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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 ophiolitesub-belts are interpreted as having formed in a similr supra-subduction zonetectonic 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 datain 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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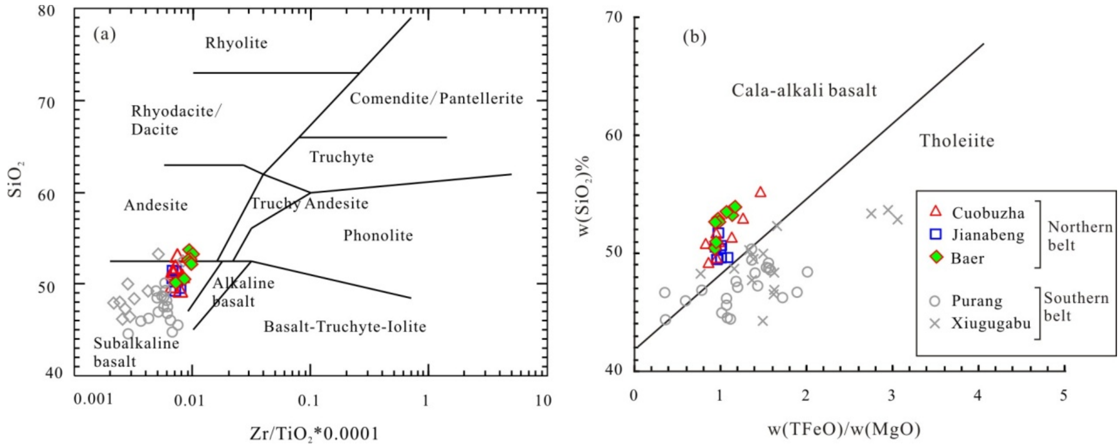

Fig.1. (a)The SiO_2-Zr/TiO_2（Winchester and Floyd, 1977）and (b) TFeO- TFeO/MgO diagrams （Miyashiro, 1974）for mafic dikes in the southern and northern sub-belts, Tibet. Purang mafic dikes from (Liu et al., 2010; Miller et al., 2003; Liu et al., 2013; Liu et al., 2011) , Xiugugab mafic dikes from (Bezard et al., 2011).

Tethys ocean lithosphere in the same tectonic setting.

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References

Bezard, R., Hébert, R., Wang, C., Dostal, J., Dai, J., and Zhong, H., 2011. Petrology and geochemistry of the Xiugugabuophiolitic massif, western YarlungZangbo suture zone, Tibet. *Lithos*, 125(1–2): 347–367.

Dai, J., Wang, C., Hébert, R., Santosh, M., Li, Y.L., and Xu, J.Y., 2011. Petrology and geochemistry of peridotites in the Zhongbaophiolite, YarlungZangbo Suture Zone: Implications for the Early Cretaceous intra-oceanic subduction zone within the Neo-Tethys. *Chemical Geology*, 288(3–4): 133–48.

Dick, H.J., and Bullen, T., 1984.Chromian spinel as a petrogenetic indicator in abyssal and alpine-type peridotites and spatially associated lavas.*Contributions to Mineralogy and Petrology*, 86(1): 54–76.

Feng Guangying, Yang Jingsui, Xiong Fahui, Liu Fei, Niu Xiaolu, Lian Dongyang, Wang Yunpeng and Zhao Yijue, 2015. Petrological, geochemical and the origin of the Cuobuzha peridotite in the western Yarlung Zangbo suture zone, *Geology in China* (in press) (in Chinese with Eng-lish abstract).

Gaetani, M., and Garzanti, E., 1991. Multicyclic history of the northern India continental margin (Northwestern Himalaya). *American Association of Petroleum Geologists Bulletin*, 75(9): 1427–1446.

Guo Tingying, Liang Dingying, Zhang Yizhi and Zhao Chonghe. 1991. *Geology of Ngari Tibet* (Xizang). Beijing: China university of geosciences press, 1–464(in Chinese).

Hébert, R., Bezard, R., Guilmette, C., Dostal, J., Wang, C.S., and Liu, Z.F., 2012. The Indus–Yarlung Zangbo ophiolites from Nanga Parb at to Namche Barwa syntaxes, southern Tibet: First synthesis of petrology, geochemistry, and geochronology with incidences on geodynamic reconstructions of Neo-Tethys. *Gondwana Research*, 22(2): 377–397.

Huang Guicheng, Mo Xuanxue, Xu Deming, Lei YiJun and Li Lijuan. 2006. Origination and evolution of Daba-Xiugugabu ophiolite belt in the Southwestern Tibet. *Geology and Mineral Resources of South China*, (3): 1–9(in Chinese with English abstract).

Ishii, T., 1992. Petrological studies of peridotites from diapiric serpentinite seamounts in the Izu-Ogasawara-Mariana forearc, LEG125[C]//Ocean Drilling Program, College Station, TX: 445–485.

Juteau, T., Berger, E., and Cannat, M., 1990.Serpentinized, residual mantle peridotites from the MAR Median Valley, ODP hole 670A (21 10’N, 45 02’W, Leg 109): primary mineralogy and geothermometry[C]//27–54.

Li Yuan, YangJingsui, Liu Zhao, Jia Yi and Xu Xiangzhen, 2011. The origins of Baer ophiolitic peridotites and its implication in the Yarlung Zangbo suture zone, southern Tibet. *Acta Petrologica Sinica*, 27(11): 3239–3254 (in Chinese with English abstract).

Liu, C.Z., Wu, F.Y., Wilde, S.A., Yu, L.J. and Li, J.L. 2010.Anorthitic plagioclase and pargasitic amphibole in mantle peridotites from the Yungbwa ophiolite (southwestern Tibetan Plateau) formed by hydrous melt metasomatism. *Lithos*, 114(3): 413–422.

Lian Dongyang, Yang Jingsui, Xiong Fahui, Liu Fei, Wang Yunpeng, Zhou Wenda and Zhao Yijue, 2014. Composition characteristics and tectonic setting of the Dajiweng peridotites in the western Yarlun-Zangbo ophiolitic belt. *Acta Petrologica Sinica*, 30(8): 2164–2184 (in Chinese with English abstract).

Liu Fei, Yang Jingsui, Chen Songyong, Li Zhaoli, Lian Dongyang, Zhou Wenda and Zhao Wen, 2013. Geochemi-stry and Sr-Nd-Pb isotopic composition of mafic rocks in the western part of the Yarlung Zangbo suture zone: Evidence for intra-oceanic supra-subduction within the Neo-Tethys. *Geology in China*, 40(3): 361–374 (in Chinese with English abstract).

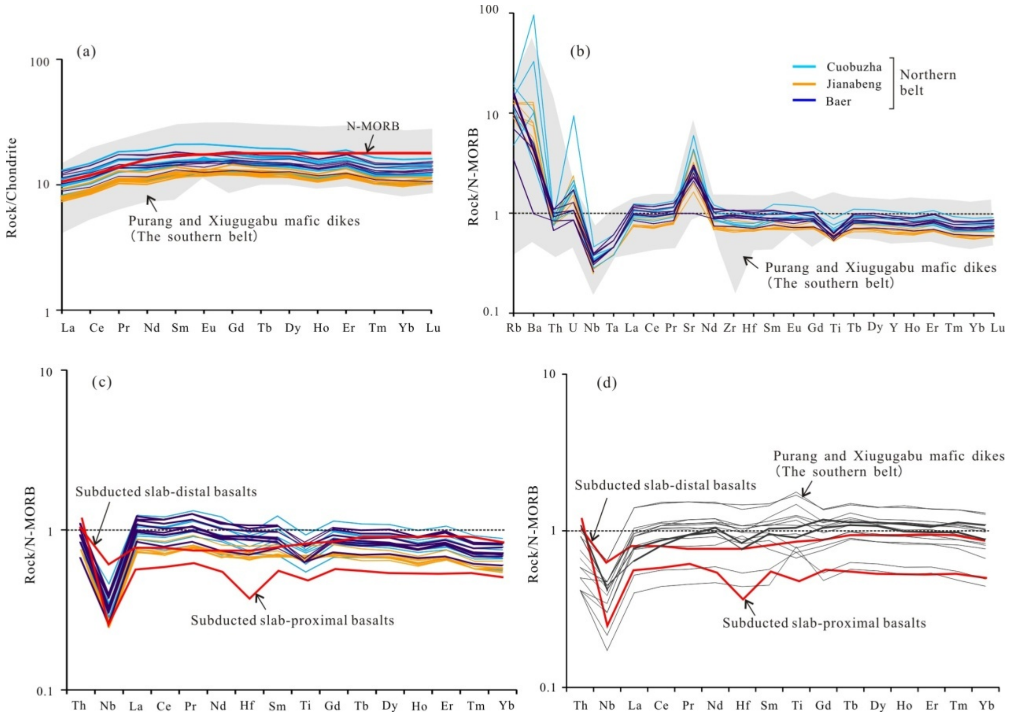

Fig. 2. Chondirite-normalized REE patterns and N-MORB normalized rare elements diagrams for mafic dikes from the southern and Northern sub-belts in the western part of the YZSZ, Tibet. (Ti content = TiO_2 at MgO=8wt%). Purang mafic dikes from (Liu et al., 2010; Miller et al., 2003; Liu et al.,2013; Liu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

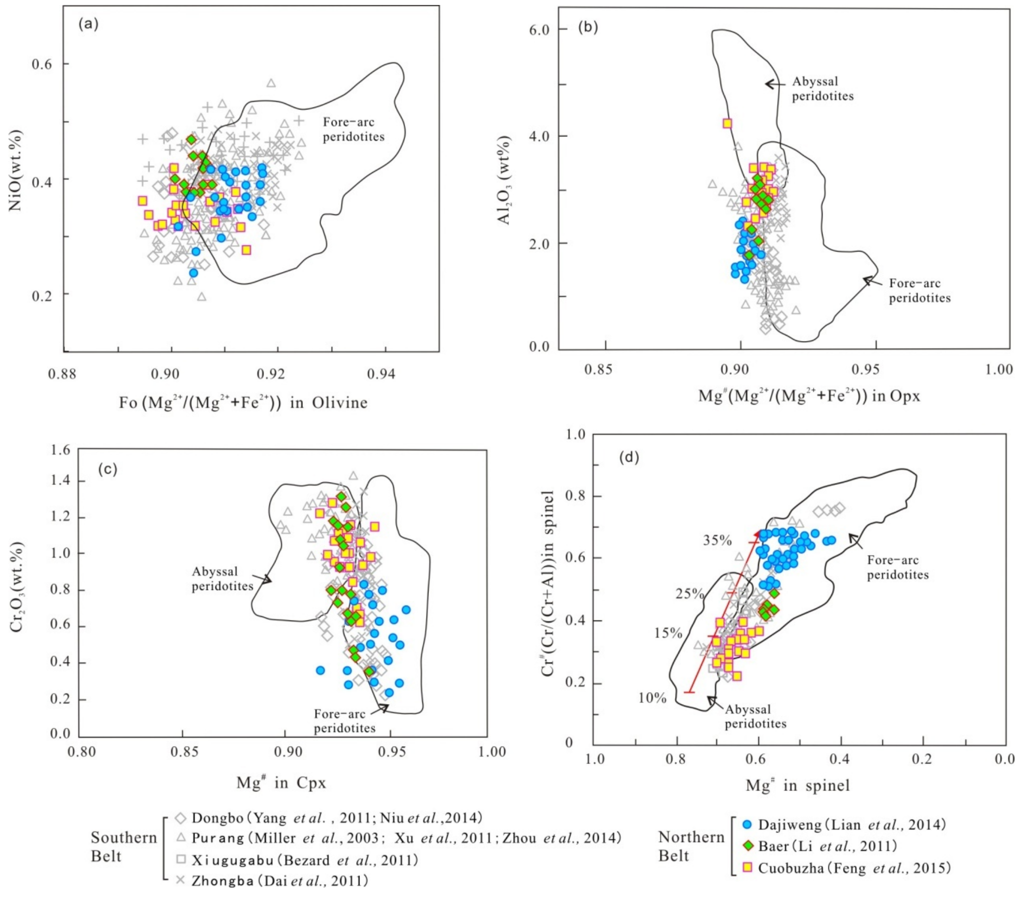

Fig. 3. Compositional variations of olivines, orthopyroxenes, clinopyroxenes and spinelsin harzbergitesfrom the southern and northern sub-belts in the western YZSZ, Tibet.a- NiO-Fo diagram for olivine；b- Al_2O_3-$Mg^{\#}$ for Opx；c- Cr_2O_3- $Mg^{\#}$ for Cpx；d- $Cr^{\#}$- $Mg^{\#}$ for Spinel. Abyssal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

Liu, F., Yang, J., Dilek, Y., Xu, Z., Xu, X., Liang, F., Chen, S., and Lian, D., 2015. Geochronology and geochemistry of basaltic lavas in the Dongbo and Purang ophiolites of the Yarlung-Zangbo Suture zone: Plume-influenced continental margin-type oceanic lithosphere in southern Tibet. *Gondwana Research*, 27(2): 701–718.

Liu Zhao, Li Yuan, Xiong Fahui, Wu Di and Liu Fei, 2011. Petrology and geochronology of MOR gabbro in the Purang ophiolite of western Tibet, China. *Acta Petrologica Sinica*, 27 (11): 3269–3279 (in Chinese with English abstract).

Miller, C., Thöni, M., Frank, W., Schuster, R., Melcher, F., Meisel, T., and Zanetti, A. 2003.Geochemistry and tectonomagmatic affinity of the Yungbwa ophiolite, SW Tibet. *Lithos*, 66(3–4): 155–172.

Miyashiro, A., 1974. Volcanic rock series in island arcs and active continental margins. *American Journal of Science*, 274 (4): 321–355.

Niu, X., Yang, J., Dilek, Y., Xu, J., Li, J., Chen, S., Feng, G., Liu, F., Xiong, F., and Liu, Z., 2014. Petrological and Os isotopic constraints on the origin of the Dongbo peridotite massif, Yarlung Zangbo Suture Zone, Western Tibet. *Journal of Asian Earth Sciences*.

Pan Guitang, Chen Zhiliang, Li Xingzhen, Yan Yangji, Xu Qiang, Jiang Xinsheng, Wu Yinglin, Luo Jianning, Zhu Tongxing and Peng Yongmin, 1997. *The geological tectonic evolution of the Eastern Tethys*. Beijing: Geological Publishing House, 1–218(in Chinese).

Winchester, J.A., and Floyd, P.A., 1977. Geochemical discrimination of different magma series and their differentiation products using immobile elements. *Chemical Geology*, 20: 325–343.

Xu Xiangzhen, Yang Jingsui, Guo Guolin and Li Jinyang, 2011. Lithological research on the Purang mantle peridotite in western Yarlung-Zangbo suture zone in Tibet. *Acta Petrologica Sinica*, 11 (27): 3179–3196 (in Chinese with English abstract).

Xu, Z., Dilek, Y., Yang, J., Liang, F., Liu, F., Ba, D., Cai, Z., Li, G., Dong, H., and Ji, S., 2015. Crustal structure of the Indus–Tsangpo suture zone and its ophiolites in southern Tibet. *Gondwana Research*, 27(2): 507–524.

Yang Jingsui, Xiong Fahui, Guo Guolin, Liu Fei, Liang Fenghua, Chen Songyong, Li Zhaoli and Zhang Liwen, 2011. The Dongbo ultramafic massif: a mantle peridotite in the western part of the Yarlung Zangbo suture zone, Tibet, with excellent prospects for a major chromite deposit. *Acta Petrologica Sinica*, 11 (27): 3207–3222 (in Chinese with English abstract).

Zhou Wenda, Yang Jingsui, Zhao Junhong, XiongFahui, Ma Changqian, Xu Xiangzhen, Liang Fenghua and Liu Fei, 2014. Mineralogical study and the origin discussion of Purang Ophiolite Peridotites, western part of Yarlung-Zangbo Suture Zone (YZSZ), southern Tibet. *Acta Petrologica Sinica*, 30(8): 2185–2203 (in Chinese with English abstract).