Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SIT038-P03 Room: Convention Hall Time: May 26 17:15-18:45

Petrogenesis of MORB-saturated harzburgite from the uppermost mantle of the northern Oman ophiolite

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We found harzburgites in equilibrium with MORB-like melt from the uppermost mantle from the northern Oman ophiolite, and would like to discuss their origin. We examined rock samples from three outcrops around the Moho transition zone along Wadi Fizh in the northern Oman ophiolite. The rocks systematically change in lithology up-section from harzburgite to gabbro through dunite and wehrlite. The lower end of the layered gabbro section is called Moho for the simplicity here. Modal amounts of clinopyroxene in harzburgite change from almost nil to approximately 3.5 vol.%. No plagioclase is observed from harzburgite samples. Upward to the Moho, aggregates of orthopyroxene are gradually reduced in size, and spinels generally associated with the orthopyroxene aggregates gradually increase their idiomorphism. Approximately 1m-thick wehrlite layer is predominant just beneath the Moho, and changes to harzburgite through dunite in 10m in depth. Wehrlite is also observed as screens between gabbro layers above the Moho. Gabbro sills with or without wehrlitic aureole exist in harzburgite, dunite and wehrlite layers. The gabbro sills increase in frequency within the dunite-wehrlite layer upward, and some of them appear to be continuous to the gabbro layers upsection.
Mineral chemistry shows systematic variations upward from the lower part of the harzburgite layer to the Moho; (1) the Fo content (92 to 85) and NiO (0.43 to 0.20 wt%) of olivines decrease, (2) the Cr/(Cr + Al) atomic ratio (0.5 to 0.6), TiO2 content (nil to 1.4 wt %) and the Fe3+/(Cr + Al + Fe3+) atomic ratio (almost nil to 0.24) in spinels increase, and (3) TiO2 content (nil to 0.6 wt%) and Na2O content (almost nil to 0.44 wt%) in clinopyroxene increase, and Cr2O3 content (1.23 to approximately nil wt%) and Mg# (0.95 to 0.85) in clinopyroxene decrease from harzburgites through dunites to wehrlites. In the lower part of the harzburgite layer, rare earth element (REE) patterns of clinopyroxene incline from light-REE (LREE) to heavy-REE (HREE). REE patterns in clinopyroxene from some parts of harzburgite show U-shaped REE patterns. REE characteristics of clinopyroxene in the other parts of harzburgites, dunites and wehrlites suggest an involvement of MORB-like melts.
Geological, petrological and mineral chemical features confirm that the harzburgite-dunite-wehrlite-gabbro suite had been related to hydrous melt, which is MORB-like. The MORB-like hydrous melt and peridotite (harzburgite) had interacted with each other accompanying incongruent melting of orthopyroxene around the Moho beneath the spreading center. The interaction was most active around the Moho. The hydrous MORB-like melt probably crystallized clinopyroxenes before appearance of plagioclases to form wehrlites. We consider a back-arc basin magma, MORB-like but hydrous, for genesis of the Moho transition zone rocks northern Oman ophiolite.

Keywords: Oman ophiolite, harzburgite, dunite, wehrlite, gabbro, hydrous-MORB