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Coupled S and Sr isotope evidences for elevated arsenic concentrations in groundwater from the world's largest antimony mine, central China

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Abstract

The Xikouangshan(XKS) mine, the world's largest antimony mine, was chosen for a detailed arsenic hydrogeochemical study because of the elevated arsenic in bedrock aquifers used by local residents. Hydrochemical data, $\delta^{34}\text{S}$ values of dissolved SO_4^{2-} and $^{87}\text{Sr}/^{86}\text{Sr}$ ratios have been analyzed to identify the predominant geochemical processes that control the arsenic mobilization within the aquifers. Groundwater samples can be divided into three major types: low arsenic groundwater (0-50 $\mu\text{g/L}$), high arsenic groundwater (50-1000 $\mu\text{g/L}$) and anomalous high arsenic groundwater (>1000 $\mu\text{g/L}$). Arsenic occurs under oxidizing conditions at the XKS Sb mine as the HAsO_4^{2-} anion. The Ca/Na ratio correlates significantly with HCO_3^-/Na and Sr/Na ratios, indicating that carbonate dissolution and silicate weathering are the dominant processes controlling groundwater hydrochemistry. The $\delta^{34}\text{S}$ values of the groundwater indicate that dissolved SO_4^{2-} in groundwater is mainly sourced from the oxidation of sulfide minerals, and elevated As concentrations in groundwater are influenced by the mixing of mine water and surface water. Furthermore, the $\delta^{34}\text{S}$ values are not correlated with dissolved As concentrations and Fe concentrations, suggesting that the reduction dissolution of Fe(III) hydroxides is not the dominant process controlling As mobilization. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratios imply that elevated As concentrations in

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