Volcanic stratigraphy of V1 extrusive sections in Northern Oman ophiolite with a special reference to the segment structure

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The Oman ophiolite is one of the best examples to study architecture of oceanic crust and its generation processes. The succession of Cretaceous oceanic crust to upper mantle is spectacularly exposed in this ophiolite. Volcanic sections are well exposed in the northern part of the ophiolite.

Volcanic sections of the Oman ophiolite consist of V1 (Geotimes), V2 (Alley), and V3 (Salahi). V1 is the oldest magmatism and regarded as mid-ocean ridge origin. V2 is formed by subduction zone magmatism, and V3 is alkalic basalt during collision stage (Alabaster et al. 1982). However, these classifications and their petrogenesises are still on debate. Distinction of V1 and V2 is due to the appearance of ferromanganoan sediment (umber) between them. In addition to above units, Lasail unit exist between V1 and V2. Alabaster et al. (1982) and Godard et al. (2003) claimed that this unit is an early phase of Alley, while Umino et al. (1991) and Durair et al. (2005) regarded that the Lasail unit is included in and undifferenciated part in Geotimes.

Lava morphology is controlled by submarine topography, cooling rate and flow rate (Perfit and Chadwick, 1998). Where being high effusion rate and flat to gentle slope, sheet flow predominates. While where being low effusion rate and steep slope, pillow lava predominates. The proportion of sheet flow to pillow lava increases with increasing spreading rate (Bonatti and Harrison, 1988).

In the Oman ophiolite, lava morphology is quite variable place to place possibly reflecting the difference in effusion rate and topography.

We have studied volcanic stratigraphies from V1 to V2 at three areas, locating at different setting of segment structure, i. e. segment center, margin and intermediate. Wadi Fizh area is regarded as segment boundary of second to third order discontinuity (Adachi & Miyashita, 2003; Miyashita et al. 2003). Ghayth area locates near the segment center and Wadi Salahi area to intermediate location.

In Wadi Fizh area (segment boundary), 650 m height column of V1 is obtained from the basal part to the second umber horizons. It is noticed that the first umber occurs just at middle of V1 succession. 36 units (a unit is defined from a bottom of the sheet flow or pillow lava to the next sheet flow or pillow lava) are defined in this area, and thickness of each unit is about 20 m. Pillow lava with 1-1.5 m in diameter predominates, attaining 66 % in total thickness.V1 section in the Ghayth area (segment center) shows more than 560 m thick below the 2 m thick umber and consists of 94 units. It is noted that thickness of each unit is 2-10 m, much thinner than Wadi Fizh. On the other hand, the proportion of massive sheet flow to pillow lava is also significantly different from Wadi Fizh. Pillow lava is only 29 % in total thickness and exhibits about 2 m in diameter. In Wadi Salahi area (intermediate), we got 500 m height of V1 succession from the basal part to umber horizon. They have 40 units ranging from 4 to 20 m thickness. Pillow lava is about 60 % in total thickness and 1-2 m in diameter. In the lower part of this succession, thickness of unit increases up to 30 m.

Consequently, segment center (Ghayth area) is characterized by predominance of massive flow and comparatively thin numerous units. While segment margin is characterized by predominance of pillow lava and thick alternation of units. Therefore, we conclude that effution rates and events were high at the segment center and low at the segment margin.

The appearance of the first umber at the middle part of V1 succession in Wadi Fizh area indicates that some time gap exists within the V1 magmatism. This may be explained by a large scale overlapping ridge system, the lower sequence below the first umber was formed at retreating ridge then the upper sequence may be overlain at propagating ridge.