Compositional variation in the oceanic lithospheric mantle: a case study from the Oman ophiolite

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The mantle section in the Fizh block of the northern Oman ophiolite continuously distributes from Moho Transition Zone to the base of the ophiolite. The maximum thickness is estimated to be about 14 km in the northern Fizh block. Recently, the study of crustal section in the northern Oman ophiolite showed that the spatial compositional variation exisits along N-S direction corresponding to a segment structure along mid-ocean ridge (e.g., Miyashita and Adachi, 2001). To investigate the spatial compositional variation within mantle section, this study collected peridotite samples from wide area in the northern Fizh block of the northern Oman ophiolite. On the basis of the structural mapping by Okayasu and Takazawa (2001), harzburgite below Moho shows high-temperature coarse granular texture. Over 5 km far from Moho the texture becomes porphyroclastic or turbular equigranular. There is a NW-SE trending shear zone that extends from Moho into mantle section. In this zone harzburgite has mylonitic texture that gradually changes into porphyroclastic texture at the end of shear zone. The basal part of mantle section is a N-S trending shear zone that is apparently structurally oblique to the porphyroclastic domain. To investigate the compositional variation within mantle section of the northern Fizh block, mineral compositions of 19 peridotite samples along a traverse from Moho to the base of ophiolite were analyzed by EPMA at the Niigata University. The analytical results show that Fo mol% of olivine, Mg# of orthopyroxene (opx) and clinopyroxene (cpx) are nearly homogeneous from the Moho to the base. However, large heterogeneities were observed in Cr# and Mg# of spinel, Al contents of opx and cpx and Na content of cpx. The central part of the mantle section is depleted in melt components. This area is transitional from coarse equigranular domain to porphyroclastic domain. In this area the Cr# and Mg# of spinel are ~0.6 and ~0.5, respectively. The Al2O3 content of opx and cpx are ~1.5 ad ~1.3 wt.%, respectively. The Na2O content of cpx is less than 0.05 wt.%. From the central part of mantle section toward the base and toward the Moho, compositions gradually change. For example, toward mylonitic domain at the base, the Mg# of spinel, the Al content of opx and cpx and the Na content of cpx continuously increases while the Cr# of spinel decreases. Takazawa (1999) reported two types of lherzolites at the base of the northern Fizh block: the first type contains cpx with low Na that is in the range of typical abyssal peridotites and the second type has cpx with higher Na content (Na2O greater than 1 wt.%). The former lherzolite distributes within the basal shear zone and compositionally continuous to the harzburgites of upper horizon. On the other hand, the harzburgite in the coarse granular domain near the Moho is also characterized by slightly higher amount of Al in opx and cpx and higher amount of Na in cpx. However, the amount of enrichment is not as much as those observed at the base of mantle section. The origin of compositional heterogeneities in the mantle section of the northern Oman ophiolite will be discussed in the presentation.