Regional variation of the Moho transition zone in the northern Oman ophiolite

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The Mohorobicic's discontinuity is defined by a sharp discontinuity in seismic velocity profiles and locates at around 6 to 7 km depth from oceanic floor. Mantle and crust are defined by this discontinuity, i.e. mantle is below and crust is above the Moho. Therefore, the Moho discontinuity corresponds to the mantle-crust boundary. Although the Moho discontinuity is showen by a sharp boundary between mantle and crust in terms of geophysics, mantle-crust transition zones (MTZ) with variable thickness are reported from ophiolites. In the Oman ophiolite, the transition zones are mainly composed of dunite and wehrlite with subordinate olivine gabbro (Lippard et al, 1986).

Benn (1988) showed that lithofacies and thickness of the MTZ are considerably varied in the central part of the Oman ophiolite. Nicolas & Boudier(1996)reviewed a regional variation in thickness of gabbro layer and MTZ for whole Oman ophiolite, and showed that the thickness of the gabbro layer tends to de thinner at the segment center and becomes to thicker away from the segment center. In contrast to this, they showed that the MTZ is thickest at the segment centers and becomes thinner to the segments margin. Above arguments indicate that segmentation structures affect seriously for the genesis of the MTZ.

Miyashita et al. (2003), Adachi and Miyashita (2003) and Umino (2003) proposed a segment structure in the northern Oman ophiolite, that is critically different from previous studies (e.g., Macleod and Rothery (1992)). They showed that Wadi Fizh area is segment end (tip of northward propagating ridge), Wadi Thuqbah area is segment center, and Wadi Sudum to Hilti area is intermediate in the segment structure.

We have studied a detailed vertical variation from mantle harzburgite (ca, 200-300 m), through MTZs to the basal part of layered gabbro along 7 routes. These 7 routes are Wadi Sudum, Hilti, Thuqbah, Hayl, Fizh, Fizh north and Zabin, from south to north.

The onset of the MTZ is defined by appearance of dunite (and wehrlite) as a predominant lithofacies, and the upper limit is shown by predominant occurrence of layered gabbro. Thickness of the MTZ is systematically varied depending on the location in the segment structure, thickest (300m) at the segment center (Thuqbah) and becomes to thinner toward the southern margin (Sudum) and the northern margin (Fizh) up to 10 m, in consistent with Nicolas and Boudier (1996). However, we found that very thick MTZs up to 250-300 m appear also at Fizh north and Zabin routes located at the most northern end of the ridge segment.

In addition to above variation in thickness of the MTZs, systematic changes in lithofacies and structural features are recognized. Harzburgites beneath the MTZ at the segment margin areas (Sudum, Fizh, Fizh north and Zabin) are characterized by abundant impregnation of plagioclase and clinopyroxene. Whereas, underlying harzburgites beneath MTZ from the segment center area are nearly free from such impregnations. Furthermore, structural features shown by foliation and liniation are also changed depending on the location in the segment structure. Apparent foliation and liniation are well observed at near the segment center, but they are not apparent near the segment margins, i.e. become to massive occurrence.

These lines of evidence described above suggest that melt extraction from upwelling mantle is efficient at the segment center and less efficient at the segment margins. Mineral compositions of the basal part of layered gabbros are consistent with this assumption.