Faro Waste Rock Project: Assessment of Geochemical Evolution of Sulfide-Bearing Waste Rock at the Field Scale

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The magnitude of environmental concerns associated with sulfide-bearing waste rock depends on the abundance, reactivity, and size distribution of reduced phases, abundance of neutralizing minerals, and the influence of coupled physicochemical processes (*i.e.*, wind, heat, gas transport, hydrological and geochemical processes on the transport of O_2 and water). Mine waste deposits at the abandoned Faro Pb-Zn Mine, located in south-central Yukon Territory, Canada, includes 320 million tonnes of waste rock, 70 million tonnes of tailings, as well as other mine and mine-waste units. Acid rock drainage from these wastes pose threat to the quality of receiving groundwater and surface water.

To assess the geochemical evolution of sulfide-bearing water rock at the field scale, a data collection system including 10 boreholes in Faro Main and Intermediate Dumps was installed to collect measurements of water content, gas pressures and gas concentrations of O_2 and CO_2, temperature, wind vector, air permeability, pore-water geochemistry and mineralogical composition. Preliminary results indicate that advection-dominated profiles of temperature, solutes released from the oxidation and weathering of waste rock (*i.e.*, Pb, Zn, Fe, SO_4, As, Cd, Cr), and pore-gas (O_2 and CO_2) are obtained, whereas diffusion-controlled profiles may exist in some parts of highly saturated waste rock. Sharp oxidation fronts build up at ~ 20 – 30 m below the top of the pile, while strong oxidation and weathering zones form in the middle of the pile which consequently cause high temperatures (~ 20 – 50 °C), O_2 depletion and CO_2 production, elevated concentrations of metal(loid)s, and strong internal evaporation (indicated by correlation of ^{18}O and ^{2}H). The results will inform the environmental impact assessment for Faro Main and Intermediate Dumps and future remediation activities.