Feedback between melt percolation and deformation at Oman crust-mantle transition zone: ICDP_ Exp. 807 Holes CM1A and CM2B

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Oman ophiolite crust-mantle transition was drilled at Holes CM1A and CM2B (Wadi Tayin Massif) during Phase 2 of the Oman Drilling Project (Nov. 2017-Jan. 2018) in the Wadi Zeb of the Wadi Tayin massif. Hole CM1A (400m-long) crosses from the lowermost crust consisting of Layered gabbros, through the crust-mantle transition zone, into residual upper mantle peridotites, while Hole CM2B (300m-long) started in the crust-mantle transition zone penetrating the underlying residual mantle peridotites. The main lithological units characterized in both holes are olivine gabbro, gabbro, dunite, harzburgite and wehrlite, associated with minor gabbronorite, troctolite, websterite, anorthosite, and chromitite. During Oman-DP Phase 2 Leg 3 (ChikyuOman; July-Aug. 2018), 95 and 67 samples of core from CM1A and CM2B, respectively, were analyzed for whole-rock major and minor elements (XRF) as well as CO_2 and H_2O concentrations (CHNS). XRD measurements were performed on the 69 onsite samples. Furthermore, whole-rock (pressed powder pellets) and mineral trace element contents were determined for selected samples onboard the D/V Chikyu, using the NewWave Research UP-213 Nd: YAG deep UV (213 nm) laser ablation system coupled with an Agilent 7500ce quadrupole ICP-MS.
Samples from holes CM1A and CM2B have a large petrological and chemical variability, mainly reflecting the different rock types, especially across the crust-mantle transition. CM1A and CM2B volatile element contents reflect extensive serpentinization linked to interaction with H_2O-rich fluids, and abundant carbonate veins downhole, suggesting an association between CO_2-rich fluids and serpentinization. Whole-rock and clinopyroxene trace element abundances are similar to Oman ophiolite compositions described in previous studies. All gabbroic domains display nearly parallel REE patterns with a strong depletion in HFSE relative to REE. Dunites and harzburgites display variable trace element contents and REE patterns, negative or positive anomalies in Eu and commonly moderate to strong positive anomalies in U, Pb, Sr and Ti. The variation of REE concentrations and patterns observed in Oman dunites could be explained by melt-rock reactions leading to dunite formation, after the dissolution of orthopyroxene in harzburgite and interaction with interstitial melt.
Another way to explore melt percolation and deformation feedback at Oman crust-mantle transition zone is the analysis of detailed olivine crystallographic preferred orientations (CPO) of 36 selected samples from hole CM1A (1 olivine gabbro, 10 dunites, and 8 harzburgites) and CM2B (6 dunites, and 12 harzburgites). Olivine CPO‘s indicates that all samples from the Oman crust-mantle transition zone display well-developed olivine CPO, the three classics high temperatures olivine CPO’s symmetries (axial-[100], axial-[010] and orthorhombic) are present with an olivine J-index varying from 1.2 to 8.6. The geochemical investigations conducted onboard D/V Chikyu (Phase 2 Leg 3; July-Aug. 2018) together with the variabilities observed in olivine CPO types and strength within Oman crust-mantle transition could be explained by the localization of deformation during diffuse (crystals grains boundaries) and focused (veins, faults) melt percolation.

Keywords: Oman crust-mantle, Melt percolation , Olivine CPO , XRF,ICP-MS, LA-ICP-MS, Oman drilling project

