Geophysical Research Abstracts
Vol. 21, EGU2019-13901, 2019
EGU General Assembly 2019

The interplay between fluid and fracturing: seismometamorphic evolution of Tsäkkok eclogites, Scandinavian Caledonides

Michał Bukała (1), Christopher Barnes (1), Pauline Jeanneret (2), Jarosław Majka (1,2), Iwona Klonowska (1,2), Karolina Kośmińska (1,3)

(1) AGH - University of Science and Technology, Faculty of Geology, Geophysics and Environmental Protection, Kraków, Poland (michal.bukala91@gmail.com), (2) Uppsala University, Department of Earth Sciences, Uppsala, Sweden, (3) University of Iowa, Department of Earth and Environmental Sciences, Iowa City, IA, USA.

The Tsäkkok Lens belongs to the Seve Nape Complex which constitutes the upper part of the Middle Allochthon of the Scandinavian Caledonides and represents the outermost parts of the rifted passive margin of Baltica. The Tsäkkok eclogites, hosted by mica schists and marbles, preserve structures of pillow basalt with a tholeiitic E-MORB affinity (Kullerud et al. 1990), which indicates an oceanic or ocean-continent transition environment. Eclogites record pervasive brittle fracturing at high-pressure conditions, from the single-grain to the outcrop scale. X-ray mapping of garnet revealed a network of healed micro-fractures and vermicular micro-channels propagating outward from inclusions of pseudomorphs after lawsonite. Additionally, garnet exhibits larger dilational fractures that are filled with omphacite (<48 Jd mol.%) $\pm$ phengite (3.47 Si apfu) whose crystallization was facilitated by fluids. Eclogite lenses are also cut by a network of two types of veins, presumably formed at high-pressure conditions: (i) <2 mm thick garnetite veins, (ii) $\sim$1 cm thick garnetite veins containing abundant remnants of interstitial glaucophane $\pm$ omphacite (among others). The composition of garnet rims, omphacite and phengite infilling the fractures in garnet were utilized for P-T estimates based on the garnet-clinopyroxene Fe2+-Mg exchange thermometer and the garnet-phengite-omphacite net-transfer reaction barometer (Ravna & Terry, 2004) and yielded a pressure of 22.2 $\pm$ 3.2 kbar and a temperature of 590 $\pm$ 60°C. Zr-in-rutile geothermometer (Tomkins et al. 2007) has also been used. The calculated temperature for both, rutile inclusions in garnet and matrix rutile show a broad range (possibly related to recrystallization along a prograde path) varying from 480°C to 680°C. The maximum pressure of metamorphism might be higher than estimated here, but further studies are required to pinpoint the peak P-T conditions.
To summarize, the Tsäkkok eclogites record burial in a cold subduction zone and exhibit a wide range of lithological subtypes representing a transition from blueschist to eclogite facies rocks. They bear a record of pervasive dehydration reactions and subsequent hydrofracturing that happened along the prograde part of the clockwise pressure - temperature path.

Research funded by NCN project no. 2014/14/E/ST10/00321 and AGH research grant no. 15.11.140.237.

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