Zircon U-Pb and Hf isotopic constraints on the multiple components in granites

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Granites are the major component of the continental crust. However, it is controversial about their petrogenesis. Recent works indicate that the granites could contain components from various sources and country rocks, but their identification is difficult before the combined zircon U-Pb, Lu-Hf and O isotopic approach is used[1-2].

In the Archean gneiss of the Liaodong Peninsula, NE China, a felsic dyke occurred along the gneissic foliation. Zircon U-Pb isotopic analyses yield a $^{207}Pb/^{206}Pb$ age of 2516±8 Ma (n=20) for the country gneiss. However, the zircons in the felsic dyke show a complex age pattern. Among the 45 analyses, eighteen measurements show some discordance with an upper intercept age of 2520±44 Ma, in which the five spots near the Concordia give a $^{207}Pb/^{206}Pb$ age of 2514±19 Ma, identical to that of the country gneiss. Two younger spots give $^{206}Pb/^{238}U$ ages of 232±2 and 199±2 Ma, respectively. All of these Archean to Jurassic ages are interpreted as inherited origin. The rest 25 analyses yield a $^{206}Pb/^{238}U$ age of 125±1 Ma, being considered as the emplacement time of the dyke.

In-situ MC-ICPMS measurements indicate that the zircons from the Archean gneiss have $^{176}Hf/^{177}Hf$ isotopic ratios of 0.281260±18 (ε_{Hf}=-53.5±0.6), and the zircons from the felsic dyke have $^{176}Hf/^{177}Hf$ ratios of 0.281308±35 (ε_{Hf}=-51.8±1.6, 2.5 Ga), 0.281912±39 to 0.282066±46 (ε_{Hf}=-25~-30, 232-199 Ma) and 0.282979±32 (ε_{Hf}=7.3±1.1, 125 Ma), indicating that at least three different components had been involved during petrogenesis of the studied rock, which is impossible to be identified by the whole-rock Sr-Nd isotopic data. Therefore, the combined zircon U-Pb and Lu-Hf isotopic data suggest that the magma of felsic dyke derived from partial melting of the underplated juvenile crust, and contaminated by the Archean, Triassic and Jurassic materials during its rising en route and/or crystallization.

References

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