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Transition from late Cretaceous seafloor spreading to arc magmatism along the Tethyan margin

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Marginal basin formation involves interaction between ambient asthenospheric mantle, material derived from subducting slab and mantle plume. These processes are critical components of material recycling between the lithosphere and asthenosphere and resulting mantle dynamics.

Some Neotethyan ophiolites are known to have preserved ocean crust of marginal basins as well as volcanic sections with supra subduction geochemical signatures, i.e., arc signature implying contribution of slab-derived component to the magma source (e.g., Dilek and Furnes, 2019). The Khoy ophiolite, which is one the eastern Neotethyan ophiolites in NW Iran, exposes mantle peridotite, gabbroic lower crust and volcanic rock sections. Volcanic section is dominantly composed of basaltic lava flows often exhibit occasionally intercalated with volcanic sandstone and epiclastic conglomerate.

Geochemical characteristics of the basalts are mostly MORB-like, and show variable degree of enrichment in incompatible elements and radiogenic isotopes. At least in one section, basalts show clear OIB signature. Some basaltic clasts in epiclastic conglomerate show distinct chemical characteristics with enrichment in LILE and depletion in HFSE, i.e., arc-like signature. Pb isotopic characteristics of the MORB-like basalts clearly show their Indian Ocean MORB-affinity, while those with OIB signature have distinct isotopic characteristics with a Pb isotopic trend toward HIMU-like endmember.

Ar/Ar dating of MORB-type basalt gave consistent ages indicating that the seafloor spreading was taking place in Campanian. An ankaramitic rock with OIB signature returned almost identical age to those from the MORB-type basalts. This strongly implies that both MORB-type and OIB source coexisted and contributed to the magmatism in the ocean basin. On the other hand, a basalt with arc signature showed significantly younger age of Maastrichtian, which is consistent with biostratigraphic age constraint.

The data collected so far, combined with regional geological setting in late Cretaceous, seem to show that the basaltic section of the Khoy ophiolite corresponds to a remnant marginal basin, possibly backarc basin ocean crust with possible presence of small scale mantle plume activity. The backarc basin might have formed intra arc setting, leaving dissected arc section in the eastern Khoy marginal basin. Arc magmatism resumed by Maastrichtian and supplied volcaniclastics to the ocean basin.