

# **Deep subduction in the Archean indicated by ultrahigh-pressure polymorphs of chromite and rutile in Archean ophiolitic podiform chromite**

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The Archean Zunhua ophiolitic mélange of the North China Craton preserves a record of oceanic and collisional processes between an old continental fragment in the east, and a Neoproterozoic arc terrane in the west. Podiform chromites within harzburgite in the mélange have Re-Os ages of 2.55 Ga. The chromite grains have mineral inclusions including crust-derived carbonates, rutile, and other minerals. Most importantly, we have identified a multiphase inclusion with an ultrahigh-pressure (UHP) polymorph of rutile, TiO<sub>2</sub> (II) that can only form at depths greater than 200 km. The lattice adjacent to the UHP TiO<sub>2</sub> (II) have an orthorhombic CF structure, which is the UHP polymorph of chromite (chenmingite), that is only stable above 12.5 GPa and 1400 °C, meaning it must have experienced PT conditions at depths of approximately 400 km. Chenmingite has only previously been identified from meteorites, and synthesized in UHP experiments, making this the first documented terrestrial occurrence of this UHP polymorph of chromite. Together with the UHP inclusions of TiO<sub>2</sub> (II), we document the world's first Archean ultrahigh-pressure orogen. We suggest that the crustal inclusions were subducted to depths of at least 400 km, then entrained in mantle convective processes to be incorporated into the oceanic lithosphere, that was later at 2.52 Ga emplaced onto the Eastern Block of the North China craton, forming the Zunhua UHP ophiolitic mélange.