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High-pressure mafic granulite at the Archean/Proterozoic boundary from the Jiaodong Terrain, North China Craton: Petrography, geochronology, geochemistry and geological implications

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High P/T metamorphism rarely occurred until the end of the Paleoproterozoic, indicating a secular change of the Earth's thermal structure throughout geological history and responsible for a change of metamorphic style and tectonic setting of the continental crust. The North China Craton is an ideal place to study the transition of the Earth's thermal structure and tectonics at the Archean–Proterozoic boundary due to good preservation of rocks formed during the *c*. 2.5 Ga tectono-thermal event. We report on the discovery of a late Archean high-pressure granulite from the Jiaodong Terrain in the North China Craton.

The mafic granulite occurs as garnet–clinopyroxene–orthopyroxene–hornblende gneiss enclaves within late-Archean trondhjemite–tonalite–granodiorite (TTG) gneiss. A typical high-pressure mineral assemblage of garnet–clinopyroxene–plagioclase–quartz ± rutile has been identified. Plagioclase + clinopyroxene ± orthopyroxene ± hornblende symplectite surrounding garnet (white eye) was also observed. Using conventional thermobarometry and pseudosection modeling, a clockwise metamorphic P–T path with peak conditions at ~17 kbar and ~880 °C was determined. Zircon U-Pb SHRIMP analyses on overgrowth rims of zircon grains from two samples of the same outcrop yielded a metamorphic age of 2473 ± 6 Ma (MSWD = 0.8). Analyses on magmatic cores gave a probable magmatic age of 2527 ± 12 Ma (MSWD = 1.9). A wall rock of the gneissic trondhjemite was also dated to constrain the age, producing a magmatic age of 2540 ± 8 Ma (MSWD = 1.8) and a metamorphic age of 2480 ± 11 Ma (MSWD = 2.1). In-situ zircon Hf isotope analyses show positive εHf(t) values close to the depleted mantle evolution line, indicating a juvenile source for the host TTG and high-pressure mafic granulite. Whole-rock geochemical features of slight enrichment in LREE, a negative anomaly in Nb and Ta, and relatively low Nb/Zr ratios (<1 vs. Zr content <100 ppm) indicate that the mafic high-pressure granuite may have formed in the root of an arc in a subduction environment.

The high-pressure granulite facies metamorphism may indicate a subduction–collision event between ~2.5 Ga crust and ~2.9 Ga crust at the dawn of the Paleoproterozoic in the North China Craton. It also represents a new but rare case of subduction–collision tectonics at the Archean–Proterozoic transition and provides insights into the change of the Earth's thermal structure.