Ocean–Continent Transition to Suprasubduction Zone Origin of the Western Yarlung Zangbo Ophiolites in Southwest Tibet, China: Constraints from the Petrology, Mineralogy, and Geochemistry of the Peridotites

Fei Liu[1, 2], Dongyang Lian[1, 3], Jingsui Yang[1], Xiaolu Niu[1], Yildirim Dilek[1, 2], Guangying Feng[1], Hui Zhao[1, 4] Guanlong Li[1, 4]

1. Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China, lfhy112@126.com, yangjsui@163.com, niuxiaoludx@126.com, fengguangying198@163.com

2. Department of Geology and Environmental Earth Science, Miami University, Oxford, USA, dileky@miamioh.edu

3. Faculty of Earth Sciences, China University of Geosciences, Wuhan, China, 947608482@qq.com

4. Department of Geology and Mineral Resources, China University of Geosciences, Beijing, China, 13717926721@163.com, 240193488@qq.com

Introduction

The ophiolites that crop out discontinuously along the ~2000 km Yarlung Zangbo Suture zone (YZSZ) between the Nanga Parbat and Namche Barwa syntaxes in southern Tibet, China represent the remnants of Neotethyan oceanic lithosphere. We have investigated the internal structure and the geochemical makeup of mafic-ultramafic rock assemblages that are exposed in the westernmost segment of the YZSZ where the suture zone architecture displays two distinct sub-belts of ophiolitic and mélange units separated by a continental Zhongba terrane. These two sub-belts include the Daba – Xiugugabu in the south (Southern sub-belt, SSB) and the Dajiweng – Saga in the north (Northern sub-belt, NSB). We present new mineralogical and geochemical data from upper mantle peridotites occurring in these two sub-belts and discuss their tectonomagmatic origin.

Results

These ophiolites are composed chiefly of peridotites with minor cumulated gabbros, volcanic and siliceous sedimentary rocks (Liu et al., 2015). No sheeted dikes and pillow lavas have been observed in this area. Harzburgites of the western Yarlung Zangbo ophiolites have prominent LREE–enriched (U-shaped or spoon-shaped) chondrite normalized REE patterns (Figure 1). Such patterns have generally been interpreted as the result of modification by suprasubduction zone (SSZ) melts/fluids. However, the abundance of peridotites sampled from mid-ocean ridge (MOR) with similar LREE-enriched REE patterns suggest that this feature is not unique to SSZ peridotites.

The U shaped REE patterns of the Dajiweng harzburgites in NSB, combined with their low HREE contents and highest partial melting degree of 17% to 22%, indicate that these rocks most likely have been modified by SSZ melts (e.g., boninitic melts) in a forearc setting (Figure 1a). Baer, Cuobuzha, Gongzhu, Kazhan and Zhalai harzburgites in NSB are similar to abyssal peridotites in mineral chemistry and whole-rock geochemistry (Figures 1b-d), most likely have been refertilized in a MOR or backarc setting. Similarly, Dongbo, Xiugugabu, Zhaga and Zhongba harzburgites in SSB shown less than 15% melting degree are consistent with abyssal peridotites (Figures 1d-f), which also have U-shaped REE patterns but are characterized by high HREE contents, high Al_2O_3/SiO_2 ratios, low MgO/SiO_2 ratios, and relatively fertile mineral compositions, have likely been modified in a MOR setting. Whereas, Purang harzburgites with a wider partial melting degree of 6% to 20% fall within the field of abyssal and forearc peridotites (Figure 1f). Furthermore, clinopyroxene-rich harzburgites and lherzolites in Purang contain rare spinel–pyroxene symplectites after garnet. Their clinopyroxenes have low MREE-to-HREE ratios at

relatively high HREE concentrations, and are Na-rich but Nd-poor, the REE patterns of western Yarlung Zangbo peridotites are also mainly comparable to those of sub-continental lithospheric mantle (SCLM) (Figures 1b-f), which suggest an origin from Na-rich SCLMs (Gong et al., 2016). All lines of evidence suggest that these peridotites underwent initial melting in the stability field of garnet–facies peridotites, followed by additional melting in the spinel–facies mantle. Combined with the mafic intrusions from Baer, Cuobuzha, Jianabeng and Purang massifs, we propose that the western Yarluang Zangbo ophiolites represent fragments of Ocean-Continent Transition peridotites altered by fluids in an initial intraoceanic SSZ setting.

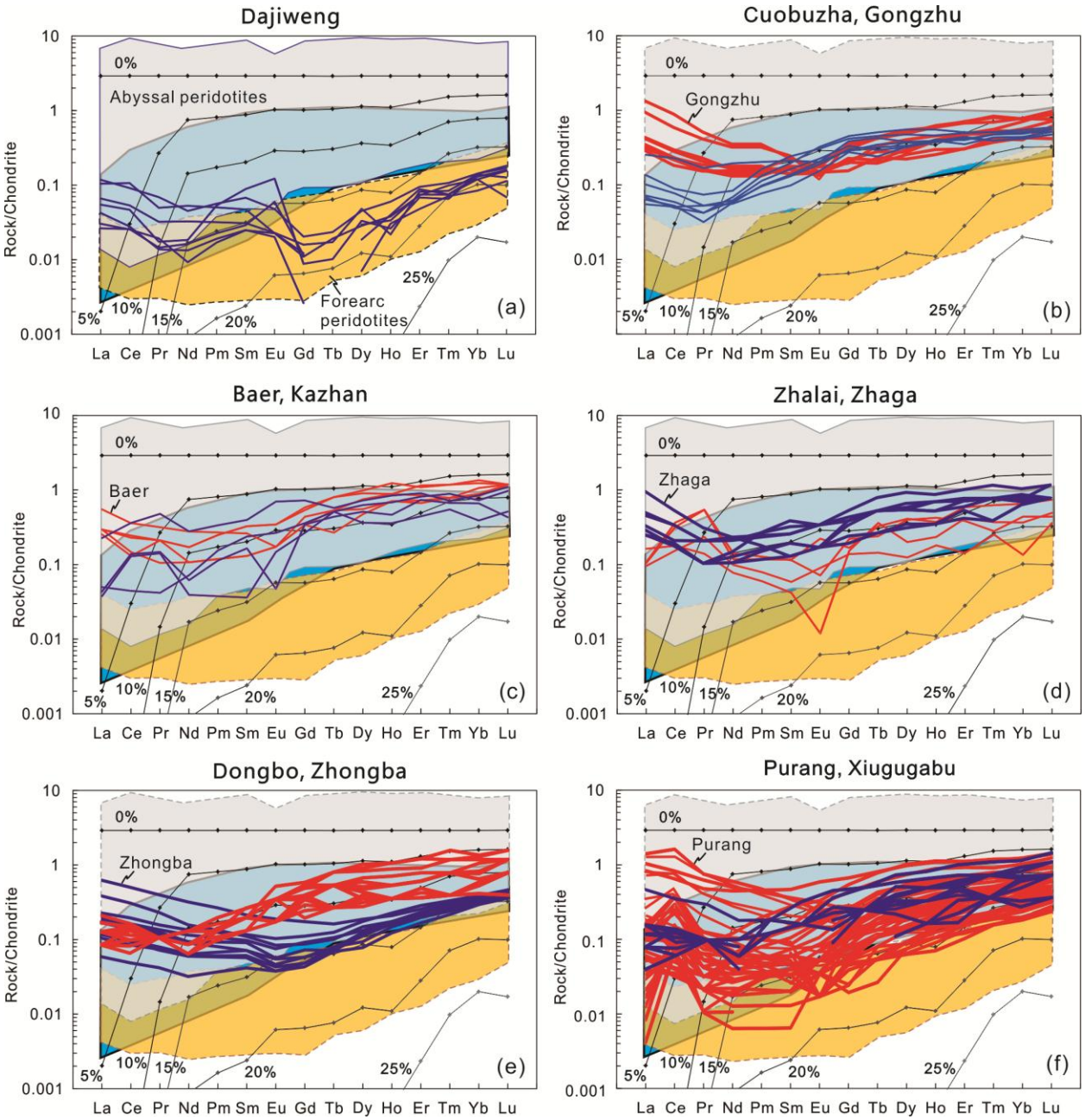

Figure 1: Chondrite-normalized rare earth element patterns for the harzburgites from the western Yarluang Zangbo ophiolites including Dajiweng (Lian, et al., 2016) (a), Cuobuzha (Feng et al., 2017) and Gongzhu (Lian et al., 2017) (b), Baer and Kazhan (c) and Zhalai (d) (Lian et al., 2016) massifs in the NSB; Zhaga (Zhang et al., 2016) (d), Dongbo (Niu et al., 2015) and Zhongba (Dai et al., 2011) (e), Purang (Gong et al., 2016; Su et al., 2015) and

Xiugugabu (Bédard et al., 2009) (f) in the SSB. Abyssal peridotite (Niu, 1997), forearc peridotite (Parkinson and Pearce, 1998), sub-continental Lithospheric mantle peridotite of Lanzo massif, Italy in blue color (Downes, 2001), Chondrite (Sun and McDonough, 1989).

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