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# Petrology and geochemistry of Abyssal Peridotites from the Manipur Ophiolite Complex, Indo-Myanmar Orogenic Belt, Northeast India: Implication for melt generation in mid-oceanic ridge environment

A. Krishnakanta Singh *

*Wadia Institute of Himalayan Geology, GMS Road, Dehradun 248 001, India*

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A B S T R A C T

The Manipur Ophiolite Complex (MOC) located in the Indo-Myanmar Orogenic Belt (IMOB) of Northeast India forms a section of the Tethyan Ophiolite Belt of the Alpine–Himalayan orogenic system. Whole rock compositions and mineral chemistry of mantle peridotites from the MOC show an affinity to the abyssal peridotites, characterized by high contents of $Al_2O_3$ (1.28–3.30 anhydrous wt.%); low Cr# of Cr-spinel (0.11–0.27); low Mg# of olivine (~$Fo_{90}$) and high $Al_2O_3$ in pyroxenes (3.71–6.35 wt.%). They have very low REE concentrations ($\sum$REE = 0.48–2.14 ppb). Lherzolites display LREE-depleted patterns ($La_N/Sm_N$ = 0.14–0.45) with a flat to slightly fractionated HREE segments ($Sm_N/Yb_N$ = 0.30–0.65) whereas Cpx-harburgites have flat to upward-inflected LREE patterns ($La_N/Sm_N$ = 0.13–1.23) with more fractionated HREE patterns ($Sm_N/Yb_N$ = 0.13–0.65) than the lherzolite samples. Their platinum group elements (PGE) contents (<50 ppb) and distinct mantle-normalised PGE patterns with the Pd/Ir values (1.8–11.9) and Pt/Pt* values (0.2–1.1) show an affinity to the characteristic of the residual mantle material. Evaluation of mineralogical and petrological characteristics of these peridotites suggests that they represent the residues remaining after low degree of partial melting (~2–12%) in the spinel stability field of a mid-oceanic ridge environment. The well-preserved mid-oceanic ridge characteristics of these peridotites further suggest that the mantle section was subsequently trapped in the forearc region of the subduction zone without undergoing significant modification in their chemistry by later subduction-related tectonic and petrological processes before its emplacement to the present crustal level.



## 1. Introduction

Abyssal peridotites represent mantle residues produced by partial melting beneath mid ocean ridges where common mid-oceanic ridge basalts are generated (Dick and Bullen, 1984; Johnson et al., 1990; Snow et al., 1994; Niu, 2004). These mid-oceanic ridge (MOR)-type peridotites differ from the supra-subduction zone (SSZ) peridotites that experience intense melting above the subduction zone and are usually highly depleted in terms of their modal compositions (low clinopyroxene, Parkinson and Pearce, 1998) and whole rock compositions (low $Al_2O_3$, CaO and HREE, Parkinson et al., 1992) and high Cr# [(Cr/(Cr + Al)] in Cr-spinel (Arai, 1994; Zhou et al., 1996).

The Naga–Manipur Ophiolites (NMO) forms a part of the Tethyan Ophiolite Belt exposed in the NNE–SSW trending Indo-Myanmar Orogenic Belt (IMOB) (Fig. 1a). The NMO has been interpreted as an accretion prism resulting from the convergence between the Indian and Myanmar plates (Acharyya et al., 1989; Mitchell, 1993). The NMO is a narrow belt trending NNE–SW, ~200 km in length, ~2–20 km in width, and covers an area of ~2000 sq. km. Although the ophiolitic suite of rocks of the NMO have been the subject of intensive geological investigations (Gansser, 1980; Ghose and Singh, 1981; Chattopadhyay et al., 1983; Acharyya et al., 1989; Anon, 1986; Venkataramana et al., 1986; Mitra et al., 1986; Agrawal and Ghose, 1986; Ghose et al., 1986; Sengupta et al., 1989; Vidyadharan et al., 1989; Bhattacharjee, 1991; Acharyya, 2007; Singh et al., 2008; Singh, 2009; Chatterjee and Ghose, 2009; Ghose et al., 2010), its origin and tectonic affinity is still a subject of debate. Some of the earlier worker believed that the NMO is rootless subhorizontal bodies, which are westward-propagated nappes from the Eastern belt ophiolite of Myanmar (Sengupta et al., 1990; Acharyya et al., 1990). In contrast, Bhattacharjee (1991) and Nandy (2001) considered the NMO originated in an Island Arc developed in the Tethyn ocean. Further, Mitchell (1993) and Acharyya (2007) believed that this ophiolite belt have been originated from multiple subduction processes of the Indian plate beneath the Eurasian Plate. Recently, Singh (2009) and Ningthoujam et al. (2012) proposed that this ophiolite was initially formed in a MOR setting. Therefore, it

* Tel.: +91-135-2525181 (O); fax: +91-135-2625212.
*E-mail address:* aksingh_wihg@rediffmail.com

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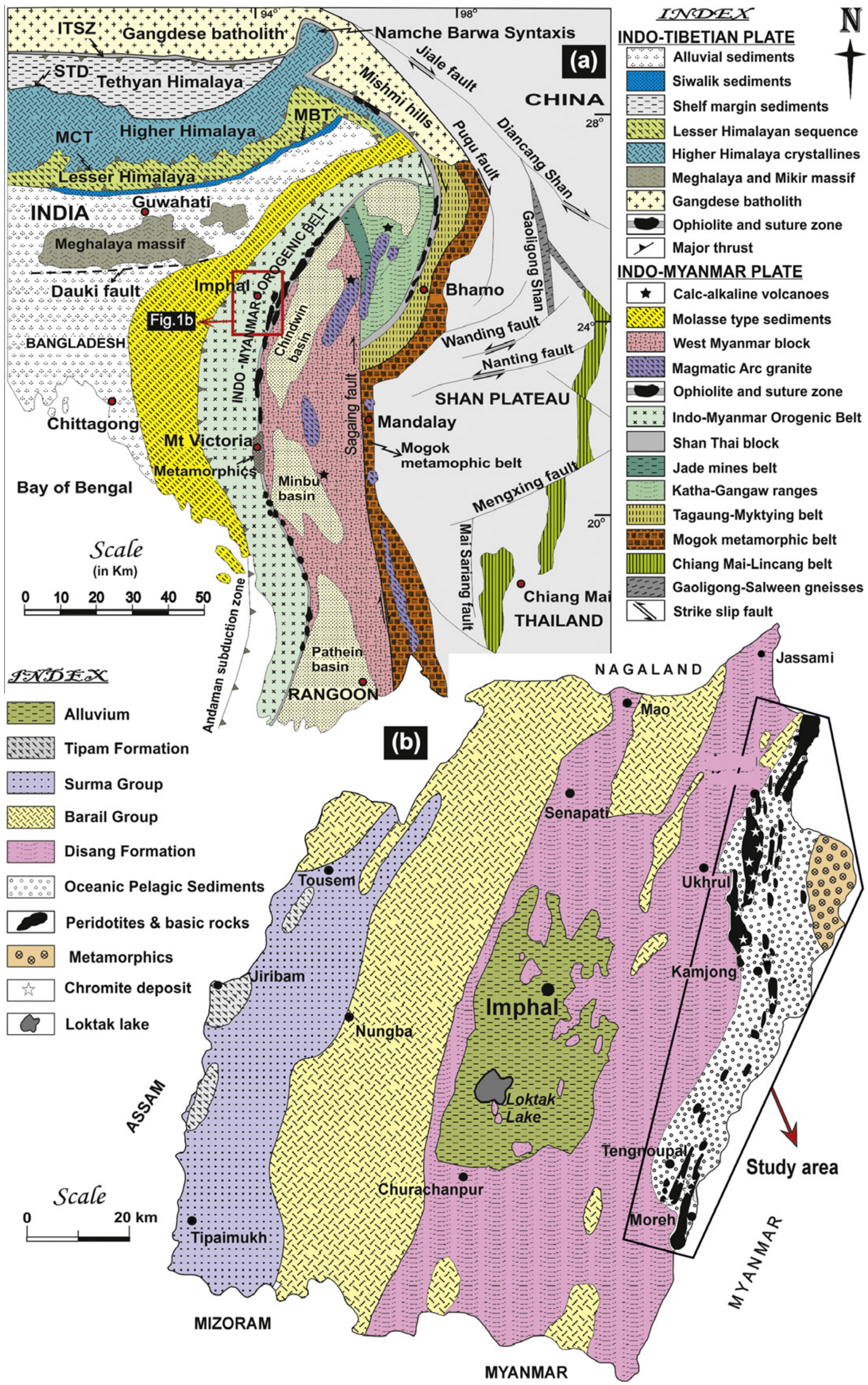


**Fig. 1.** (a) Geological map of eastern Himalaya, Indo-Myanmar Orogenic Belt, northern and central Myanmar and adjacent areas (modified after Mitchell et al., 2007; Searle et al., 2007) and (b) Generalized geological map of Manipur, Northeast India (after Geological Survey of India, M.N.C. DRG. No.42/87, 1987), showing the Manipur Ophiolitic Complex, Indo-Myanmar Orogenic Belt, Northeast India.