

## Fate of high-T subduction zone and the obduction of the Oman Ophiolite

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Obduction of ophiolitic bodies onto continental crust inevitably follows a tectonic event of conversion from divergence to convergence of plates. This is commonly accomplished by the formation of intraoceanic subduction zone near the ridge axis, where lithospheric lid is thinnest and weakest, and accompanies the boninite volcanism [3]. The upper part of the subducted slab is metamorphosed and later thrust over onto a continent with the overlying mantle to become " the metamorphic sole ". Known examples of metamorphic soles record peak T-P of 600~840 °C and ~1 GPa, whereas the thickness of overlying ophiolite sheets are only 10-20 km, yielding too small lithospheric load compared to the metamorphic pressure of the sole [4]. This discrepancy has been explained that the ophiolite sheet and the metamorphic sole formed at discrete places were emplaced and superposed at the same place during the obduction process [3].

However, we have demonstrated by examining the trace element geochemistry of the arc magmas and metamorphic sole of the Oman Ophiolite that fluid liberated from the metamorphic sole triggered flux melting of the overlying depleted mantle peridotite and produced arc tholeiitic basalt magma first, and subsequently low-Si boninite magma. Therefore, the ophiolite and the underlying metamorphic sole did not form independently at distant places, but were formed and transported together as an intact body with the present structural relationship. Genetic conditions estimated for a primitive boninite melt with 16 wt% MgO enclosed by Cr spinel indicate the segregation pressure of 0.5 GPa and 1320 °C from the mantle with the potential T of 1400 °C [1, Kusano et al., this session]. Thus, the boninite magma should have segregated from the mantle at a depth >17 km. Nevertheless, the present ophiolite body has the maximum thickness <15 km.

The above lines of evidence urged us to propose the following model; Conversion from spreading to closure of the Tethys resulted in the subduction of young and hot oceanic lithosphere beneath the Tethyan ridge axis. The oceanic crust of the subducted slab was metamorphosed to cpx-bearing amphibolite at a depth of ~35 km and 800 °C. Trace elements and Nd-isotopic evidence indicate fluids and partial melt of subducted sediments liberated from the dehydrated slab migrated upward and formed a partially melted column in the wedge mantle [6, 7]. Primary boninite magmas segregated from the residual harzburgite on the top of the melting column at a depth of ~17 km and at 1320 °C and ascended to form dunite channels and depleted zones through the uppermost lithospheric mantle [8]. Because serpentine and chlorite are unstable >800 °C, the subducted crustal rocks are metamorphosed to amphibolite and the overlying mantle peridotite becomes amphibolite-bearing lherzolite. The lack of mineral phases which could act as lubricant caused large friction and eventual cohesion of the metamorphic slab and hanging wall of the mantle peridotite. Because of the large mechanical strength of the upper crustal and the lower mantle section of the slab, the lower slab of lithospheric mantle are decoupled from the crustal upper slab and continued to subduct without dehydration because the lower slab was virtually anhydrous. This terminated the Oman arc volcanism in a few million years with the production of boninite magma. The strongly coupled upper slab with the overlying wedge mantle obducted together onto the Arabian Peninsula as the metamorphic sole. During the course of thrusting toward the continent, the hot and partially molten asthenospheric mantle in the wedge was squeezed and flattened by the load of the overlying lithosphere, resulted in the present structure of the thin (<15 km) ophiolite sheets underlain by the metamorphic sole formed at a high pressure ~1 GPa.

Keywords: Oman Ophiolite, boninite, high-T subduction zone, metamorphic sole, subduction initiation, obduction

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