Abstract: The Early Cretaceous Xigaze ophiolites (XO) exposed along the central segment of the more than 2000 km long Yarlung Zangbo Suture Zone in southern Tibet, preserved the structure of the upper mantle and oceanic crust, is interpreted as a definite record of Neo-Tethys oceanic lithosphere. Many evolution models of the XO have been proposed since the 1980s (Nicolas et al., 1981; Hébert et al., 2012; Maffione et al., 2015). However, the geodynamic environment of the XO whether at a MOR or SSZ remains controversial. As key evidence for the identification of the SSZ ophiolite, the boninite-like dolerites from the XO are still controversial and poorly constraint (Chen et al., 2003; Bao et al., 2013; Dai et al., 2013). According to previous reports, dolerites were subdivided to MORB-like type and boninite-like type (Chen et al., 2003; Dai et al., 2013). Apart from high-SiO$_2$ (>52 wt%), high MgO (>8 wt%) and low-TiO$_2$ (<0.5 wt%), we found the boninite-like and MORB-like dolerites are indistinguishable in outcrop, mineral and chemical. They are sills invaded into mantle sequence of the XO, with 50.35–56.80 wt% SiO$_2$, 0.32–1.19 wt% TiO$_2$, 7.39–8.89 wt% Fe$_2$O$_3$, 5.50–10.42 wt% MgO and Mg$#$ of 0.49–0.74. MORB-like dolerites display trace element and REE patterns similar to those of most fore-arc or and back-arc basalts from Izu-Bonin-Mariana (IBM), i.e. enrichment in large ion lithophile elements (LILEs, e.g. Cs, Rb, Ba, Pb, U) and depletion in high-field strength elements (HFSE, Nb, Ta) (Fig. 1). Boninite-like dolerites resemble the MORB-like dolerites in trace elements and REE patterns, excepting for lower concentrations in REE, but distinct from the boninites discovered from the IBM or Troodos ophiolite (Fig. 1c, d)
d). Th in both dolerites deviate from the MORB array with negative slopes on the Th/Yb vs. Nb/Yb diagram (Fig. 2a), suggesting constant subduction component added to the mantle source (Pearce et al., 1995). We chose depleted MORB source Mantle (DMM, Workman and Hart, 2005) as the starting composition computing immobile element contents for primary melts using the methods and partition coefficients of Shervais and Jean (2012). The results show that MORB-like and boninite-like dolerites can be explained by non-batch fractional melting (≥15%) of a depleted spinel peridotite with few subduction-derived components (Fig. 2b). Therefore, the boninite-like dolerites from the XO cannot be regarded as a product of hydrous melting of hot and highly depleted mantle wedge fluxed by the slab-derived fluid and the XO cannot be used as analogs for the subduction initiation.

Key words: Yarlung Zangbo suture zone, Xigaze ophiolite, depleted mantle, mid-ocean ridge

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References


Fig. 2. Th/Yb vs. Nb/Yb diagram and trace element melting models for the Xigaze crust rocks, Tibet (modified after Pearce et al., 1995).

(a) Th/Yb vs. Nb/Yb diagram; Deviations above that array are attributed to slab-derived components: i) variable addition of a subduction component to a constant mantle composition. ii) addition of a constant subduction component to a variable mantle composition. Red dotted lines indicate the percent added by subduction. Data sources: Boninite-like dolerites (Chen et al., 2003; Dai et al, 2013), N-MORB (Jenner and O’Neill, 2012); for-ore-arc basalt (Reagan et al., 2010; Shervais et al., 2019), back-arc basalt (Gaile et al., 2013); boninite (Reagan et al., 2010; Woelki et al., 2018; Li et al., 2019). (b) Trace element melting models. All melt models: 3%, 5%, 7.5%, 10%, 15%, 20% and 30% spinel-field melt. Data sources: Boninite-like dolerites (Dai et al., 2013), mafic crust (Bao et al., 2013; Jenner and O’Neill, 2012).

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