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High Grade Garnet Clinopyroxene Bearing Metamorphic Sole from South-Eastern Manipur Ophiolite Belt

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Abstract

The reported garnet-clinopyroxene bearing metamorphic rocks occurs as metamorphic sole in the ophiolite belt of south-eastern Manipur. Textural evidences show preserved peak assemblages of grt+ cpx + amp +pl + rt ± qtz. The garnet porphyroblast have composition of ($Ca_{0.74\text{-}1}$, $Mg_{0.03\text{-}0.77}$, $Mn_{0.01\text{-}0.9}$, $Fe^{2+}_{1.2\text{-}1.6}$) ($Al_{1.90\text{-}1.98}$, $Cr_{0\text{-}0.03}$, $Fe^{3+}_{0.03\text{-}0.34}$) Si_3O_{12} and shows a progressive phase metamorphism with higher $Alm_{42\text{-}52}$ $Grs_{25\text{-}32,}$ $Sps_{3.66\text{-}6.91}$and low $Pyp_{12\text{-}17}$ at the core and lower $Alm_{38\text{-}49}$ $Grs_{24\text{-}29,}$ $Sps_{0.25\text{-}1.90}$ and high $Pyp_{18\text{-}29}$ towards the rim. The high X_{Mg} (0.74-0.84) value of Clinopyroxene and negligible amount of orthopyroxene suggest a high-grade metamorphism condition. The reported garnet-clinopyroxene bearing metamorphic rock has preserved progressive metamorphic assemblages at P-T condition of 7.5 ± .50 kbar and 700-800°C. The estimated metamorphic pressures suggest a metamorphism at depths of around 25-28 km. The recorded high temperature and its mineral assemblages infer a metamorphism in a mafic granulite facies during Cenozoic continent-continent collision between Indian plate and Myanmar microplate. The intake prograde metamorphic textures with lack of prominent symplectite growth over garnet grains suggested a rapid exhumation. The exhumation history suggests a wedge exhumation along the foreland basin of the Neo-Tethyan sutures of Indo-Myanmar Ranges and is control by the presence of westerly dipping thrust that is normally out sequence to the regional thrust. Such wedge exhumation mechanism of granulite facies metamorphic sole has been reported in the central and eastern parts of Himalayas and in Kalaymyo, Myanmar, a southern extension Manipur-Nagaland ophiolite belt.

Keywords: Garnet-clinopyroxene, Metamorphic Sole, Subduction, Ophiolite, Symplectite, Out of Sequence Thrust

Introduction

Many Tethyan ophiolite are structurally underlain by thin sheets of metamorphic sole rocks (Williams and Smyth, 1973; Dilek *et al.*, 1999; Robertson, 2002). Metamorphic soles are thought to form at the inception of oceanic subduction beneath the hot sub ophiolitic mantle of the hanging wall (Jamieson, 1986). Initiation of subduction and formation of metamorphic soles have been linked to the ophiolite emplacement process (Hacker *et.al.*, 1996; Williams and Smyth, 1973). Most studies on the metamorphic evolution of metabasites in the Himalaya and Trans-Himalayan region focused on high P/T type eclogites (de Sigoyer *et al.*, 2000; Kaneko *et al.*, 2003; Parrish *et al.*, 2006; Chatterjee and Ghose, 2010) and on retrogressed eclogite overprinted by amphibolite–granulite facies metamorphism (Lombardo and Rolfo, 2000; Groppo *et al.*, 2007; Liu *et al.*, 2007; Chakungal *et al.* 2010; Corrie *et al.*, 2010), which were formed during subduction and/or subsequent continent–continent collision. High pressure metamorphic rocks from ophiolite melanges occurs as thin dismembered thrust slices and provide significant information in understanding and reconstruction of subduction history and exhumation process (Agard *et al.*, 2009; Tsujimori and Harlow, 2012). The high-pressure eclogite and blueschist facies metamorphic rocks associated with ophiolites are reported from different parts of the Tethyan ophiolite belt of the Indian sub-continent, from Yarlung-Tsangpo Suture of Ladakh Himalayas (Groppo *et al.*, 2016) and along the Indo-Myanmar Range (IMR) from different parts of Naga Hills Ophiolite (NHO) belt (Ao and Bhowmik, 2014). On the other hand, most metabasites exposed in the Himalaya, occurring as interlayer and tectonic lenses embedded within the metapelites or granites, are normal amphibolite and granulite, not recording eclogite-facies metamorphism. The Himalaya and Trans-Himalayan is one of the best-documented examples of continent–continent collision orogenic meta-morphism. The high-grade metamorphic rocks of pelitic and felsic granulite from eastern and central part of Himalayan Orogen, have

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