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Metamorphism and geochronology of the Jining khondalites in the UHT belt, North China Craton, China

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The basement rocks of the North China craton (NCC) are divided into the Eastern and Western blocks separated by the Trans-North China orogen on the basis of lithologic associations, structures, metamorphism and isotopic ages. In the Western block, a belt of khondalite-series rocks are believed to represent the products of collision between the north Yinshan block and the south Ordos block before the final amalgamation of the NCC basement. The Jining Complex occurs in the eastern part the khondalite belt, and is intersected by Trans-North China orogen. Khondalite rock of the complex consist of mainly graphite-bearing sillimanite–garnet gneiss associated with syntectonic garnet/sillimanite-bearing granite, massive porphyritic granite, garnet quartzite, calc-silicate and marble with minor felsic gneiss and mafic granulite.

LA-ICP-MS zircon U–Pb dating and cathodoluminescene (CL) image analysis were used to determine the protolith and metamorphic ages of khondalite rocks. The analytical results of 317 detrital zircon grains indicate five main age populations: 2410∼2550 Ma, 2162 Ma, 2047∼2099 Ma, 1944∼1993 Ma and 1842 Ma. CL results reveal that zircon grains of majority samples are rounded, unzoned with low Th/U, indicating a metamorphic origin, while some zircon grains of a few samples are characterized by magmatic oscillatory zoning and comparatively high Th/U, but are typically overgrown by metamorphic low CL rims with low Th/U.

Five-type rocks are used in this study: (1) Sil-Bt-Grt leptynite-gneiss; (2) a Spl- Sil-Ksp-Grt vein in Sil-Grt-Fsp gneiss (garnet–sillimanite khondalite relic of an UHT event that involved partial melting to form granite; (3) Sil-Grt-K-Fsp mylonite from a shear zone in the khondalite complex; (4) Crd-bearing two-feldspar Sil-Grt gneiss; (5) granite. Three samples of Sil-Bt-Grt gneiss record the oldest ages of 2550∼2480 Ma, suggesting the existence of a Paleoproterozoic provenance for the Jining Complex. Ages of 2162∼2047 Ma are interpreted as metamorphic ages of supercrustal rocks of the khondalites series. The Sil-Ksp-Grt vein and granite probably record the same metamorphic event with single population ages of 1985±28 Ma and 1957±19 Ma, respectively, representing formation of the khondalite belt within the western block when collision between the north Yinshan block south Ordos block occurred. The Sil-Grt-K-Fsp mylonite also yielded a single group age of 1842±18Ma, that may date the final collision of the Eastern and Western block, leading to establishment of the NCC.

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