U-Pb ages and trace elements of metamorphic rutile and zircon from ultrahigh-pressure metamorphic quartzite in the Sulu orogen

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Rutile and zircon U-Pb ages and trace elements were determined by the LA-(MC)-ICPMS technique for ultrahigh-pressure (UHP) metamorphic quartzite in the Sulu orogen. The results provide insights into the effect of metamorphic fluid on element transport in continental subduction factory. Rutile U-Pb dating yields a concordant age of 205 ± 2 Ma, whereas U-Pb dating of coexisting zircon gives two groups of concordant ages at 243±4 Ma and 223±3 Ma, respectively. The Zr-in-rutile thermometry yields temperatures of 600-640°C, and the diffusion of radiogenic Pb in the rutile is estimated to have the closure temperatures of 600-650°C. Although the rutile U-Pb age is significantly younger than the younger group of zircon U-Pb ages, the consistency in the two kinds of temperatures indicates that the rutile U-Pb age has dated its growth rather than slow cooling during exhumation and thus the termination of amphibolite-facies retrogression.

Core-rim profile analyses across a large rutile grain (~15 mm in diameter) yield remarkable trace element zoning, with much lower contents of HFSE such as Nb, Ta, Sb and W but significantly higher U contents in the core than in the rim. The variations in HFSE are ascribed to growth zoning rather than diffusion resetting. In this regard, the rutile may have grown in two metamorphic stages that exhibit variable caompatibilities of trace elements with respect to the property of metamorphic fluid. The significant enrichment of HFSE in the rutile rim suggests its overgrowth from the metamorphic fluid that is locally enriched in Nb, Ta, Sb and W and thus interpreted as the product of phase separation from a supercritical fluid into aqueous fluid and hydrous melt during the exhumation.The occurrence of suprachondritic Nb/Ta ratios for the rutile suggests that eclogite-facies rocks left behind metamorphic dehydration during the retrograde exhumation tend to exhibit subchondritic Nb/Ta ratios. This differs from eclogites left behind metamorphic dehydration during the prograde subduction, which tend to exhibit suprachondritic Nb/Ta ratios in complementary to the subchondritic Nb/Ta ratios for the continental crust.