

TIMING OF PROGRADE METAMORPHISM IN THE DABIE SHAN UHP COMPLEX: U-Pb AND Sr SYSTEMATICS OF PRE-UHP TITANITE

WAWRZENITZ, N.¹, ROMER, R.L.² & OBERHÄNSLI, R.¹

¹Institut für Geowissenschaften, Universität Potsdam, Postfach 601553, D-14415 Potsdam, Germany

²GeoForschungszentrum Potsdam, Telegrafenberg, D-14473 Potsdam, Germany
e-mail: nicolew@geo.uni-potsdam.de

Prograde mineral relics that formed during the subduction stage are rarely preserved within UHP metamorphic rocks. Such relics, however, may provide crucial geochronological information that allows to constrain subduction rates and the time span between subduction and the early phases of exhumation of UHP rocks. This is essential to understand the processes that occur in the lithosphere and in the upper asthenosphere during collision.

U-Pb dating of titanite has the potential to constrain successive stages of the burial and exhumation history: (1) especially in marbles, due to large viscosity contrasts between titanite and carbonate, prograde titanite may escape strain induced recrystallization, (2) the U-Pb system in titanite may remain closed even during high temperatures (> 1000 °C), (3) correlation of titanite with metamorphic reactions, deformation fabrics, and U-Pb data allows to establish a dated PTd-path.

We analyzed a relictic prograde titanite from calcsilicate rocks from the Dabie Shan UHP complex (eastern China). It survived UHP metamorphism and recrystallization and HT-deformation events related to exhumation. The calcsilicate rocks also locally preserve UHP peak pressure conditions ($P > 40$, $T > 750$ °C). The prograde titanite are porphyroclastic megacrysts in a strained calcite matrix, with a margin rich in rutile inclusions, that formed at the expense of the titanite megacryst by the reaction titanite + CO₂ = rutile + calcite (aragonite) + quartz (coesite).

Nine subsamples yield concordant ²⁰⁶Pb/²³⁸U data constraining titanite formation, and give an upper age limit for UHP metamorphism at 245 ± 5 Ma (2σ), thus being only ca. 5 Ma older than UHP peak conditions. Assuming that the megacryst had formed at ca. 10 - 12 kbar, the average vertical subduction rate would be 1.7 cm / a, though the PT-range of the formation of the prograde titanite megacryst is not well confined.

The Sr and Nd isotopic compositions (and chemical composition) are homogenous among the subsamples of the titanite megacryst, but fundamentally different from titanite in the calcite matrix. The ⁸⁷Sr/⁸⁶Sr value in the titanite megacryst is higher than 0.70712, whereas calcite yields a value as low as 0.70457, indicating that calcite probably changed its Sr isotopic composition during later fluid-infiltration and recrystallization. This demonstrates that Pb is likely to have been isotopically homogeneous, and that the U-Pb system of the titanite megacryst remained closed. There is no indication for a heterogeneous initial Pb isotopic composition, which could have induced excess scatter among the age data.