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First occurrence of very low pressure ultra-high temperatures metamorphism in the Khondalite Belt, North China Craton.

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This study report the first occurrence of very low pressure (<0.4GPa) ultra-high temperatures metamorphism within the Paleoproterozoic Khondalite Belt of the North China Craton. This high grade orogenic domain is mostly composed of garnet +/- spinel +/- sapphirine-bearing migmatites, numerous Grt-bearing granites and marbles. These rocks are intruded by numerous metric to kilometric mafic intrusions. Petrological analyses and phase equilibria diagram modeling were performed on garnet and spinel-bearing and olivine-bearing migmatites.
Garnet and spinel-bearing migmatites show a quartz, ternary feldspar, garnet, biotite sillimanite and spinel main assemblage. Pseudosection diagram calculations give suprasolidus P-T conditions around ca. 0.7GPa for ca. 900°C that correspond to the peak temperature conditions. Thermometry using ternary feldspar thermometry gives temperatures estimations at ca. 950-1015°C for a pressure of 0.7GPa.
The Olivine-bearing migmatite, located at the contact with a mafic intrusion, shows two main assemblages. The first assemblage that makes the rock matrix consists of a micrographic quartz and feldspar domains associated with biotite, sillimanite and spinel. The second assemblage appears within mm-scale pockets with a complex symplectitic texture. Careful investigation revealed that theses pockets formed after garnet pseudomorphosis, with the development of an Opx-Sp-Crd association. Within this assemblage, an olivine-cordierite and Opx-Crd-Bi-Qtz assemblage occurred as smaller pockets. The petrogenetic grid and pseudosection calculations made for this olivine-bearing migmatite give P-T conditions around 0.35GPa for ca. 950°C that correspond to the peak temperature conditions recorded by the olivine-cordierite assemblage. The succession of reactions with garnet pseudomorphosis into an Opx-Spl-Crd followed by the crystallization of an Ol-Crd assemblage is modelled in the petrogenetic grid calculation and correspond to an isobaric clockwise P-T path.
Results from in situ LA-ICP-MS U-Th-Pb dating on monazite performed on the Grt-Spl bearing migmatite suggest a duration of partial melting bracketed between ca. 1932Ma and ca. 1898Ma. Zircon U-Th-Pb SIMS dating yield an age of a ca.1.92-1.94 Ga for the olivine-bearing migmatite and the adjacent gabbroic bodies. This age is interpreted as the timing for the very low pressure UHT metamorphism.
This first occurrence of very low pressure UHT metamorphism bring new insight for the understanding of the UHT Khondalite Belt. Implications about spatial and temporal distribution of heat and UHT metamorphism in the orogenic crust are discussed.