



## **Paleoproterozoic ultrahigh-temperature metamorphism in the Helanshan complex, North China Craton**

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A detailed petrological study is carried out on the recently discovered spinel-bearing garnet–sillimanite granulites in the Helanshan complex of the Khondalite Belt in the North China Craton. Based on the calculated  $P - -T$  pseudosections, we determined that their metamorphic peak occurred at  $T$  of 963–1031 °C and  $P$  of 6.3–7.3 kbar. A minimum temperature limit of the peak metamorphic conditions is constrained to be ~910–955 °C at 6.5 kbar using ternary feldspar thermometry. Therefore, these spinel-bearing pelitic granulites experienced UHT metamorphism. In addition, a clockwise  $P - -T$  evolution is determined, which involves pre- $T_{max}$  decompression followed by nearly isobaric cooling. We propose that the Khondalite Belt is an ultra-hot metamorphic orogen formed by collision between the Yinshan and Ordos Terranes. The style of this continental collision was rather different from Phanerozoic collisions, but was similar to the two-sided hot collision model of Sizova et al. (2014) during the Proterozoic. Two-sided hot collision involves shallow slab breakoff during collision, which leads to extension and the development of a wide plateau-like orogen, similar to that represented by the Ordos Terrane.