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Geochemistry of Cretaceous Lamprophyre and Paleogene Basalt in Guangxi Province, South China: Transformation of Mantle Source

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The South China Block is divisible into the Cathaysia block in the southeast and the Yangtze Craton in the northwest. The Cathaysia block, especially its eastern region, suffered intensive tectonic and magmatic events in Phanerozoic. Previous studies in eastern and central regions of the Cathaysia block have discussed that the old (i.e., Proterozoic) mantle that existed beneath the block has been largely removed and replaced by younger, hotter and fertile mantle (Xu et al., 2000, 2002; Zheng et al., 2004; Liu et al., 2012). This lithospheric replacement could be associated with the lithospheric extension and thinning process (Li et al., 2004; Xie et al., 2006). In contrast, the western region of the Cathaysia block was relative stable since Mesozoic, and the study of its lithospheric evolution is relative sparse. The lamprophyres and basalts are found and distributed as diatremes and dykes in central Guangxi Province, western region of the Cathaysia block. Elemental and Sr-Nd isotopic compositions of the Cretaceous (89 Ma) lamprophyres and Paleogene (51-28 Ma) basalts were analyzed to reveal their petrogenesis and source natures.

The Cretaceous lamprophyres are ultrapotassic (K_2O/Na_2O=2.9-3.2) mafic ($Mg^{\#}$=66-70) rocks with high SiO_2 (50.6-54.6 wt.%), Ni (206-349 ppm), Cr (365-414 ppm) and low MgO (4.5-5.7 wt.%), Fe_2O_3 (4.5-4.9 wt.%), TiO_2 (~0.9 wt.%). They are strong enriched in LREE-LILE and depleted in HFSE, with high $(^{87}Sr/^{86}Sr)_i$ and negative ε_{Nd} (t) values. The lamprophyres could be derived from an EM2-type lithospheric mantle in garnet-facies stable region (>80 km), followed by the olivine and clinopyroxene fractionation. This source could be a metasomatic refractory mantle, main phlogopite-bearing harzburgite.

The Paleogene basalts ($Mg^{\#}$=56-64) are alkali (K_2O+Na_2O=4.8-6.1 wt.%), possessing lower SiO_2 (42.8-46.8 wt.%), Ni (143-236 ppm), Cr (150-283 ppm), and higher MgO (6.7-9.9 wt.%), Fe_2O_3 (9.6-11.5 wt.%), TiO_2 (2.2-2.8 wt.%) than the lamprophyres. These basalts are enriched in LILE-LREE with negative Nb-Ta anomalies and DM-type Sr-Nd isotopic signatures, similar to the oceanic island basalts. They could be derived from an asthenospheric-like mantle. The mantle are fertile and mainly spinel to spinel-garnet transitional facies lherzolite (<80 km).

The mantle source transformation, from EM2- in Cretaceous to DM-mantle in Paleogene, could be companied by slight lithospheric thinning. These processes may correspond to the dynamics of the two-sided affections to the Cathaysia block, the Pacific subduction in east and the Eurasian-Indian plate collision in west. The subduction dynamics leads to the asthenospheric convection, and a regional lithospheric extension beneath the Cathaysia block.

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