Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SIT05-03 会場:104 時間:5 月 21 日 09:30-09:45

高速拡大海嶺におけるマグマシステム：オマーンオフィオライトからの検討
Magma system along fast-spreading ridges: Evidence from the northern Oman Ophiolite

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Ocean ridges are segmented into various scales with a hierarchy, from the biggest 1st-order to the smallest 4th-order segments. These segment structures control magmatic processes beneath ocean ridges in respect to upwelling mantle, partial melting, and magma delivery system. However, systematic studies on the segment control for the magmatic processes are few at present ocean ridges due to difficulty to obtain samples from different depths. Therefore, studies of ocean ridge segmentation in ophiolites would bring significant information to understand magmatic processes beneath ocean ridges. Because, precise 3-D architectures from mantle to the uppermost extrusive layer and their lateral variations would be determined in ophiolites. We have studied northern Oman ophiolite where a complete succession from mantle peridotite to the uppermost extrusives is well exposed. Miyashita et al. (2003), Adachi and Miyashita (2003) and Umino et al. (2003) proposed a segment structure in the northern Oman ophiolite; Wadi Fizh area is regarded as northward propagating tip of ridges based on geological lines of evidence (Adachi and Miyashita. 2003). On the other hand, Wadi Thuqbah area, about 25 km south to Wadi Fizh, is regarded as a segment center based on the thickest Moho transition zone, well developed EW-trending lineations in the MTZ and layered gabbro and comparatively primitive compositions of layered gabbros. Furthermore, the southern margin of the Hilti block, about 40 km south to Wadi Thuqbah, is assumed to be the segment end, based on a regional compositional variation of sheeted dike complex (Miyashita et al., 2003).

The bulk rock compositions of sheeted dike complex show systematic variations along the ridge segment; both highly evolved and less-evolved compositions appear at northern and southern segment margins, respectively, while narrow and uniform mildly evolved compositions appear at the segment center. This is interpreted by that larger and more persistent melt lenses at the segment center but much smaller and more transient melt lenses at the segment margins due to a difference of thermal conditions. At the larger and more persistent melt lenses, multiple magma mixings suppress advance of fractional crystallization and resulted in comparatively uniform mildly evolved melts. On the contrary, at the smaller and transient melt lenses at the segment margins, more intensive fractional crystallization resulted in highly evolved melts due to cooler conditions. On the other hand, primitive melts without stagnant in the melt lenses may extrude at the segment margin because of absence of the melt lenses. Thus, both evolved and primitive melts may be produced at the segment ends.

We have also examined along axis variations of the mantle-crust transition zone (MTZ) in the northern Oman ophiolite. Systematic variations of thickness of the MTZ are apparent; very thin at the segment margin (ca. 10 m), intermediate at the intermediate locations (ca. a few tens m) and thick MTZ at the center (ca. 250-300 m). Also mode of occurrence just beneath the MTZ is variable depending the location in the segment architecture. Abundant gabbroic pods and veins are found in the harzburgites just beneath the MTZ at the segment margins, but they are very few at the segment center. These lines of evidence show that the melt extraction from the upper mantle to the crust is more efficient at the segment center. On the contrary, melt extraction is inefficient at the segment margins, resulting in stagnant and crystallization of melts in the upper mantle at the segment ends.

References

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キーワード: 海洋地殻, 火成作用, MORB, 海嶺セグメント構造, オマーンオフィオライト
Keywords: oceanic crust, magmatism, MORB, ocean ridge segmentation, Oman ophiolite