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Late Permian Pack-Arc Basin Development in the Western Jinshajiang Suture Zone: Geochronological, Geochemical and Isotopic Evidence From Yushu-Zhiduo Mafic Rocks, Central Tibet

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Although numerous geological studies had been done in the Jinshajiang suture zone (JSZ), the tectonic nature of JSZ is still unclear. There is much controversy whether the JSZ represents a major branch of the Paleo-tethyan ocean or a back-arc basin (e.g. Zhong et al., 1998; Metcalfe, 2006; Pullen et al., 2008; Fan et al., 2010). This study reports new geochemical, isotopic and geochronological data for the Late Permian mafic rocks developed in the Yushu-zhiduo region, western Jinshajiang suture zone (WJSZ) and discusses their petrogenesis and tectonic implications.

The Late Permian mafic rocks consist of Yushu gabbros, Haxiu hornblende gabbros and Zhiduo hornblende gabbros and dolerites. LA-ICP-MS Zircon U-Pb analysis of Yushu gabbro (259±2Ma), Haxiu hornblende gabbro (257±3Ma) and Zhiduo hornblende gabbros (257±1Ma) and dolerites (257±2Ma) show that the rocks were almost contemporaneous. All the samples from Yushu gabbros display alkaline affinities, and have relatively MgO (3.98~7.30wt.%) and Mg#(41~51), high FeOt (10.08~12.20 wt.%) and TiO₂ (2.22~3.00 wt.%), Cu (63.67~157.00ppm) and Cu/Ni (0.96~3.09), which are similar to Fe-Ti riched mafic rocks from Panzihua, East Greenland and northern Somalia (Zhou et al. 2005; Anden and Frizzo 1996; Brooks et al. 1991). And they have positive εHf(t) (+8.3~+11.2), enrichment of LILE (e.g. Rb, Ba, Th, U and K), LREE and HFSE (e.g. Nb, Ta and Ti), similar to Ocean island basalts (OIB) (Sun and McDonough 1989). The samples from Haxiu hornblende gabbros display subalkaline affinities and have relatively low FeO*/MgO(0.57~0.83), high Ni(138~485ppm), Cr (726~895ppm) and Mg# (69~76), slight differentiation of REE (LaN/YbN=1.01~1.24), enrichment of LILE(e.g. Rb, Th and K) and marked depletion of HFSE(e.g. Nb, Ta, P

and Ti), similar to primitive continental arc magmas (Leat et al, 2002). The samples from Zhiduo mafic rocks could be divided into two types- alkaline series and subalkaline series based on the Nb/Y vs. Zr/TiO₂ classification diagram. The alkaline series include dolerites and layered hornblende gabbros, characterized by low Mg#(28~59) and relatively high FeOt (9.81~15.97 wt.%), TiO₂ (1.56~4.37 wt.%), Cu (63.8~296.78ppm) and Cu/Ni (0.45~27.19), positive εHf(t) (+6.7~+11.9), and enrichment of LILE, LREE and HFSE, similar to OIB and Yushu gabbros, while the subalkaline series consists unlayered hornblende gabbros, characterized by relatively low FeOt (8.34~11.40 wt.%) and TiO₂ (0.85~1.48 wt.%), relatively high Mg# (53~60), positive εHf(t) (+8.8~+12.6), obvious enrichment of LILE and LREE and slight depletion of HFSE (e.g. Nb, P and Ti), similar to E-MORB.

Based on our petrological, geochemical and isotopic studies, it is suggested that the Yushu and Zhiduo alkaline mafic rocks were generated by crystal fractionation of previous tholeiitic magmas which derived from an depleted mantle, Zhiduo subalkaline mafic rocks were generated by partial melting of an depleted mantle metasomatised by aqueous fluids and some degrees of crystal fractionation prior to the emplacement, and Haxiu mafic rocks were mostly generated by partial melting of an enriched mantle. Taking into account the other geological records from the JSZ, we suggest that the Late Permian Yushu-Zhiduo mafic-ultramafic rocks most likely formed in a back-arc basin spreading environment. Finally, we propose the JSZ represents a limited back-arc basin rather than a major branch of the Paleo-tethyan ocean.

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