

Arsenic mobility in limestone and fertiliser-amended tailings

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Remediation of acid rock drainage (ARD) through the addition of limestone results in the removal of deleterious metals (e.g. Cd, Cu, Pb) from solution, by mineral precipitation and adsorption reactions as the pH increases. However, arsenic (As) can be mobilised under neutral to alkaline pH conditions due to desorption reactions from different mineral surfaces. Also, the mobility of As is complicated by fluctuations in redox chemistry as well as As desorption in the presence of competitive anions. We investigated the mobility of As at a historic cassiterite tailings deposit (Royal George, Tasmania), where recent remediation efforts by statutory authorities included the application of crushed limestone and phosphate fertiliser pellets to the tailings surface.

Scorodite and iron oxide phases were identified to be the main As-host phases in non-amended tailings. Leaching experiments using different extraction solutions were conducted on amended and non-amended tailings. Results show that As mobility was considerably reduced in near neutral pH, low sulphate extraction solutions for both amended and non-amended tailings. However, a significant proportion of As was mobilised in the amended tailings relative to non-amended tailings, when extraction solutions with high sulphate concentrations were used. Since high dissolved sulphate (>1000 mg/L) waters are present in ARD environments, the application of phosphate fertiliser, in addition to limestone as an amendment strategy, may mobilise As from waste rocks and tailings in the long term. Rehabilitation efforts of As-rich wastes need to consider both the mineralogical siting of As and porewater chemistry.

Trace Element and Isotope Geochemistry of Cretaceous Basalts from Axel Heiberg Island, Arctic Canada

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Cretaceous volcanic rocks related to the High Arctic Large Igneous Province (HALIP) in the Canadian Arctic Islands comprise dykes, sills and lava flows emplaced within the Sverdrup Basin. During an expedition to northwestern Axel Heiberg Island in the summer of 2007, a suite of 114 - 130 Ma basaltic rocks was recovered from the Bukken Fiord region. We present the first geochemical study on 11 of these basalts, including isotopic compositions by MC-ICP-MS (Pb) and TIMS (Sr and Nd).

All samples are tholeiitic. They cover a narrow range of MgO (3.2 to 7 wt%) and SiO₂ (45 to 54 wt%) contents and have high TiO₂ contents that range from 2 to 4 wt%. Trace element ratios of immobile, alteration resistant elements (e.g., Th/Nb, Th/Ta, La/Yb, Zr/Y, Nb/Y) suggest interaction and incorporation of crustal material by an enriched mantle source. The preliminary isotopic compositions of these basalts also support contamination by a crustal component. This is evidenced by their high ⁸⁷Sr/⁸⁶Sr (0.7036 to 0.7084), ²⁰⁶Pb/²⁰⁴Pb (18.5 to 19.1) and ²⁰⁸Pb/²⁰⁴Pb (38.2 to 38.9) values despite the acid leaching treatment prior to isotopic analyses to remove the disturbance effects of post-magmatic alteration.

Additional isotopic analysis will further constrain the mantle-crustal components involved in the formation of these basalts and the extent of contamination or assimilation. Integration of these new data with prior HALIP studies will contribute to a better understanding of Cretaceous magmatism during the opening of the Canada Basin.