Petrogenesis of the Early Cretaceous Funiushan Granitoids in the Southern North China Carton: Evidence from Geochronology and Geochemistry

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Abstract: This paper presents new zircon U-Pb ages and Hf-O isotope data, and whole-rock geochemical and Sr-Nd isotopic data for the Early Cretaceous Funiushan granitoids in the southern margin of the North China Carton (NCC). The results will provide significant constrains on the crustal evolution of the southern margin of the NCC. New zircon laser-ablation inductivity coupled plasma mass spectrometry (LA-ICP-MS) U-Pb data indicate that the granitoids were emplaced during the Early Cretaceous (145–126 Ma) and the late Early Cretaceous (116 Ma). Based on the whole-rock geochemical, here we report cooccurrence of the common granites, adakitic granites, and highly evolved granites types from the Funiushan pluton. The common granites contain 65.01–75.28 wt.% SiO₂, 3.12–5.48 wt.% Na₂O, 3.88–5.47 wt.% K₂O, 13.27–16.45 wt.% Al₂O₃, 0.19–0.91 wt.% MgO, and –0.91 wt.% Na₂O, 3.88–5.47 wt.% K₂O, 13.27–16.45 wt.% Al₂O₃, 0.19–0.91 wt.% MgO. They are enriched in the light rare earth elements (LREE) and large-ion lithophile elements (LILE), –0.91 wt.% MgO. They are enriched in the light rare earth elements (LREE) and large-ion lithophile elements (LILE), depleted in the heavy REE (HREE) and high-field-strength elements (HFSE), and have negative Eu anomalies (Fig. 1a, b). The common granites also have relatively high εHf(t) values (generally between –23.66 and –6.70), TDM2 model ages of 3042–1616 Ma and relatively high δ¹⁸O values from 4.81 ‰ to 6.55 ‰. These data indicate the primary magmas generated by partial melting of the Paleoproterozoic crustal rocks with contamination of mantle materials. In contrast, the adakitic granites possess high SiO₂ (70.49–76.32 wt.%), Sr (332–566 ppm) contents, high ratios of Sr/Y (53–138) (Fig. 2a), (La/Yb)N (28.78–52.03) (Fig. 2b) and low concentrations of MgO (0.15–0.40 wt.%). They are also characterized by enrichment of LREE and LILE, depletion of HREE and HFSE and P (Fig. 1c, d). They show relatively low εNd(t) values (–5.69), low εHf(t) values varying from –20.93 to –0.04, relatively high TDM2 model ages from 2512 Ma to 1192 Ma and high δ¹⁸O values (5.34–7.48 ‰), indicating that the adakitic granites were derived from partial melting of lower crustal material with relatively high extent contamination of mantle derived materials accompanied by the strongly fractional crystallization. Three types granites were most likely related to the collision between NCC and YC. When extension environment substitute compression conditions caused by subduction of YC under NCC, delamination of thickened continental crust and asthenosphere upwelling provide heat to melt the thick bottom crust and forward to form magma.

Key words: Early Cretaceous, granite, Yangtze Craton, southern margin of the North China Carton

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Fig. 1. (a, c, e) Chondrite-normalized REE patterns and (b, d, f) primitive-mantle-normalized trace element diagrams for the Funiushan granitoids normalized to the chondrite and primitive mantle compositions of Sun and McDonough (1989).

Fig. 2. (a) Sr/Y vs. Y (Defant and Drummond, 1990) and (b) (La/Yb)_N vs. Yb_N (Martin, 1986) diagrams for the Funiushan granitoids, including curves showing calculated partial melting trends.