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Heterogeneous magma sources of the Nagaland Ophiolite mafic rocks, northeast India: Implications from whole rock and clinopyroxene phase in situ geochemistry

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Mafic rocks of the Nagaland Ophiolite Complex, Indo Myanmar Ranges (IMR) were characterized by integrated whole rock and clinopyroxene in situ phase geochemical analyses to reconstruct the magma source and tectonic environment. Based on the whole rock geochemical signatures, the mafic samples are subdivided into two groups. Group 1 mafics show an EMORB-OIB affinity characterized by relatively higher concentrations of SiO_2 (46.16−50.50 wt %) and TiO_2 (1.48−3.84 wt %) derived from an enriched source (La_n/Yb_n 4.59−16.14, Sm_n/Yb_n 2.60−4.43, La_n/Sm_n 1.68−3.74). Group 2 mafics have relatively lower SiO_2 (45.49−48.24 wt %), TiO_2 (0.33−1.61 wt %) and higher values of La/Nb (1.34−12.75), Th/Nb (0.08−2.78), Ba/Nb (30.76−123.72) with lower Nb/Y (0.04−0.14), Nb/La (0.07−0.74) indicating subduction affinity. Chondrite normalized REE trend of Group 2 mafics are similar to the Mariana Forearc basalt with Rb, Ba enrichment and Th, Nb depletion. Group 1 mafics have close similarities with OIB but also indicate crustal signatures observed in Nb/Yb−Th/Yb plot and higher La/Yb (6.40−22.51). Major oxide, trace element composition, and REE patterns of the mafic clinopyroxenes reflect diverse geochemical signatures. Clinopyroxene phenocrysts are augite-diopside with Mg# ($Mg/Mg+Fe^{2+}$) varying between 60−86. Zoned clinopyroxene of a volcanic sample of Group 1 shows transitional alkaline affinity derived from an enriched OIB-type melt and crystallized at intermediate P-T in a relatively oxidized environment. Group 2 mafic clinopyroxenes are sub-alkaline derived from similar magma sources in a subduction setting. The temperature and pressure of crystallization are estimated between 823−1171°C and 1−8 kbar, respectively, by single clinopyroxene geothermobarometry. Geochemical interpretation of the studied samples suggests their possible derivation from heterogeneous sources, that is, a plume-influenced and oceanic arc magmatism in the Neo-Tethyan oceanic lithosphere.