

LIU Fei, YANG Jingsui, LIAN Dongyang, ZHAO Hui, ZHANG Lan, NIU Xiaolu, FENG Guangying, ZHANG Li and HUANG Jian, 2015. Geogenesis and characteristics of the western part of the Yarlung Zangbo ophiolites, Tibet. *Acta Geologica Sinica* (English Edition), 89(supp. 2): 52-55.

Geogenesis and Characteristics of the Western Part of the Yarlung Zangbo Ophiolites, Tibet

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1 Introduction

The ophiolites that crop out discontinuously for more than 2000 km along the Yarlung-Zangbo suture zone (YZSZ, also called the Indus-Tsangpo suture) in southern Tibet are the remnants of the Neotethyan oceanic lithosphere, which evolved between the Indian and Eurasian continental plates (Gaetani and Garzanti, 1991; Hébert et al., 2012; Xu et al., 2015). The tectonic setting and relationship between the Daba-Xiugugabu (Southern belt) and Dajiweng - Saga (Northern belt) ophiolitic sub-belts in the western part of the Yarlung Zangbo suture zone are the subject of debate. In 1990s, the northern belt was interpreted as a Late Triassic to Early Jurassic oceanic crustal remnant, and the southern was a Late Jurassic to Early Cretaceous remnant (Guo et al., 1991). Some authors consider the ophiolites in the northern belt to have formed in the Early Triassic Neotethys oceanic basin, and the southern belt ophiolites to have formed in the Late Triassic small oceanic basin near a continent margin (Pan et al., 1997; Huang et al., 2006). However, several studies interpreted the southern belt ophiolites as having been overthrust from the northern belt during ophiolite emplacement (Xu et al., 2015; Liu et al., 2015). The arguments mainly focused on whether the two belts originated in the same oceanic basin or in two different oceans.

This paper imposes some restrictions on the genesis and relationship between the southern and northern sub-belts based on the construction of geological sections across from the Gangdise island arc, the Southern sub-belt, the Zhada-Zhongba terrane, the Northern sub-belt and the

Tethyan Himalayan formation, as well as on the rock associations, geochronology and geochemistry of the mafic dikes and the mineral compositions of the wall rock harzburgites in two sub-belts.

2 Discussion and Result

The mafic dikes from the Cuobuzha, Jianabeng and Baer ophiolites in the northern belt are characterized by high Si, Al contents and low Ti, K, P contents. They plot as members of the calc-alkaline basalt series and in-situ analysis of the zircon grains yielded ages of 125–128 Ma. However, the mafic dikes from the Dongbo, Purang and Xiugugabu ophiolites in the southern belt are characterized by high Mg and Ti contents and low Si and K contents, so belonging to a low potassium tholeiite series (Fig. 1), and the zircon grains yielded ages 120–130 Ma. The Southern and Northern ophiolite sub-belts are interpreted as having formed in a similar supra-subduction zone tectonic setting, because both mafic dikes share similar occurrences, the zircon dating gives overlapping ages (120–130 Ma), and both show N-MORB type REE patterns and noticeable negative Nb, Ta and Ti anomalies in N-MORB normalized spider diagrams (Fig. 2). The mafic dikes and wall rocks harzburgites have geochemical compositions of both fore-arc and abyssal peridotites (Fig. 3). Combined with the absence of any island arc, but showing a southward tectonic emplacement direction in the southern belt, detrital zircon geochronology and Hf isotope data in Permian clastic rocks suggest that, during the Paleozoic period, the Zhada-Zhongba terrane was a part of the Qiangtang-Greater India-Tethyan Himalaya system. Those lines of evidence indicate that both ophiolitic sub-belts probably represent the same Neo-

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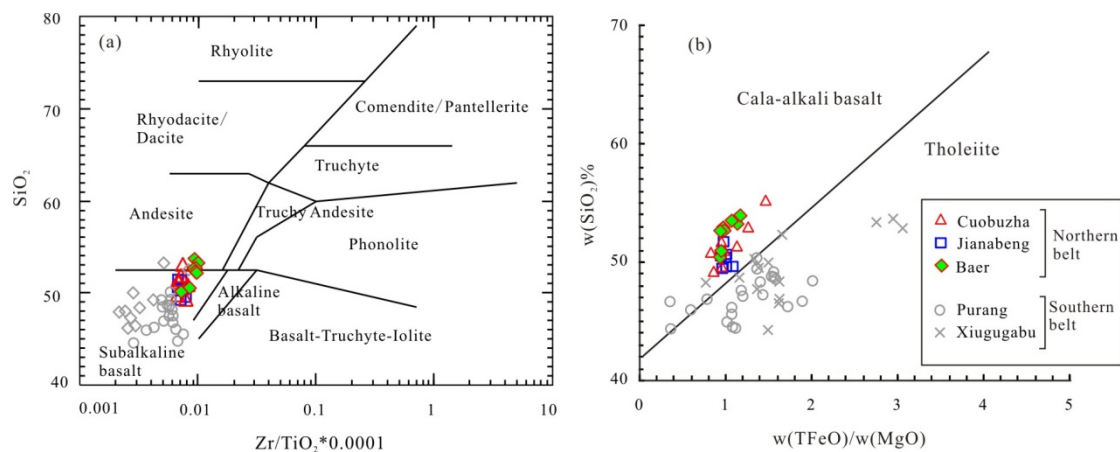


Fig.1. (a)The SiO₂-Zr/TiO₂ (Winchester and Floyd, 1977) and (b) TFeO- TFeO/MgO diagrams (Miyashiro, 1974) for mafic dikes in the southern and northern sub-belts, Tibet. Purang mafic dikes from (Liu et al., 2010; Miller et al., 2003; Liu et al., 2013; Liu et al., 2011), Xiugugab mafic dikes from (Bezard et al., 2011).

Tethys ocean lithosphere in the same tectonic setting.

Acknowledgements

Qiwei Li, Wenda Zhou, JianGao and Lan Zhang helped with our fieldwork in the southern Tibet. This research was funded by grants from the Ministry of Science and Technology of China (2014DFR21270), China Geological Survey (12120115026801, 12120115027201, 201511022) and the Fund from the State Key Laboratory of Continental Tectonics and Dynamics (Z1301-a20).

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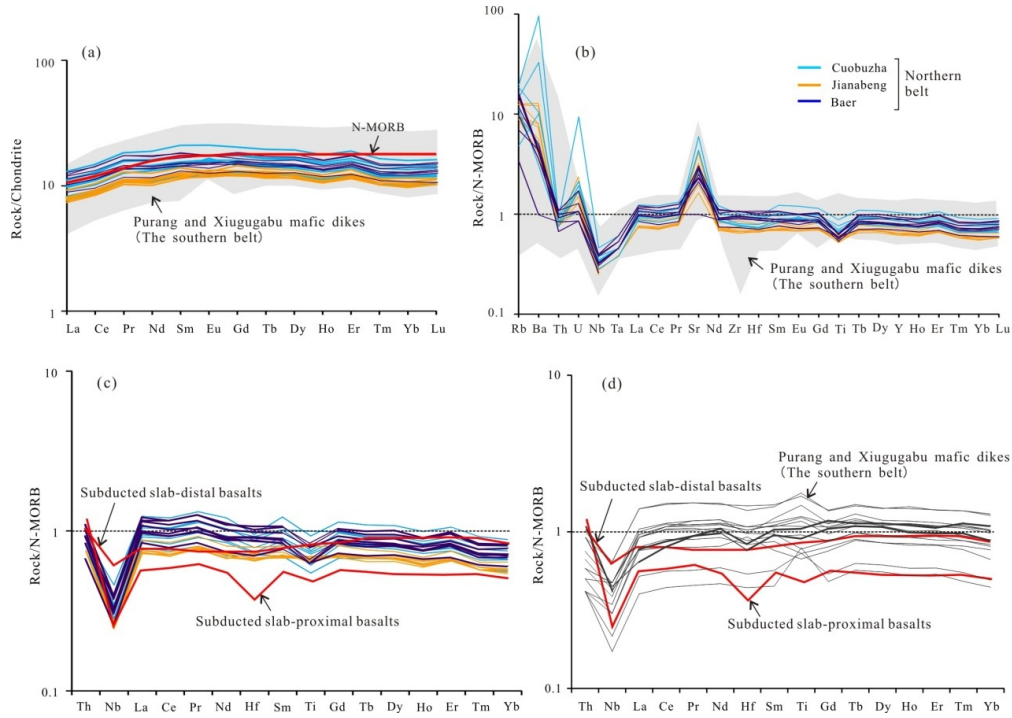


Fig. 2. Chondrite-normalized REE patterns and N-MORB normalized rare elements diagrams for mafic dikes from the southern and Northern sub-belts in the western part of the YZSZ, Tibet. (Ti content = TiO_2 at $MgO=8wt\%$). Purang mafic dikes from (Liu et al., 2010; Miller et al., 2003; Liu et al., 2013; Liu et al., 2011), Xiugugabu mafic dikes from (Bezard et al., 2011).

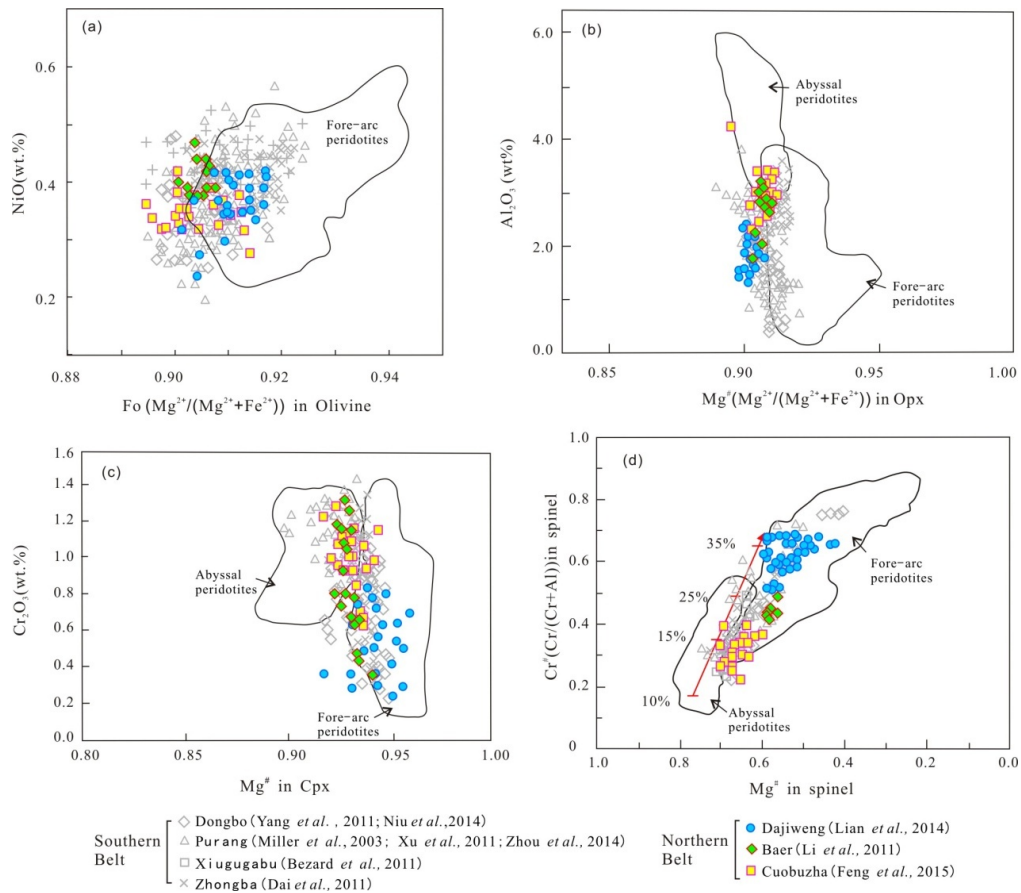


Fig. 3. Compositional variations of olivines, orthopyroxenes, clinopyroxenes and spinels in harzburgites from the southern and northern sub-belts in the western YZSZ, Tibet. a- NiO-Fo diagram for olivine; b- Al_2O_3 - $Mg^\#$ for Opx; c- Cr_2O_3 - $Mg^\#$ for Cpx; d- $Cr^\#$ - $Mg^\#$ for Spinel. Abyssal peridotites (Dick and Bullen, 1984; Juteau et al., 1990), fore-arc peridotites (Ishii, 1992).

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