# Investigating mine-drainage geochemistry using stable isotopes of molybdenum and zinc

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The Antamina mine in Peru extracts Cu, Zn and Mo from a mineral deposit formed by igneous intrusion into carbonate terrain. Long-term environmental management of the hundreds of thousands of tons of heterogeneous waste rock which are produced daily requires detailed characterization of the geochemical reactions governing the fate of several elements in this setting. This study's objective is to investigate the use of stable isotopes as a diagnostic tool to identify the geochemical processes governing Mo and Zn release and attenuation in mining waste rock drainage.

A new single-pass ion-exchange protocol allows for the isolation of Mo and Zn from samples prior to isotope analysis by MC-ICP-MS. Mo double-spike isotope analyses reveal a 1.5‰ variability in $\delta^{98/95}$Mo among solid-phase and aqueous samples, which is resolvable within our 2σ analytical precision of <0.1‰. Zn isotope compositions of sphalerites are homogeneous ($\delta^{66/64}Zn_{PCIGR\text{-}1}$ = 0.11 ± 0.01‰, 2σ, n=5) and slightly heavier than drainage waters. These variabilities indicate the occurrence of isotopic fractionation in the mining waste rock environment. Hence we confirm the potential usefulness of isotope studies to characterize geochemical processes at Antamina.