Zr-in-rutile thermometry of metamorphosed high-aluminous rocks in Southwest Transbaikalia (Russia)

IZBRODIN, I. A.[1], DOROSHKEVICH, A. G.[1] AND KLEMD, R.[2]

[1]Geological Institute SB RAS, isbrodin@rambler.ru
[2]Friedrich-Alexander-Universität Erlangen-Nürnberg, reiner.klemd@fau.de

Last Mesozoic high-aluminium rocks in Southwest Transbaikalia (Ichetuy,Kyakhta) are kyanite- and sillimanite-schists. This study is initiated to investigate the applicability of the Zr-in-rutile thermometer to metamorphic rocks at different pressures and then compare these temperatures with those derived from mineral and isotope thermometers. We analysed the chemical composition of rutiles by LA-ICP-MS. Rutile from sillimanite schists and quartzites has lower Nb/Ta and Zr/Hf ratios (18-19 and 18 -29, respectively) than that from kyanite schists (17-21 and 20-35, respectively). The HFSEs vary over a wide range (ppm): Nb = 157-1007, Ta = 8-76, Zr = 44-770, Hf = 19-29. Rutile from the sillimanite schists has Zr contents of 550-770 ppm, and rutile inclusion in Ti-hematite - 353 ppm. Calculated temperatures, based on the Zr-in-rutile geothermometer, vary between 674-705°C and 634°C, accordingly. Zr contents in rutiles from the kyanite schists range from 44 to 129 ppm, corresponding to temperatures of 495–563°C. Oxygen-isotope temperatures of the sillimanite schists calculated for quartz-mineral pairs vary from 534-740°C (Kyakhta) and from 594-670°C (Ichetuy). Temperatures calculated using conventional mineral geothermometry range from 620-650°C for Kyakhta and from 570-660°C for Ichetuy. Thus, temperatures calculated on the basis of isotopic thermometry differ from those obtained by Zr-in-rutile thermometry and conventional mineral geothermometry. The mismatch is hardly surprising because the isotopic equilibration continued in sub-liquids or even in sub-solidus or isotopic resetting in minerals.

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