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# The Noearchean granulite facies metamorphism in East Hebei, North China Craton

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The East Hebei early Precambrian terrane, located in the northwestern part of the Eastern Block of the North China Craton, is composed predominantly of tonalitic-trondhjemitic-granodioritic (TTG) gneisses and potassium-rich granitoids, with supracrustal rocks consisting of ultramafic to felsic volcanic and sedimentary rocks. Recent studies suggest that the most TTG and supracrustal rocks were subjected to granulite/amphibolite facies metamorphism in the Neoarchean around 2.45–2.50 Ga, and overprinted by a second phase of high-pressure granulite facies metamorphism at *c*. 1.82 Ga, as recorded in mafic dykes.

The Neoarchean mafic granulites in the East Hebei occur as blocks of various scales in the extensive TTG gneisses. They are distributed as two-pyroxene granulites at Taipingzhai in the east, garnet two-pyroxene granulites at Saheqiao in the central part, and garnet-clinopyroxene granulites at Malanyu in the west. The garnet two-pyroxene granulites at Saheqiao show two-stage assemblages with an early stage consisting of orthopyroxene and clinopyroxene-I and a late stage consisting of garnet and clinopyroxene-II, but the mafic granulites from the other two areas mainly show one-stage assemblage. Using REE-based thermometers for two-pyroxene and garnet-clinopyroxene pairs, temperature conditions were recovered to be 980–1100 °C for two-pyroxene granulites at Taipingzhai, 950–1100 °C for the early stage and 810–890 °C for the late stage of garnet two-pyroxene granulites at Saheqiao, and 800–860 °C for garnet clinopyroxene granulites at Malanyu. These results suggest that the mafic granulites at Taipingzhai and Saheqiao may have reached a possible UHT condition and followed by an apparent isothermal cooling process, and the mafic granulites at Malanyu have mainly recorded the cooling conditions.

The Neoarchean pelitic granulites together with banded iron formation mainly occur as small rafts in TTG gneisses at Taipingzhai area and are mainly comprised of garnet, biotite, plagioclase, K-feldspar and quartz, commonly with sillimanite and orthopyroxene. Plagioclase occurs as inclusion in garnet porphyroblasts or as grains in the matrix. The inclusion type shows higher anorthite content (An = 0.43-0.45) than the matrix type with An = 0.28–0.34, and the later shows zoning with An decreasing towards the rim. Phase modelling using pseudosections suggests that the pelitic granulites have recorded a P–T condition of 8–10 kbar/850–880 °C for their final assemblages, and an isobaric cooling process from a much higher temperature indicated by the matrix plagioclase zoning. However, the anorthite-rich plagioclase of inclusion-type can suggest a possible early stage with P–T condition at ~1000 °C and ~4 kbar. Thus, an anticlockwise P–T path is proposed, involving an isothermal compression from ~4 to 9 kbar under ~1000°C followed by isobaric cooling from ~1000 °C to 850 °C under ~9 kbar.

The UHT conditions and special P–T paths revealed for both mafic and pelitic granulites from the East Hebei are significant for documenting the Neoarchean tectonic evolution.