LIU Liang, CHEN Danling, ZHANG Junfeng, KANG Lei, LIAO Xiaoying and REN Yunfei, 2018. Quartz paramorphs after former stishovite in UHP eclogite from the South Altyn Tagh, western China and its significance. *Acta Geologica Sinica* (English Edition), 92(supp.2):18.

Quartz paramorphs after former stishovite in UHP eclogite from the South Altyn Tagh, Western China and its Significance

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Abstract

The long prism/needle-shaped polycrystalline quartz aggregates and square/ parallelogram-shaped singlephase quartz inclusions in omphacite and garnet of ultrahigh pressure eclogite were first discovered from the Jiangalesayi area, South Altyn UHP belt. Based on their morphology, these quartz inclusions are quartz paramorphs after stishovite. The minimum peak pressure of the eclogite is estimated to be >8–9 GPa at 800–1000 °C based on the stability field of stishovite. This new evidence, together with previous stishovite exsolution microstructure in the gneiss from the same region, suggests an ultra-deep subduction and exhumation of the South Altyn continental rocks to/from mantle depths in stishovite stability field. Evidence of ultra-deep subduction of continental materials might be more common and diverse than previous thought.

Exhumation of subducted continental rocks from≥300 km has been considered impossible because they are denser than mantle at these depths. How did the stishovite bearing continental rocks of the South Altyn exhumated?

As we all know, the densities of stishovite (4.3 g/cm^3) are much higher than coesite (2.9 g/cm^3), and stishovite transforms into coesite with temperature increases. Density calculations were performed for subducted continental rocks along phase transition of stishovite to coesite, using the third-order Birch-Murnaghan equation of state based on mineral fractions obtained from experiments and Perple_X. The results show that the density of Siliceous rocks decrease remarkably, lower than the surrounding mantle in coesite stability field, whereas the density of Oligosiliceous and Silicon unsaturated rocks is higher than surrounding mantle.

Thus,we propose that the thermal induced transformation could provide an initial driven force for the exhumation of ultra-deep subducted silica-enriched felsic continental rocks. Temperature increase could be derived from an increased geothermal gradient from convective mantle or mantle plume. Mafic to ultra-mafic rocks and silica-deficient rocks may be captured by the upwelling subducted continental rocks and exhumated together.

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