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Whole rock geochemical and zircon isotopic (U-Pb, Hf, O) study of magmatic rocks of the Manipur Ophiolite, northeast India: implications for the prolonged juvenile magmatism

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The Nagaland Manipur Ophiolite Belt (NMOB) of the Indo-Myanmar Ranges (IMR) represents lithospheric remnants of the Neo-Tethyan Ocean that evolved during the accretion of the Indian and Myanmar plates. Mafic rocks of the NMOB are characterized by whole-rock and in situ phase geochemistry to constrain the source characteristics and the tectonic environment. Zircon U-Pb geochronology and isotopic (Lu-Hf and O) measurements were also carried out to estimate the timing and nature of the magma composition. Whole-rock geochemical signatures of mafic rocks indicate two different magma sources. Group 1 shows an EMORB-OIB affinity produced by 3-20% partial melting of an enriched to mixed garnet-spinel lherzolite source in a within-plate setting. Group 2 reflects IAT-CAB signatures, derived from 6-30% melting of a depleted spinel lherzolite source in an SSZ setting. The ΣREE of the mafic rocks of Group 1 ranges from 8 to 177 ppm with La/Sm (2.60-5.79), Sm/Yb (1.34 and 3.99), Nb/Yb (1.17-26.60), Nb/Th (1.21-13.59), whereas Group 2 samples have a relatively lower ΣREE (1−22 ppm), Nb/Yb (0.26-1.46) and higher La/Sm (0.08−6.42), Sm/Yb (0.19 − 179), Nb/Th (2.04-15.22). The whole-rock signatures of the studied samples reflect the combined effect of melt heterogeneity, magma mixing, different degrees of partial melting, and subduction influence. In situ clinopyroxene phase chemistry reflects the coexistence of (i) an OIB-like transitional alkaline magmatism and (ii) sub-alkaline magmatism in an island arc to back-arc region (Wangjam et al., 2024).

U-Pb zircon geochronological study shows an age spectrum of 123±1 to 111±1 Ma, and the εHf values of the dated zircons ranging between +12.8 and +24.6 suggest that the zircons were derived from a prolonged and episodic (123±1, 118±1, 111±1 Ma) juvenile magma. The zircon O-isotope data $d^{18}O$ value ranging between 1.69 to 6.24‰ reveals that they are mantle-derived, with the melt showing effects of hydrothermal alteration (low $\delta^{18}O$). The present study implies the coexistence of subduction-related (SSZ) and plume-influenced magmatic remnants, both preserved in the present-day configuration of the NMOB.

References

Wangjam et al., Geochemistry, 84, 126150, 2024.