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Geochronology and geochemistry of leucogranites from the south-east margin of North China Block: Tracing a lower crust flow during continental collision

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Flow of the lower continental crust has been proposed as a mechanism to explain crustal thickening and the driving force for shallow earthquakes within continental crust. However, almost all evidences for this process are from geological and geophysical observations, geochemical evidence has not been reported yet. Here we present geochronological and geochemical data for the Late Jurassic leucogranites from the Bengbu area at the south-east margin of North China Block (NCB), suggesting a crustal flow from the mountain root of the Dabie-Sulu orogen to the NCB during the Triassic-Jurassic continent collision between the South China Block (SCB) and NCB. The leucogranites contain abundant both inherited Neoproterozoic igneous zircons and Triassic metamorphic zircons, which show a high agreement in ages with the ultrahigh-pressure (UHP) metamorphic rocks from the Dabie-Sulu orogen, but a significant difference with the country rocks. Mineral inclusions such as quartz, feldspar, apatite, titanite, biotite, muscovite and phengite occurring in the inherited metamorphic zircons suggest that the protolith of the leucogranites might have not experienced UHP metamorphism. Furthermore, steep HREE patterns of the inherited metamorphic zircons and very low bulk REE contents as well as Sr-Nd-Pb isotopic compositions of the rocks indicate that the leocugranites are most likely derived from partial melting of the subducted felsic gneiss from the Dabie-Sulu orogen rather than eclogite, with residual allanite in the source. In addition, given the same $^{206}Pb/^{204}Pb$ ratios, the diabase dykes in the leucogranites have relatively lower $^{208}Pb/^{204}Pb$ ratios than the post-collisional mafic igneous rocks in the Dabie orogen, suggesting that the lithosphere mantle underneath the Bengbu area is different from that underneath the Dabie-Sulu orogen. We argue that all these observations can be best explained by “channel flow” model, i.e. the investigated leucogranites originated from the partial melting of a shallowly subducted felsic crust of the SCB which “flowed” from the mountain root of the Dabie-Sulu orogen into the NCB because of its low viscosity.