Zircon ages and Hf isotopic composition of gneisses from the Sulu UHP terrain, China

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Identification of coesite and micro-diamond inclusions in eclogites of the Dabie-Sulu terranes in east-central China [1-2] demonstrates that supracrustal material was subducted to mantle depth of >120 km and underwent UHP metamorphism. Time of this collision was constrained at ca. 230-220 Ma by radiometric studies [3-4]. UHP eclogites occur as lenses in dominant gneisses of different types.

This study presents zircon U-Pb ages and Hf isotopic composition of gneisses in the Sulu UHP terrain for origin and provenance of the protoliths. Zircon grains from three samples of gneiss yield SHRIMP U-Pb ages of 710- 770 Ma, consistent with protolith ages of eclogites and orthogneisses in other regions of the Dabie–Sulu orogen, interpreted as formation time of magmatic protoliths of the gneisses, which were contemporaneous with the magmatism during the breakup of the suppercontinent Rodinia. Initial ε_{Hf} values (at 750 Ma) and Hf modal ages of zircon grains from the fourteen gneiss samples are variable. Zircon grains from two gneiss samples commonly give very low initial ε_{Hf} values (average -16.4) and a mean Hf modal age of about 2.70 Ga. Seven gneiss samples contain zircon grains that yield a mean initial ε_{Hf} value of -7.7 and Hf modal age of 2.15 Ga. These results suggest that part of protoliths were formed in Neoproterozoic by remelting Archean to Paleoproterozoic crustal material and further indicate existence of Archean crustal section probably of the Yangtze affinity beneath the Sulu UHP terrain. Other six gneiss samples mostly contain young zircon grains, having mean initial ε_{Hf} values of -0.56 to 6.6. Part of them give Hf modal ages of 0.81 to 0.94 Ga. This suggests magmatic activity of mantle origin, new crustal formation and coeval crust-mantle interaction probably during breakup of suppercontinent Rodinia in Neoproterozoic. Underplating of magmas of mantle origin caused remelting of the overlying Archean - Paleoproterozoic crustal section to form granitic magma along rift zones or marginal regimes of the Yangtze block.

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Ca. 850 Ma intraplate magmatism in South China: implications for onset of the breakup of Rodinia

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Early to middle Neoproterozoic igneous rocks are widespread throughout South China, and their genesis and tectonic affiliations are important for understanding the geological evolution of South China with direct bearing on the Rodinia reconstruction. There are two main competitive models regarding their genesis. One is that the ≥900 Ma rocks were formed prior to or during the Sibao Orogeny related to the Rodinia assembly, whereas the 830-740 Ma rocks were anorogenic products related to mantle plume activities during the breakup of Rodinia. An alternative model is that all these rocks were formed in active continental margins and/or during the amalgamation between the Yangtze and Cathaysia Blocks, and the coherent South China could not have formed until ca. 800 Ma.

We report here geochronological and geochemical data for the Shenwu dolerite dykes and Gangbian syenite intrusion from SE Yangtze Block. These rocks were dated at ca. 850 Ma by SHRIMP U-Pb zircon method. The Shenwu dolerites are tholeiitic in compositions, and exhibit overall moderate enrichment in most incompatible trace elements resembling intraplate basaltic rocks. They have relatively restricted range of εNd(T) value between 0.4 and 2.1, suggesting derivation from a metasomatized lithosphere mantle. The Gangbian syenites show a wide range of SiO_2 = 46-67% and Mg# = 0.61-0.39, belonging to the shoshonitic series with K_2O = 1.7-4.8% and K_2O/Na_2O = 0.4-1.2. They are enriched in LIL and LREE and depleted in Nb and Ta with εNd(T) = 0 to -6. The syenites were likely derived from the common metasomatized mantle source by small degrees of partial melting followed by varying degrees of crystal fractionation associated with minor crustal contamination. These ca. 850 Ma dolerites and syenites share close affinities with the intraplate basaltic and alkaline rocks, indicative of an intraplate origin, rather than products of arc magmatism.

The studied dolerites and syenites postdate the ca. 1.1-0.9 Ga Sibao Orogeny, and predate the formation of ca. 820-650 Ma Nanhua rift basin, providing an important petrological constraint on the tectonic transformation from ca. 1.1-0.9 Ga orogensis to ca. 850 Ma intraplate rifting in South China. These rocks are synchronous with some reported ca. 850 Ma anorogenic igneous rocks in other Rodinian contonents, possibly pointing to onset of the breakup of Rodinia supercontinent.