Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14315

Significant Mass Changes by Multi-Stage Fluid-Rock Interactions in the Lowermost Ocean Crust of Samail Ophiolite.

FRANCESCA ROTONDO[1], MATTHEW J. COOPER[1], ROSALIND M. COGGON[1], MICHELLE HARRIS[2] AND DAMON A. H. TEAGLE[1]

[1]University of Southampton
[2]Plymouth University
Presenting Author: fcr1d19@soton.ac.uk

The ocean crust interaction with hydrothermal systems at mid-ocean ridges and on ridge flanks contributes to global geochemical budgets by modifying the chemical and isotopic compositions of seawater and the lithosphere. The hydrothermal alteration recorded within the Cretaceous lower ocean crust of the Samail ophiolite of Oman and the United Arab Emirates has been investigated to establish the impacts of and extent of interaction between the fast-spreading lower ocean crust and hydrothermal circulation. Structural and petrographic analyses of layered olivine gabbros from Oman Drilling Project Hole CM1A into lower ocean crust directly above the crust-mantle transition zone in Wadi Zeeb (Wadi Tayin massif), suggest conditions of fluid-rock interaction from Epidote-Amphibolite (450-550°C) to Prehnite-Actinolite (200-450°C) and Zeolite (100-200°C) facies. These hydrothermal alteration stages are characterized by pervasive background alteration of primary minerals and by five vein generations: V1) chlorite + serpentine and chlorite + amphibole veins and microcracks; V2) clinozoisite ± prehnite veins; V3) prehnite veins and microcracks; V4) prehnite + calcite veins; V5) calcite veins and microcracks. The veins commonly exhibit two types of cm-wide alteration halos, where the primary plagioclase is completely replaced by either chlorite or prehnite. Five major fault zones display either prehnite-rich or chlorite-rich incipient cataclasites to cataclasites with dense anastomosing fracturing, and minor zones of hydrothermal brecciation are linked to dense networks of prehnite veins and associated halos. The extensively altered layered olivine gabbros and fault rocks have high whole rock concentrations of CaO (17-25 wt.%), Al_2O_3 (16-23 wt.%) and LOI (>4.5 wt.%). Calculations of whole rock mass changes in cataclasites show gains of Al_2O_3, MgO, CaO, Li, LOI, Co, Ni, Zn, Rb, Zr, Nb, Cs, light rare earth elements (LREE), Hf, Ta, Th and U, but losses of P_2O_5, V, Cu, Sr, Ba and Eu. Olivine gabbro layers with 61-75% alteration intensities display additional enrichments in SiO_2, FeO_{tot}, MnO, Cr and Pb, but losses of Na_2O and Cs. This geochemical record indicates extensive fluid-rock interaction during the circulation of hydrothermal fluids in the lowermost ocean crust, both along fault zones and pervasively within the host layered gabbros.