Geophysical Research Abstracts
Vol. 19, EGU2017-2994, 2017
EGU General Assembly 2017

Combined garnet and zircon geochronology and trace elements studies – constraints of the UHP-(U)HT evolution of Orlica-Śnieżnik Dome (NE Bohemian Massif).

Katarzyna Walczak (1), Robert Anczkiewicz (2), Jacek Szczepański (3), and Daniela Rubatto (4)

(1) Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Kraków, Poland (kwalczak@agh.edu.pl), (2) Institute of Geological Sciences, Polish Academy of Sciences, Kraków, Poland, (3) Institute of Geological Sciences, University of Wrocław, Wrocław, Poland, (4) Institute of Geological Sciences, University of Bern, Bern, Switzerland

The Orlica-Śnieżnik Dome (OSD), located on the NE margin of the Bohemian Massif, is predominantly composed of amphibolite-facies orthogneiss that contain bodies of HP and UHP eclogites and granulites. Numerous geochronological studies have been undertaken to constrain the timing of the ultra-high grade metamorphic event. Despite this, the exact timing of UHP-(U)HT conditions remain dubious (e.g. Brueckner et al., 1991; Anczkiewicz et al., 2007; Bröcker et al., 2009 & 2010).

We have utilized garnet and zircon geochronology to provide time constraints on the evolution of the UHT-(U)HP rocks of the OSD. We have combined the ages with trace element analyses in garnet and zircon to better understand the significance of the obtained ages in petrological context.

Lu-Hf grt-wr dating of peritectic garnet from two felsic granulites constrained the time of its initial growth at 346.9 ± 1.2 and 348.3 ± 2.0 Ma, recording peak conditions of 2.7 GPa and 950°C (e.g. Ferrero et al., 2015). In situ U-Pb SHRIMP dating of zircon from the same granulite gave a younger age of 342.2 ± 3.4 Ma. HREE partitioning between garnet rim and metamorphic zircon indicate their growth in equilibrium, hence, the U-Pb zircon date constrains the terminal phase of garnet crystallization.

Similar ages were obtained from two eclogite bodies from Międzygórze and Nowa Wieś localities; Lu-Hf (grt-cpx-wr) dating provided ages of 346.5 ± 2.4 and 348.1 ± 9.1 Ma for samples from Międzygórze and Nowa Wieś, respectively. The same age (within error) of 346.3 ± 5.2 Ma was reported by Bröcker et al. (2010) for zircon from the Międzygórze eclogite. Comparison of REE concentrations in garnet (this study) and in metamorphic zircon (reported in Bröcker et al., 2010) indicate that garnet and zircon crystallized in equilibrium. Furthermore, M-HREE patterns observed in both garnet and zircon strongly suggest their growth at eclogite facies conditions.

Sm-Nd garnet ages obtained for both felsic and mafic granulites and eclogites are identical within error and are consistently younger than corresponding Lu-Hf dates. Sm-Nd grt-wr ages of two samples of felsic granulite provide 332.4 ± 5.2 and 337.6 ± 2.3 Ma, while Sm-Nd grt-cpx age of a mafic granulite provides 336.9 ± 6.0 Ma. Sm-Nd grt-cpx(-wr) ages obtained for three eclogite samples range from 336.2 ± 3.5 to 337.7 ± 2.6 Ma. The foregoing ages are interpreted to reflect cooling through the Sm-Nd closure temperature at about 337 Ma.

The estimated PTt path documents the evolution of the OSD, characterized by two distinct periods: (1) nearly isothermal decompression resulting from crustal scale folding and vertical extrusion of granulites at 347–342 Ma, and (2) fast, nearly isobaric cooling at 342 - 337 Ma, becoming very rapid towards the end of this period.

Anczkiewicz, R. et al. 2007. Lithos, 95, 363-380.
Bröcker , M. et al. 2009. Journal of Metamorphic Geology, 27, 385-403.
Bröcker, M. et al. 2010. Geological Magazine, 147(3), 339-362.
Brueckner, H. K. et al. 1991. Neues Jahrb Mineral Abh, 63, 169-193.
Ferrero S. et al. 2015. Geology, 43, 447–450.