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Rutile U-Pb geochronological record of pre-subduction history of medium-temperature orogenic eclogites (North Muya complex, Eastern Siberia)

SERGEI SKUZOVATOV[1], TONNY B. THOMSEN[2], SERGEY SKUBLOV[3] AND VLADISLAV S. SHATSKY[4]

[1]Vinogradov Institute of Geochemistry, Russian Academy of Sciences

[2]Department of Petrology and Economic Geology, Geological Survey of Denmark and Greenland (GEUS)

[3]Institute of Precambrian Geology and Geochronology

[4]Sobolev Institute of Geology and Mineralogy

Presenting Author: skuzovatov@igc.irk.ru

Rutile is a ubiquitous accessory mineral found in a wide range of environments and P-T-*X* thermodynamic conditions, from mantle eclogites and peridotites to present-day sediments and placers. In metamorphic lithologies, rutile is a common high-pressure, high-temperature phase, and its stability encompasses that of the peak assemblages found in crustal granulites and eclogites. For high-grade crustal lithologies, rutile has been shown to successfully retain high- to ultrahigh-temperature records corresponding to peak heating of deeply buried crustal domains. Nonetheless, its U-Pb system closure temperatures are estimated within only ~500–650°C [1-3] and should more often record post-peak, medium-temperature cooling stage during exhumation to middle-crustal levels. Therefore, rutile from medium- to high-temperature orogenic eclogites in continental-subduction settings may have biased U-Pb records due to diffusion-induced partial Pb loss. Herein, we report the new U-Pb ages combined with corresponding trace-element and mineralogical characteristics for rutiles from seven HP (quartz-facies) eclogites in the North Muya complex (Eastern Siberia), which experienced variable exhumation-related rehydration. During the metamorphic evolution linked to the Ediacarian continental subduction (~630 Ma) [4-5] and subsequent exhumation, the eclogites possessed medium-temperature conditions within ~550-700°C, which fit or somewhat exceed rutile U-Pb closure temperatures. The present observations indicate predominant preservation of prograde rutile with inclusions of amphibolite-facies minerals with the corresponding uniform Zr-in-rutile temperature estimates within ~615-640°C (at 1.5 GPa). Within-sample common Pb-corrected U-Pb ages, however, are mainly Cryogenian (698–668 Ma), and significantly pre-date subduction, hinting at a distinct metamorphic event in the tectonic history of the Northeastern Transbaikalia. The obtained results are used to show the ability of eclogitic rutile to retain a prograde or pre-subduction U-Pb system state up to ~650°C and survive both peak and retrograde resetting/recrystallization, as well as its potential usage for recovering pre-convergence metamorphic history of high-pressure rocks.

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