Geochemical Constraints on the Origin of the Ophiolites of the Indo-Myanmar Orogenic Belt, North East India

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The Naga-Manipur Ophiolite (NMO), oceanic lithosphere of probable upper Cretaceous age, forms part of the NNE-SSW (~200 km in length, ~ 2-20 km in width, covers an area ~2000 sq. km.), trending Indo-Myanmar Orogenic Belt (IMOB). Further south in structural continuity with this belt, the Andaman and Nicobar Islands Arc has formed and the belt continues further southeast to the Mentawai Islands representing the outer Indonesian Island Arc (Moore and others, 1980). The IMOB is interpreted as representing the eastern suture of Indian plate formed due to the collision of the Indian plate with the Myanmar plate (Mitchell, 1981; Acharyya and others, 1989). The ophiolite sequence in this region is highly tectonised, dismembered and shows three phases of deformational events broadly comparable to the Himalayan orogeny and sea floor spreading of the Indian Ocean (Ghose and others, 1986). The ophiolites occur mainly as rootless subhorizontal bodies overlying Eocene-Oligocene flyschoid sediments.

Peridotites (harzburgite, lherzolite, wehrlite, dunite), mafic intrusives (gabbro, dolerite), mafic volcanics (massive basalt, pillow basalt, agglomeratic basalt), pelagic sediments (chert, cherty quartzite, marl, shale, phyllite, limestone) and podiform chromitites (massive, nodular, disseminated, granular) are the dominant lithologic units of this ophiolite. The absence of sheeted dykes together with the paucity of lavas in the ophiolites might be explained by formation in a slow-spreading environment where the magma budget was low and volcanism was episodic. Random distribution of chromitites suggests deep-mantle magmatic segregation and subsequent disruption of primary cumulate chromitites by deep-seated mantle subsolidus deformation (Coleman, 1977).

The Cr-spinel in peridotites of NMO is characterized by low Cr_2O_3 (10.03-41.12 wt.%) and high Al_2O_3 (25.34-55.86 wt.%), FeO (11.45–14.51 wt.%) and MgO (13.27–18.41 wt.%). Their chemistry is comparable to those of observed Cr-spinel of abyssal peridotites (Dick and Bullen, 1984; Arai, 1992). The mafic volcanics are represented by chemically two distinct groups of high-Ti and low-Ti mafic volcanics. The high-Ti type shows relatively uniform compositions and they have geochemical characteristics of Ti > 1 wt. %; Ti/V = 21-45; mild LREE depletion with flat HFSE patterns that are compatible with those of high-Ti basalts generated at mid-ocean ridges, whereas the low-Ti type shows Ti < 1 wt. %; Ti/V < 20; strong depletion of LREE with mild depletion of HFSE is consistent with the composition of magma generated in a supra-subduction zone setting from partial melting of refractory mantle source (Saccani and others, 2003).

The ophiolites containing both the high Al (Cr# = 30-60) and high-Cr chromite (Cr # = 75-80) chromitites, suggest a genetically separate process for these chromitites. Further it is suggested that high-Al chromite was modified by reaction with boninitic melts from which high-Cr chromite precipitated. These would typically be interpreted as chromites in equilibrium with tholeiitic melt and boninitic melts, indicating their genesis in mid-oceanic ridge and supra-subduction zone environment, respectively. Chromitites has higher concentrations of IPGE (Os, Ir, Ru) as compared to the PPGE (Rh, Pd, Pt) with concentration of PGE between 135 ppb and 551 ppb. The chondrite-normalized PGE patterns for these chromitites are comparable with typical podifom chromitites in ophiolite with enriched in IPGE and depleted in PPGE (Page and others, 1982; Zhou and others, 2005). Systematic study confirmed sulphide mineralization in these chromitites, and alloys were identified as argentite (Ag_2S), millerite (NiS), pentlandite (Fe, Ni)S etc. The sulphide mineral grains occur mainly as anhedral to subhedral (~ 5-20 mm in size) grains along the boundaries and fractures of chromites.

Evaluation of geochemical and petrogenetic data of the mantle sequence and cumulates reveals that the ophiolites of the Indo-Myanmar Orogenic Belt under investigation appear to have formed due to tectonic dismemberment and accretion of material generated in an oceanic environment (i.e. MORB and OIB-type rocks) and after the process of accretion of the ophiolitic suite of rocks were affected by boninitic melts generated by partial melting of depleted peridotites in the fore-arc setting. This feature implies that tectonic incorporation into the accretionary wedge of MORB-type and OIB-type material occurred prior to the development of boninitic magmatism.

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