Metamorphic *P–T* evolution and U–Pb dating of the high-grade metapelitic rocks from the Khondalite Belt, North China Craton

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The Wulashan-Daqingshan Complex and the Jining Complex in the Khondalite Belt, the North China Craton yield high-grade sillimanite-cordierite-garnet metapelitic rocks with representative metamorphic assemblages and microstructures. In combination with petrological observation and *P–T* pseudosections, a clockwise *P–T* path involving periods of near-peak, post-peak near-isothermal decompression and decompressional cooling is therefore inferred. For the garnet-cordierite-sillimanite metapelitic rocks of the Wulashan-Daqingshan Complex, the peak assemblage is garnet + biotite + K-feldspar + plagioclase + sillimanite + quartz + ilmenite + magnetite + liquid with *P–T* conditions of 830–860 ˚C and 9.5–11 kbar. The following near-isothermal decompression assemblage is garnet + biotite + cordierite + K-feldspar + plagioclase + quartz + magnetite + ilmenite + liquid at 840–880 ˚C and 6.0–7.5 kbar, characterized by matrix cordierite isolated from garnet by biotite decompressional dehydration melting reaction of Bt + Sil + Qz ±Pl →Crd + Kfs ±Ilm + Melt. Subsequent decompressional cooling processes resulted in cordierite and biotite + plagioclase symplectites surrounding garnet due to the following reactions of Grt + Sil + Melt →Crd + Bt + Fe-oxide and Grt + Melt →Bt + Qz ±Pl. The sillimanite-cordierite-garnet metapelitic rocks of the Jining Complex have preserved polyphase mineral assemblages and microstructural evidence of anataxis, resulting from biotite dehydration melting. Petrological observations revealed that these rocks contain three metamorphic assemblages: a peak assemblage of garnet porphyroblast and matrix biotite + sillimanite + K-feldspar + plagioclase + quartz + ilmenite + magnetite, a post-peak near-isothermal decompressional assemblage of garnet + cordierite + biotite + sillimanite + K-feldspar + plagioclase + quartz + ilmenite + magnetite, and a decompressional cooling assemblage of garnet + biotite + cordierite +K-feldspar + plagioclase + quartz + ilmenite + magnetite. A clockwise *P–T* path was defined involving the inferred peak stage followed by post-peak near-isothermal decompression and decompressional cooling stages, with *P–T* conditions of 790–825˚C and 9–10 kbar, 810–890˚C and 6.0–6.5 kbar, and 780–810 ˚C and 4.0–5.5 kbar, respectively. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) U–Pb analyses of the sillimanite-cordierite-garnet metapelitic rocks on detrital zircons yield yielded a protolith age of ~2.0 Ga. Moreover, metamorphic zircons yielded the late Paleoproterozoic metamorphic age of 1850 ~ 1950 Ma with age groups of ~1950 Ma, ~1900 Ma, and ~1850 Ma. The clockwise *P–T* paths and new zircon data reveal that the Paleoproterozoic Khondalite Belt involved in continent–continent subduction and collision followed by exhumation and cooling between the Yinshan and Ordos Blocks in the Western Block of the North China Craton, and experienced the Paleoproterozoic granulite-facies metamorphism.

Keywords: metapelitic rocks, partial melting, phase equilibria modeling, P–T path, Khondalite Belt

