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Spatial variability in composition and structure of Fizh mantle section of the Oman ophiolite

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The Oman ophiolite originally formed as a part of Neo-Tethys mid-ocean ridge and was obducted on the Arabian peninsula in the Late Cretaceous due to the collision between Eurasia and Arabia-African plates. To understand the formation, detachment and obduction of oceanic lithosphere we studied spatial variability in terms of composition and structure of mantle peridotites and mafic-ultramafic dikes in the Fizh mantle section from the northern Oman ophiolite. The mantle section mainly consists of harzburgites and dunites that have been thought homogeneous in composition. However, the composition and structure of mantle section systematically vary with regard to a depth from the Moho, to ridge segment structure and to shear zone.

The Fizh block has a N-S striking Moho in the center dividing the crust section in the east from the mantle section in the west. The maximum thickness of the mantle section is up to 17 km. Coarse granular microstructure distributes in the uppermost part of the mantle section where a relic of high-temperature asthenospheric flow has been frozen (Nicolas, 1989). The shear sense in the northern part of the Fizh mantle section (Wadi Rajmi to Wadi Zabin) is top to the south. In the middle part of the Fizh block (Wadi Zabin to Wadi Fizh) paleo-flow line dominates E-W direction while N-S directed in the south. These flow patterns are explained by a micro plate that rotated clockwise within overlapping spreading center in which eastern ridge axis proceeded to the north while western ridge axis toward the south. This is also consistent with the location of ridge segment end inferred from compositional variability. The peridotites with porphyroclastic microstructure are distributed structurally below the coarse granular domain. Plastic flow may have continued longer after freezing of asthenospheric flow in the upper level. N-S directed paleo-flow line dominates in the porphyroclastic domain through the Fizh block. Moreover, NW-SE directed sinistral shear zones crosscut the peridotites in the coarse granular and porphyroclastic domains (Takazawa et al., 2003; Michibayashi et al., 2006). These shear zones represent the latest deformation probably during oceanic detachment.

In the Fizh block the center of paleo-ridge segment has been detected in the south while the segment end in the north (Miyashita et al., 2003; Takazawa et al., 2003; Le Mee et al., 2004; Monnier et al., 2006). The range in Cr# of spinel broaden from the south toward the north in the Fizh block (Murakami et al., 2007). In the south where paleo-ridge segment center has been detected homogeneous harzburgites with spinel Cr# around 60 are widely distributed indicating that the degree of partial melting was uniform in this region. On the other hand, in the north, i.e., an inferred paleo-ridge segment end, the degree of partial melting was lower than the south. During oceanic detachment remelting of residual harzburgites occurred in the north because of fluid migration forming highly depleted zone with spinel Cr# greater than 70.

During oceanic detachment the Oman ophiolite became an incipient subduction zone (Ishikawa et al., 2005; Arai et al., 2006; Dare et al., 2008). Many dunites contain spinel with Cr# greater than 7 0 in the Fizh block, especially near the basal thrust (Suetake and Takazawa, abstract submitted to

JpGU 2010). Gabbronorite and pyroxenite dikes may have formed from Si-rich melt after remelting of hydrous mantle peridotite (Python and Ceuleneer, 2003; Tamura and Arai, 2006). Such melt flew passing through dunites and precipitated pyroxenites and gabbronorites during fractional crystallization (Kanazawa and Takazawa, 2008; Satoh and Takazawa, 2008).

Keywords: ophiolite, mantle, peridotite, oceanic lithosphere, partial melting, subduction zone