

Paleostress analysis of dike swarms of the V2 arc magmatism in the Oman Ophiolite

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The world largest and best preserved Oman Ophiolite provides the entire geological records of intra-oceanic subduction zone formation and arc evolution. The fast-spread oceanic crust consisting of 98-96 Ma MORB-like basalt (V1) was followed by 96-94 Ma arc volcanism (V2) on a shallow dipping subduction zone, most likely resulted from microplate rotation including the spreading axis [1-9]. The V2 volcanism was dominated by arc tholeiitic rocks and terminated with sporadic activities of low-silica boninite. Through the V2 magmatism, the same source mantle shows progressive depletion by stepwise melt extraction, as shown by the lower Nb/Ta ratios for the younger volcanic rocks (V2 boninite < V2 tholeiite < V1)[7]. The V2 arc tholeiitic and boninitic magmas were successfully modelled as the results of progressive remelting of the V1 residual mantle promoted by the high-T hydrous fluid and sedimentary melt liberated from the metamorphic sole as evidenced by the eHf(t) and Sr-Nd isotopic ratios of the amphibolite and metachert in the sole and clinopyroxene separates from boninites [8,10].

Although volcanic stratigraphy and geochemical evolution of the V2 arc magmatism are well constrained, the V2 magma plumbing system is poorly understood. The lower V2 tholeiitic strata are widely distributed over 200 km, however, the upper boninitic rocks show only limited and sporadic distribution with the largest exposure in the north between wadis Hatta and Ahin, where boninitic and tholeiitic volcanic rocks are intimately associated with hypabyssal and plutonic equivalents, such as dikes, gabbro and gabbros. In the north of Wadi Fizh, intense E-W-striking dike swarms that cross cut the N-S-striking V1-stage sheeted dikes are considered to be the feeders of the V2 flows and pyroclastic rocks and have emanated from diorite-gabbro-gabbro-ultramafic cumulate complex, which intruded into and replaced the V1-stage layered gabbros, sheeted dikes and lavas. On the other hand, the V2 feeders in the south of Wadi Fizh are N-S to NW-SE dikes and low-angle sheets, the latter of which locally form intense swarms and were hence interpreted as cone sheets [12]. We investigated the distribution, structure and lithology of the E-W-striking dike swarms to understand the paleostress field and genetic relationships between the dike swarms and the V2 extrusive rocks and the plutonic equivalents. The dike swarms strike mostly in two directions of WNW-ESE and E-W, and forms four dense clusters of dikes 3-4 km in width and every 5 km apart N-S. The most intense swarms consist of 100 % sheeted dikes that appear between the lower plutonic bodies and the upper V2 strata. The paleostress analysis [12] of the E-W dike swarms shows that each swarm of dikes is divided into a couple of group of dikes with different paleostress orientations. All these dikes indicate vertical to steeply dipping maximum compressive stress axis and high magmatic pressure exceeding the minimum compressive stress, indicating intrusions along extensional shear fractures oblique to the minimum stress axis, as shown by the coexistence of dikes with two different orientation.

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