Integrated geochemical constraints on source nature and melting conditions of Triassic granites from South Qinling, central China

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Granites are the most abundant plutonic rocks in the upper continental crust, and can provide great information on the generation and evolution of continental crust. Although various models have been proposed, the granite petrogenesis is still enigmatic, especially with respect to the origin of their geochemical diversity.

To constrain the petrogenesis of granites and provide insight into the source nature and melting conditions on their geochemical compositions, we performed a combined study of petrology, geochronology and geochemistry for Triassic Guangtoushan (GTS) and Huayang (HY) granites in South Qinling, central China. The results indicate that they were derived from partial melting of metasedimentary rocks and thus belong to S-type, rather than I-type as suggested by previous studies. LA-ICPMS zircon U-Pb dating yields concordant ages of 207–212 Ma for their magma emplacement. The GTS and HY granites show weakly to strongly peraluminous features. The former have high whole-rock $\delta^{18}O$ values of 9.52–11.20‰, the latter also have high zircon and whole-rock $\delta^{18}O$ values of 10.71–11.43‰ and 12.42–13.77‰, respectively. In addition, the GTS granites exhibit low K_2O/Na_2O, Rb/Sr but high Sr/Ba ratios, variable Eu anomalies and low T_{Zr} values. In contrast, the HY granites have high K_2O/Na_2O, Rb/Sr but low Rb/Ba ratios, conspicuous negative Eu anomalies and relatively high T_{Zr} values. An integrated interpretation of all these results is that the GTS granites were produced by fluid–present partial melting of a mixture source of metapelite and metagreywacke at low temperature, whereas the HY granites were generated by fluid–absent partial melting of metagreywacke at relatively high temperature. Moreover, they show variably enriched whole-rock Sr-Nd-Hf isotopic compositions and negative zircon $\varepsilon_{Hf}(t)$ values, with Meso-Paleoproterozoic two-stage Nd-Hf model ages. Their $\varepsilon_{Nd}(t)$ values are comparable with those for adjacent sedimentary rocks in South Qinling and the Yangtze craton, suggesting a genetic link between them. It is inferred that these sedimentary were subducted to the lower crustal depths during the Late Triassic continental collision for partial melting to produce these S-type granites.