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Petrogenesis of Triassic Mafic Complexes with MORB/OIB Affinities from the Western Garzê-Litang Ophiolitic Mélange, Central Tibetan Plateau

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1 Abstract

There is a general consensus that most ophiolites formed above subduction zones (Pearce, 2003), particularly during forearc extension at subduction initiation (Shervais, 2001; Stern, 2004; Whattam and Stern, 2011). “Supra-Subduction zone” (SSZ) ophiolites such as the well-studied Tethyan ophiolites, generally display a characteristic sequential evolution from mid-oceanic ridge basalts (MORBs) to island arc tholeiites (IATs) or bonites (BONs) (Pearce, 2003; Dilek and Furnes, 2009, 2011), which were generated in sequence from the decompression melting of asthenospheric mantle and partial melting of subduction-metasomatized depleted mantle (Stern and Bloomer, 1992; Dilek and Furnes, 2009; Whattam and Stern, 2011). However, ophiolites with MORB and/or oceanic-island basalt (OIB) affinities are rare, and their origin and tectonic nature are poorly understood (Boedo et al., 2013; Saccani et al., 2013). It is interesting that the composition of these ophiolites from the central Tibetan Plateau (CTP) is dominated by MORBs and minor OIBs and a distinct lack of IATs and BONs, which is inconsistent with most ophiolites worldwide (Robinson and Zhou, 2008; Zhang et al., 2008). But the generation and tectonic nature of these ophiolites are still controversial.

In this study, we present new geochronological, mineralogical and Sr-Nd isotopic data for the Chayong and Xiewu mafic complexes in the western Garzê-Litang suture zone (GLS), a typical Paleo-Tethyan suture crossing the CTP (Fig. 1). The Triassic ophiolite in the western GLS has been described by Li et al. (2009), who found

that it mainly consists of gabbros, diabases, pillow basalts and a few metamorphic peridotites. The ophiolite has been tectonically dismembered and crops out in Triassic clastic rocks and limestones as tectonic blocks. The Chayong and Xiewu mafic complexes are generally regarded as important fragments of the Triassic ophiolites (e.g., Jin, 2006; Li et al., 2009). Zircon LA-ICP-MS U-Pb ages of 234 ± 3 Ma and 236 ± 2 Ma can be interpreted as formation times of the Chayong and Xiewu mafic complexes, respectively. The basalts and gabbros of the Chayong complex exhibit enriched MORB (E-MORB) compositional affinities except for a weak depletion of Nb, Ta and Ti relative to the primitive mantle, whereas the basalts and gabbros of the Xiewu complex display distinct E-MORB and OIB affinities. The geochemical features suggest a probable fractionation of olivine \pm clinopyroxene \pm plagioclase as well as insignificant crustal contamination.

The geochemical and Sr-Nd isotopic data reveal that the Chayong mafic rocks may have been derived from depleted MORB-type mantle metasomatized by crustal components and Xiewu mafic rocks from enriched lithospheric mantle metasomatized by OIB-like components. The ratios of Zn/Fet, La/Yb and Sm/Yb indicate that these mafic melts were produced by the partial melting of garnet + minor spinel-bearing peridotite or spinel \pm minor garnet-bearing peridotite. We propose that back-arc basin spreading associated with OIB/seamount recycling had occurred in the western GLS at least since the Middle Triassic times, and the decompression melting of the depleted MORB-type asthenosphere mantle and partial melting of sub-continental lithosphere were metasomatized by plume-related melts, such as OIBs, which led to the generation of the Chayong and Xiewu mafic melts.

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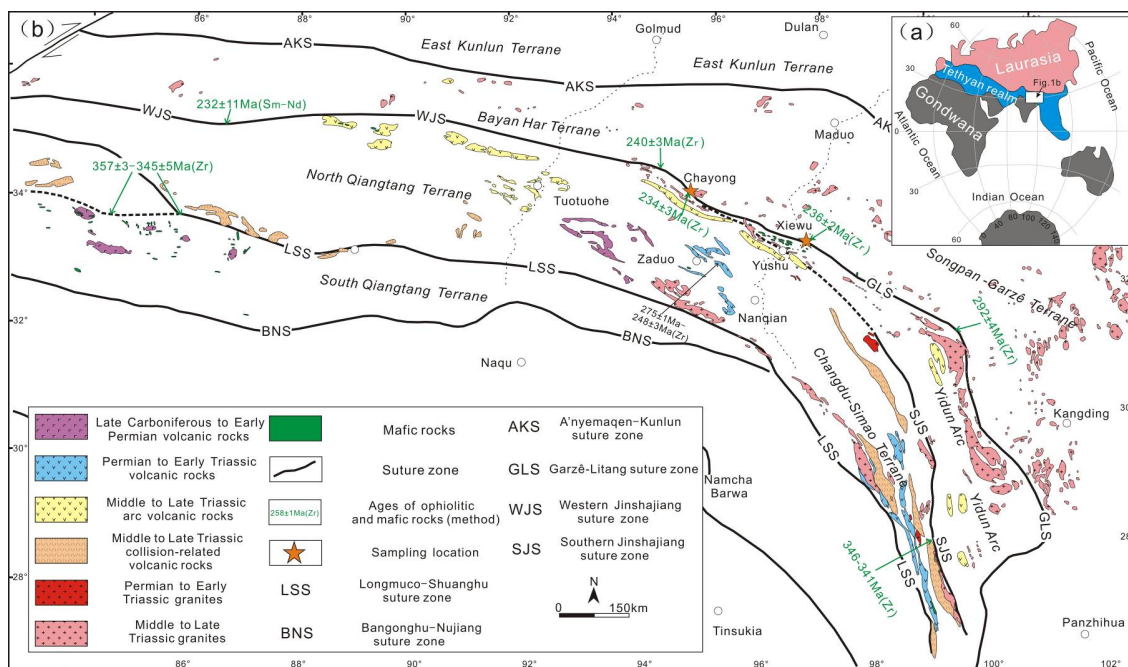


Fig. 1. Location of the Tibetan Plateau in the Tethyan realm (a) and simplified geological map of the TP (b).