

Geochemical Heterogeneity of impregnating melts in the Oman lithospheric mantle

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The oceanic lithosphere exposed in the Oman ophiolite records a complex history of melt migration processes and magmatic accretion, involving melts with various geochemical affinities. Despite many studies focused on documenting the magmatic records in the Moho Transition Zone (MTZ) and the layered crust, detailed microstructural and geochemical investigations of melt migrating and impregnating the Oman mantle harzburgite section are still very limited. Here, we focus on plagioclase-bearing impregnation structures recorded in the Wadi Tayin mantle section, with the aim to document the geochemical signature of melts percolating through the shallow lithospheric mantle and their relationships with the overlying MTZ and oceanic crust. Studied impregnation structures are composed of various proportions of interstitial plagioclase + clinopyroxene $\pm$ orthopyroxene in a harzburgitic or dunitic host rock, forming impregnated harzburgites and troctolites, respectively. Within the harzburgite, melts form impregnation-related trails or veinlets, whereas in the dunites their percolation leads to the formation of troctolitic pods or lenses included in the host harzburgite. Magmatic clinopyroxene Mg# ($\text{Mg}/(\text{Mg}+\text{Fe}) \times 100$ mol%) and plagioclase An ($\text{Ca}/(\text{Ca}+\text{Na}) \times 100$ mol%) contents are positively correlated and range between 90.6% - 92.9% and 86.4% - 98%, respectively, highlighting a general depleted geochemical signature of all impregnating melts. Trace element compositions of computed melts in equilibrium with clinopyroxene from all studied lithotypes show variable LREE depletion and Zr/Hf elemental ratios. Namely, independently of the mineral modal contents, some computed melts show La/Yb (0.63-1.34) and Zr/Hf (34.5-64.1) ratios similar to the Oman V1/Geotimes lava and the Oman oceanic gabbros, whereas other computed melts exhibit very low La/Yb (0.07-0.26) and Zr/Hf ratios (12.9-24.3), evidencing a significant depletion in highly incompatible trace elements. The chemical heterogeneity of impregnating melts could reflect different extents of reaction between MORB-type melts and peridotites and/or the occurrence of unaggregated melts characterized by primary depletion in incompatible trace elements. Deciphering such processes will shed light on the latest magmatic events recorded in the residual harzburgites and the role of migrating melts in the geochemical budget of the oceanic crust, thus adding an important piece to the complex accretional history of the Oman oceanic lithosphere.