

Geochemical evidence for multiple mantle sources for Late Carboniferous mafic rocks in the northern Sibumasu terrane, SW China

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A Late Paleozoic mafic-dominant magmatic flare-up was triggered in the northern Sibumasu terrane of marginal East Gondwana during the creation of the Meso-Tethyan Ocean due to Pangaea breakup. The magmatic origin provides vital perspective for understanding the nature of deep mantle and its geodynamics but is still poorly constrained. Here, we report zircon SHRIMP U-Pb ages and Hf-O isotopes and bulk elements and Sr-Nd isotopes of the dolerites and related basaltic rocks from several regions at Sibumasu. Ages of ca.308-305 Ma verify the presence of Late Carboniferous igneous activity. Two groups of volcanic rocks are identified. Group I is calc-alkaline, with low TiO₂ (0.98-1.48 wt. %) and Ni (29-55 ppm), strong depletions in Nb-Ta ((Th/Nb)_N=3.9-6.3), and markedly negative $\epsilon_{Nd}(t)$ values from -8.4 to -3.9. Group II, by comparison, is mostly of tholeiitic, characterized by high TiO₂ (1.2-2.6 wt. %) and Ni (22-165 ppm), and insignificant negative Nb-Ta anomalies ((Th/Nb)_N=1.1-4.5), and mildly enriched $\epsilon_{Nd}(t)$ values from -3.7 to -0.5. Dolerites with two clear major elemental group have consistent variation trend with the volcanic Group II. The high MgO group (6.8-9.2 wt. %) show more negative Nb-Ta anomalies ((Th/Nb)_N=4.5-4.9) and lower zircon $\epsilon_{Hf}(t)$ (1.7-8.8) and higher $\delta^{18}O$ (5.9-7.7‰) values comparing to those of the low MgO group (4.8-5.5 wt. %) with (Th/Nb)_N=2.4-2.5, $\epsilon_{Hf}(t)$ =3.2-8.2 and $\delta^{18}O$ =3.8-6.5‰.

Discrimination diagrams suggest the Group I rocks are likely derived from an enriched lithospheric mantle source. The notable negative $\epsilon_{Nd}(t)$ values do not reflect an origin of oceanic slab subduction due to limited sediments involvement. The Group II rocks are geochemically similar to oceanic island basalt (OIB) and could be derived from a deeper enriched mantle source. Many kinds of transitional basaltic rocks and dolerites with varied elemental and isotopic compositions are invoked by the mixing between the two sources. Magmas resulted from partial melting of OIB mantle and lithospheric mantle were intensely mixed beneath the Sibumasu block during Pangaea rifting.