Multiple stage magmatism during the evolution of Nagaland-Manipur ophiolites, northeast India: Evidence from geochemical and mineralogical characteristics of volcano-plutonic mafic rocks

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The Nagaland-Manipur ophiolites (NMO), which are tectonically sandwiched between India-Myanmar continental blocks, are among the geologically least explored regions of the Tethyan ophiolite belt. Geochemical studies suggest that high-Ti basalts of NMO show highly enriched LREE pattern [$(La/Sm)_N$ = 2.27–3.44], equivalent to alkaline OIB composition, whereas, low-Ti basalts exhibit flat REE pattern and slightly depleted LREEs [$(La/Sm)_N$ = 0.62–1.03], similar to tholeiitic N-MORB. P-MORB signatures are also observed in the NMO basalts formed by mixure of enriched OIB and depleted N-MORB melts. 5–10% partial melting of enriched mantle at garnet facies zone was responsible for production of OIB-types and 20% partial melt of depleted mantle within spinel facies zone for MORB tholeiites. MORB-type affinity of these volcanic rocks is also supported by the composition of mafic dykes and non-hornblende bearing plutonic gabbros of the NMO. However, hornblende bearing gabbros exhibit very low-Ti content (TiO_2 = 0.54 wt.% to 0.86 wt.%) and depleted LREEs, suggesting their formation in a SSZ tectonic setting. Presence of calcium-rich plagioclase ($An_{16.6-32.3}$) also supports SSZ origin. Tectonic settings of the investigated rock samples are shown in Fig.1. Thus we conclude that OIB and MORB samples of NMO represent the first stage magma generation by plume eruption and decompressive mantle upwelling at sea floor spreading zone between India-Australian plates, while SSZ samples represent the second stage of magmatism induced by the subduction of Indian plate beneath the Myanmar plate during the evolution of Indo-Myanmar orogenic belt (IMOB).

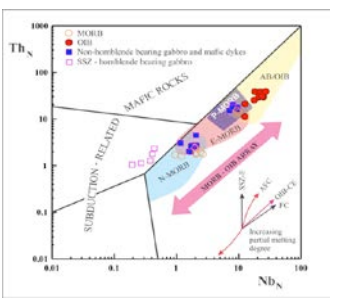

Fig.1. *Th_N vs. Nb_N diagram of [1] indicating tectonic settings of NMO mafic rocks. Normalizing values are the N-MORB composition from [2].*

[1] Saccani (2015) *Geosci. Front.* **6**, 481–501. [2] Sun & McDonough (1989) *Geological Society of London* **42**, 313–345.