Major magmatic and metamorphic events in the Trans-North China Orogen: A geochemical and geochronological synthesis

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The Trans-North China Orogen (TNCO) was a Paleoproterozoic collisional belt along which the Eastern and Western Blocks amalgamated to form the North China Craton. Recent structural, geochemical and isotopic data show that the orogen was an Andes- or Japanese-type arc at the western margin of the Eastern Block, which was separated from the Western Block by an old ocean, with eastward-directed subduction. At 2550–2520 Ma, the subduction caused partial melting of the medium-lower crust, producing granitoid plutons in the granite-greenstone terranes. At 2530–2520 Ma, subduction of the oceanic lithosphere caused partial melting of the mantle wedge, forming greenstone-type mafic-felsic volcanic assemblages. Extension driven by widespread volcanism led to the development of back-arc basins in the orogen. At 2520–2475 Ma, the subduction caused further partial melting of the lower crust to form large amounts of TTG gneisses. In the Paleoproterozoic, episodic granitoid magmatism occurred, forming 2360 Ma, ~2250 Ma 2110-21760 Ma and ~2050 Ma granites and volcanics in the orogen. At 2150–1920 Ma, the subduction of an oceanic ridge led to emplacement of mafic dykes that were subsequently metamorphosed to high-pressure granulites. At 1880-1820 Ma, the closing of the ocean led to the continent-arc-continent collision, which caused large-scale thrusting and isoclinal folds and formed HP granulites or eclogites. Peak metamorphism was followed by exhumation/uplift, resulting in widespread development of symplectic textures in the rocks.

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Neoproterozoic mafic dike swarm in the northern margin the Yangtze Block was not part of Rodinia

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The ~800 Ma Huangling mafic dike swarm, located at the northern margin of the Yangtze Block, has been proposed to be comagmatic with mafic dikes in western North American and central-southern Australia [1]. The dikes are alkaline to sub-alkaline with SiO2 ranging from 43.3 to 57.2 wt.% and MgO from 3.7 to 9.2 wt.%. They exhibit LREE enrichment ((La/Yb)n = 3.3-28.5) with slightly negative Eu anomalies (Eu/Eu*=0.6-1.0). The rocks have arc-related compositions, characterized by enrichment of LILE and depletion of HFSE with positive Pb and negative Ti anomalies in the primitive mantle-normalized trace elemental diagram. They have high initial $^{87}Sr/^{86}Sr$ ratios (0.7052 to 0.7080) and variably negative εNd(t) values (-4.2 to -10.9). The rocks have highly variable whole-rock εHf values ranging from -0.35 to -11.34. Their $^{206}Pb/^{204}Pb$ ratios range from 16.96 to 17.97, $^{207}Pb/^{204}Pb$ from 15.41 to 15.58, and $^{208}Pb/^{204}Pb$ from 38.08 to 39.66. Initial $^{87}Sr/^{86}Sr$ values correlate negatively with $^{206}Pb/^{204}Pb$, whereas $^{143}Nd/^{144}Nd$, εHf and $^{208}Pb/^{204}Pb$ correlate positively with $^{206}Pb/^{204}Pb$, suggesting an EM2 source region. The EM2 signature in the these mafic dikes indicates that their source region was likely lithospheric mantle modified by subducted components during the Neoproterozoic. The linear isotope variations are indicative of strong crustal contamination during magma emplacement. Emplacement of the mafic dikes was a consequence of post-orogenic extension. Available data support a model of asynchronous extension along the northern margin of the Yangtze Block, beginning at about ~800 Ma in the east and ~735 Ma in the west. The tectonic evolution of the northern margin of the Yangtze Block differs from that in the west where subduction was still active at 740 Ma. This conclusion rules out the possibility that the Yangtze Block was located in the center of Rodinia [1]. More likely it lay along the margin of the Neoproterozoic supercontinent [2].

[1] Li *et al*. (2004) *Earth Planet. Sci. Lett*. **220**, 409-421. [2] Zhou *et al*. (2006) *Precamb. Res*. **144**, 19-38.