Heterogeneous basal lherzolites from the north to south Oman ophiolite: evidence for the mantle heterogeneity

M.Z. KHEDR*[1,2], S. ARAI[1] AND A. TAMURA[1]

[1]Kanazawa University, Kanazawa, Ishikawa 920-1192, Japan (*khedrzm@yahoo.com)

[2]Faculty of Science, Kafrelsheikh Univ., Kafrelsheikh, Egypt

The fertile lherzolites (Types I and II) are dominant in the north (Wadi Ajran) and central (W. Sarami and Hawasina) Oman ophiolite, whereas depleted lherzolites to harzburgites are abundance in the south (Fanjah,Chunayb,Halfayn) Oman ophiolite. Basal lherzolites show heterogeneous distribution along the metamorphic sole and provide us with meter-scale (<50 m) lithological and chemical heterogeneities. Cpx of Type II lherzolites shows higher contents of Al_2O_3 (4.5–8.0 wt%), Na_2O (0.6–1.5 wt%) and TiO_2 (0.2–0.5 wt%), but low in spinel Cr# (0.07–0.2) than those of Type I. Primary spinel of these peridotites shows a wide range of Cr#, 0.07 to 0.5, covering the entire chemical range of spinels in abyssal peridotites. Their Cpx HREE contents and spinel chemistry suggest two melting trends, 1–8% melting for type II lherzolites and 5–12% for type I, followed by higher-grade partial melting, 12–25%, to form harzburgites. Lherzolites and harzburgites in the south Oman ophiolite are depleted as compared with those from the north-central parts. Their spinel Cr#s display a wide range from 0.15 to 0.35 for the former and 0.3 to 0.65 for the latter, suggesting high degrees of partial melting in the south ophiolite. Lherzolite Cpx shows lower contents of Al_2O_3 (2.2–4.6 wt%), Na_2O (<0.3 wt%) and TiO_2 (<0.2 wt%) than those from the northern part. The Cpx HREE contents and spinel-olivine chemistry suggest a continuous melting trend beginning with 5–15% melting for lherzolites to 15%–30 for harzburgites. The compositional variation of lherzolites from north to south Oman reflect heterogeneous compositions of sub-oceanic mantle as a source, whereas their heterogeneous distribution is possibly due to a heterogeneous structure of ridge segment cut by fracture zones. These oceanic fractures are trapped and exposed some parts of athensopheric materials (Type II) at the base of lithospheric mantle (TypeI) during detachment. Chondrite (CI)-normalized REE patterns for Cpx (1–10 CI times for HREE) in the investigated peridotites are convex upward with strong LREE depletion due to their residual origin, similar to abyssal peridotites from a normal ridge segment. The hydrous peridotites after lherzolites have been formed as a result of LREE-rich fluid metasomatism from the slab. The edenite-tremolite exhibits a spoon-shaped pattern with LREE enrichment. The Cpx and hydrous phases are enriched in B, Li, Cs, Rb, Pb and Sr due to influxed fluids during detachment and emplacement stages.