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# First record and timing of UHP metamorphism from zircon in the Xitieshan terrane: Implications for the evolution of the entire North Qaidam metamorphic belt

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## Abstract

The Xitieshan terrane is one of four metamorphic terranes in the North Qaidam metamorphic belt, which is an early Paleozoic high-pressure to ultrahigh-pressure (HP-UHP) metamorphic belt in NW China. However, conclusive evidence and precise timing of UHP metamorphism in the Xitieshan terrane have not been well documented. In this study, we report an integrated study of zircon grains from an amphibolite in the Xitieshan terrane in terms of mineral inclusions, trace elements, and U-Pb age systematics. The first record of coesite is reported as an inclusion in a metamorphic zircon, which provides unambiguous evidence for the UHP metamorphism of the Xitieshan terrane. The metamorphic zircon domains have weak or no zoning, very low Th/U ratios, insignificant Eu anomalies, and flat HREE patterns. Zircon grains contain inclusions of garnet, omphacite and rutile, in addition to the coesite inclusion. These inclusions indicate that the metamorphic zircon grains formed under UHP metamorphic conditions. The metamorphic zircon grains were dated by the SIMS and LA-ICPMS methods and yield weighted mean ages of 432 ± 14 and 441 ± 9 Ma, respectively. Combined with previous results, the HP-UHP metamorphism of the Xitieshan terrane may have lasted 460–440 Ma with the peak UHP metamorphism at 441 ± 9 Ma. A compilation of the reported geochronological data reveals that all four terranes of the North Qaidam metamorphic belt might have experienced coeval UHP metamorphism during the early Paleozoic (420–450 Ma), and thus may have suffered a coherent subduction, UHP metamorphism, and exhumation cycle.

**Keywords:** The Xitieshan terrane, coesite, zircon U-Pb age, UHP metamorphism, the North Qaidam metamorphic belt