

EGU2020-13756

<https://doi.org/10.5194/egusphere-egu2020-13756>

EGU General Assembly 2020

© Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License.



Deciphering the brittle failure of eclogites at high-pressures: hydrofractures as fluid-escape pathways

Michał Bukala^{1,2}, Károly Hidas³, Carlos J. Garrido², Christopher Barnes^{1,4}, Iwona Klonowska^{1,5}, and Jarosław Majka^{1,4}

¹AGH - University of Science and Technology, Department of Mineralogy, Petrography and Geochemistry, Kraków, Poland (michal.bukala91@gmail.com)

²Instituto Andaluz de Ciencias de la Tierra (IACT), CSIC & Universidad de Granada, Armilla, Spain

³Instituto Geológico y Minero de España, Tres Cantos, Spain

⁴Department of Earth Sciences, Uppsala University, Uppsala, Sweden

⁵Department of Earth Sciences, Syracuse University, Syracuse, United States

The Tsäkkok lens (northern Scandinavian Caledonides) represents the outermost part of the rifted Baltica passive margin and consists of sediments and pillow basalts of MORB affinity that were metamorphosed in eclogite facies. The Tsäkkok eclogites underwent metamorphism in a cold subduction regime (~8 °C/km) at the onset of the Iapetus Ocean closure. These rocks record pervasive high-pressure, fracturing during prograde dehydration at eclogite-facies conditions reaching up to 2.2 GPa and 590 °C. Locally, the omphacite-dominated groundmass is transected by fractures sealed either by omphacitite or garnetite veins. Garnetite veins form a dense network that disrupt intact eclogite blocks, whereas omphacitite is found in rare, single veins. The garnetite veins are dominated by dense, poikiloblastic garnet clusters and display two chemically different zones, i.e., a high-Mn inner zone and a low-Mn outer zone. Detailed microstructural and geochemical mapping by EDS-EBSD SEM revealed that the high-Mn inner zone is disrupted and sealed by the low-Mn garnet zone. Garnets in the vein usually show little elongation and moderate intracrystalline substructure that is dominated by slightly changing misorientations without clear subgrain boundaries. By contrast, garnets of the sealed domain display an abrupt grain size reduction and anomalously high density of sharp intracrystalline misorientations in equant grains. The interstitial space between garnet grains in both of the inner and outer zones of the vein is infilled by omphacite + rutile + quartz + phengite + glaucophane.

The textural relationship between the inner- and outer zones of the garnetite vein implies syn-deformation growth of the outer zone, while the mineral assemblage attests for high-pressure conditions of the vein formation. Considering the lack of significant offset along the vein, we interpret the observed microstructures as formed during the sudden opening and closing of a brittle fracture, typical of hydrofracturing, and fast crystal growth assisted by high-pressure fluids. Presumably, these fractures constitute a fluid escape pathway during dehydration at prograde/peak conditions.

Research funded by NCN project no. 2019/33/N/ST10/01479 (M.Bukala) and no.

2014/14/E/ST10/00321 (J.Majka), as well as the The Polish National Agency for the Academic Exchange scholarship no. PPN/IWA/2018/1/00046/U/0001 given to M.Bukała.