Quantitatively reconstructing the trace and metal composition of seawater derived hydrothermal fluids from (ultra)mafic rocks

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If partitioning data between a mineral and a fluid at relevant conditions are known, these can be used to quantitively reconstruct the trace and metal composition of palaeo-fluids. Partitioning data can be experimentally determined, but these are highly sensitive to pressure, temperature and composition (P-T-X). The 3.2 Ga Tartoq Group, a supracrustal belt in SW Greenland contains an ophiolite-style section of oceanic crust containing mafic and ultramafic rocks, along with minor meta-sediments. The P-T-X conditions of these rocks have been determined [1] and indicate that the lowest-grade, and best-preserved rocks, retain a hydrothermal fluid signature linked to prograde interaction with seawater-derived fluids. Partitioning experiments were carried out under conditions that represent sub ocean floor mafic to ultramafic crust. A saline, reduced fluid doped with trace elements was reacted in sealed quartz glass tubes with mineral chips of natural antigorite or San José olivine, both of known composition, representing a reversal experimental set. The quartz glass tubes were placed in steel autoclaves and heated to 300 to 400°C. Major and trace elements were determined by WDS-EPMA and LA-ICPMS respectively and electron imaging used to characterise run products. Here, we present the results and observed controls on partition coefficients in terms of pressure, temperature and fluid composition. We assess the applicability of antigorite for reconstructing the composition of the fluid from which it formed. Chemical reconstruction of the hydrothermal fluid reservoir in Archean oceanic crust will ultimately allow for fingerprinting of the elemental flux into an Archean ocean by deep-sea venting, and thereby an indirect view into the compositional changes of the ocean through time.

[1] van Hinsberg, V, Crotty, C, Roozen, S, Szilas, K & Kisters, A 2018, 'Pressure--Temperature History of the >3 Ga Tartoq Greenstone Belt in Southwest Greenland and Its Implications for Archaean Tectonics' *Geosciences*, vol 8, nr. 10, 367