ABSTRACT

Late Cretaceous magmatism in the southern Lhasa subterrane, Tibet, provides critical constraints on the subduction processes of the Neo-Tethyan oceanic plate. Here, we provide data on the whole-rock geochemistry, zircon U–Pb ages, trace element contents, and Hf isotopes of early Late Cretaceous volcanic rocks from Sangri County to Sangye Temple (SS) along the southern Lhasa subterrane. The SS volcanic rocks include basalts, andesites, and dacites. SIMS and LA–ICP–MS zircon U–Pb data indicate that the SS dacites were erupted at ca. 95 Ma, coeval with the early Late Cretaceous “flare-up” event in the southern Lhasa subterrane. The SS volcanic rocks belong to the calc-alkaline to high-K calc-alkaline series and have the geochemical features of subduction-related volcanic rocks with negative Nb, Ta, and Ti anomalies. The basalts have similar rare earth element (REE) patterns to E-MORB and are characterized by high Zr abundances (65–190 ppm) and Zr/Y ratios (3.3–6.5). They were possibly derived by high-degree partial melting of mantle peridotite that had been metasomatized by subduction-related fluids with an input of asthenospheric components. Positive whole-rock $\varepsilon_{Nd}(t)$ (+2.9 to +3.2) values for the andesites, and their variable Mg# values (35–61) and MgO (2.29–7.32 wt.%), Cr (12–232 ppm), and Ni (10–127 ppm) contents can be attributed to medium-degree partial melting of mantle peridotite followed by fractional crystallization of clinopyroxene and olivine. The calc-alkaline SS dacites are similar to adakites with high Sr (663–1188 ppm) and low heavy rare earth element (HREE) and Y (10.7–11.5 ppm) contents. These adakitic dacites have positive whole-rock $\varepsilon_{Nd}(t)$ (+2.9 to +3.4) and zircon $\varepsilon_{Hf}(t)$ (+8.4 to +14.9)

values with relatively high values of Mg# (36–57) and high contents of compatible elements, indicating that they were derived from the partial melting of subducted oceanic slab, and with the ascending magma interacting with mantle wedge peridotite. Our new data indicate a distinct rock association of coeval asthenosphere-component-involved basalts and slab-derived adakitic dacites. Such an association, together with the coeval high-temperature charnockites and high-temperature granulite-facies metamorphism of the charnockitic country rocks in the southern Lhasa subterrane, indicates an anomalous input of materials and heat during the early Late Cretaceous “flare-up” event. Such an event can probably be attributed to the northwards subduction of a Neo-Tethyan oceanic ridge that allowed for contributions from upwelling asthenosphere that differed from the typical results of normal-angle subduction or low-angle/flat subduction and subsequent slab rollback.