxyhydroxide surface.
This process contributes to the immobilization of As in surface water. Remaining dissolved As in surface water can be re-introduced in alluvial groundwater downstream of the reducing zone.