Distinction between S-type and peraluminous I-type granites: zircon versus whole-rock geochemistry

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Biotite and two-mica granites are common in continental crust. Although they are generally peraluminous in lithochemistry, their petrogenesis has been controversial. Because these peraluminous granites often show a negative correlation between P_2O_5 and SiO_2 and a positive correlation between A/CNK and SiO_2, they are commonly considered as I-type granites of metaigneous origin. However, such lithochemical consideration is not certain in view of their other geochemical characteristics.

To constrain the source nature of peraluminous granites, we performed a combined study of *in-situ* U-Pb age, O isotope and trace element for synmagmatic and relict zircons from Triassic biotite and two-mica granites in the Nanling Range, South China. Zircon U-Pb dating yields concordant ages of 230±3 to 237±3 Ma for synmagmatic zircons, and 335 to 2379 Ma for relict zircons with two clusters at ca. 440 Ma and ca. 800 Ma, respectively. Both the synmagmatic zircons and the ~440 Ma relict zircons are characterized by high $\delta^{18}O$ values of 8.8-11.4‰ and 8.6-10.3‰, respectively. In contrast, the majority of the other relict zircons show relatively low $\delta^{18}O$ values of 5.1 - 7.9‰. The high $\delta^{18}O$ values for synmagmatic zircons indicate that the Triassic granites were originated from metasedimentary sources. The two age clusters for relict zircons overlap with two episodes of granitic magmatism, respectively, in the early Paleozoic and the middle Neoproterozoic in South China, suggesting their inheritance from the metasedimentary sources. Thus, these Triassic granites were derived from partial melting of metasedimentary rocks rather than metaigneous rocks; they belong to S-type granite though their lithochemical relationships are akin to common I-type granites. Therefore, the zircon *in-situ* geochemical analyses have the capacity to unravel the source nature of controversial granites. Our data indicate that fractional crystallization of heterogeneous magmas is the possible mechanism for the decoupling between major element and stable isotope compositions in the peraluminous granites. Such heterogeneities are inherited from the heterogeneous metasedimentary source.