The Trans-North China Orogen – A long-lived arc: Evidence from SHRIMP U-Pb zircon ages of granitoid gneisses in the Lüliang Complex

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The Lüliang Complex is situated in the central segment of the Trans-North China Orogen (TNCO), a continent-continent collisional belt along which the discrete Eastern and Western Blocks amalgamated to form the basement of the North China Craton [1-5]. The complex consists of supracrustal and granitoid gneisses, of which the latter can be subdivided into the Yunzhongshan TTG gneisses, Guojiazhuang granitic gneisses and Chijianling-Guandishan granitoid gneisses. These granitoid gneisses are mostly calc-alkaline and considered to have formed in a magmatic arc environment. SHRIMP U–Pb analyses reveal that the Yunzhongshan TTG gneisses were emplaced at ~2499 ± 9 Ma, representing the earliest arc-related magmatic event in the Lüliang Complex. This was followed by the intrusion of the Guojiazhuang granitic gneisses at 2375 ± 10 Ma. The most widespread arc-related magmatic event in the region was the emplacement of the Chijianling-Guandishan granitoid gneisses at 2199-2173 Ma, respectively. Metamorphic zircon overgrowth rims from a tonalitic gneiss yielded a weighted mean $^{207}Pb/^{206}Pb$ age of 1872 ± 7 Ma, consistent with the metamorphic age range of 1880-1820 Ma defined by metamorphic zircons from various high-grade rocks in the TNCO. Thus, the evolution of the Lüliang Complex involved emplacement of the Yunzhongshan TTG suite at ~2499 Ma, the Guajiazhuang granites at ~2375 Ma and the Chijianling-Guandishan granitoids at 2199-2173 Ma, with the final collision between the Eastern and Western Blocks in this area occurring at 1872 ± 7 Ma, the whole series of magmatic eventsd lasting nearly 650 Ma. This suggests that the Trans-North China Orogen represents a long-lived magmatic arc. This study was financially supported by the Hong Kong CERG grants (7055/05P, 7058/04P, and 7063/06P) and a Chinese NSFC Grant (40429001).

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Crustal architecture of the Dabie orogen: Constraints from U-Pb age, Hf and O isotopes in zircon from UHP granitic gneiss

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Zircon U-Pb dating, Hf and O isotope analyses were carried out for granitic gneiss from North Dabie, the largest lithotectonic unit of ultrahigh-pressure (UHP) metamorphic rocks in the Dabie orogen, east-central China. The results are used to provide not only insight into its protolith origin and metamorphic history with respect to continental subduction, but also constraints on crustal architecture prior to and after collision. Zircon U-Pb dating gives consistent ages of 751 ± 7 Ma for protolith crystallization, and two group ages of 213 ± 4 to 245 ± 17 Ma and 126 ± 4 to 131 ± 36 Ma for metamorphism. Most of zircon Hf isotope analyses show negative $\varepsilon_{Hf}(t)$ values of –5.1 to –2.9 with crust Hf model ages of 1.84 to 1.99 Ga, suggesting that their protolith was originally derived from reworking of Paleoproterozoic crust. The remaining analyses from one sample exhibit strongly positive $\varepsilon_{Hf}(t)$ values of 10.6 ± 0.8; some of them have the highest values of 12.4 to 14.5, corresponding to the youngest Hf model ages of 743 to 827 Ma relative to the depleted mantle. Thus, gneiss protolith was derived from reworking of the Paleoproterozoic crust due to rift magmatism in response to the Rodinia breakup at about 750 Ma. This differs from bimodal protolith of the classic Central Dabie UHP metamorphic zone, which has zircon Hf isotope features indicating prompt reworking of Neoproterozoic juvenile crust. Oxygen isotope analysis yields zircon $\delta^{18}O$ values of –3.26 to 2.79‰, which are considerably lower than those of the normal mantle. This suggests differential involvement of meteoric water in protolith magma by remelting of hydrothermally altered low $\delta^{18}O$ rocks. It appears that North Dabie shares the same ages of Neoproterozoic low $\delta^{18}O$ protolith and Triassic UHP metamorphism with Central Dabie, but it was significantly reworked at Early Cretaceous. The Rodinia breakup at about 750 Ma would lead to not only growth of juvenile crust in an active rift zone for bimodal protolith of Central Dabie, but also reworking of Paleoproterozoic crust in an arc-continent collision zone for the North Dabie protolith. The difference in the occurrence of Cretaceous ages between North Dabie and Central Dabie suggests that the two UHP metamorphic units were not located on the same level during the Cretaceous magma emplacement, but a lower level for North Dabie. This also provides a constraint on the source depth of Cretaceous granitoids, which was probably deeper than the North Dabie gneiss.