EGU2020-19034
https://doi.org/10.5194/egusphere-egu2020-19034
EGU General Assembly 2020

Reaction-induced strain localisation in garnet pyroxenites during mantle corner flow: an example from the Ulten Zone (Eastern Alps, N Italy)

Stefano Zanchetta[1], Luca Menegon[2], **Luca Pellegrino**[1], Simone Tumiati[3], and Nadia Malaspina[1]
[1]Department of Earth and Environmental Sciences, University of Milano Bicocca, Milano, Italy
[2]Department of Geosciences, University of Oslo, Oslo, Norway
[3]Department of Earth Sciences, University of Milano, Milano, Italy

In the Ulten Zone (Tonale nappe, Eastern Alps, N Italy), numerous peridotite bodies occur within high-grade crustal rocks. Peridotites show a transition from coarse protogranular spinel-lherzolites to fine-grained mylonitic garnet-amphibole peridotites (Obata and Morten, 1987). Pyroxenites veins and dikes, transposed along the peridotite foliation, show a similar evolution from coarse garnet-free websterites to fine-grained garnet + amphibole clinopyroxenites (Morten and Obata, 1983). This evolution has been interpreted to reflect cooling and pressure increase of pyroxenites and host peridotites from spinel- (1200 °C, 1.3-1.6 GPa) to garnet-facies conditions (850 °C and 2.8 GPa) within the mantle corner flow (Nimis and Morten, 2000).

The newly formed garnet occurs as exsolution within porphyroclastic, high-T pyroxenes, and crystallises along the pyroxenite and peridotite foliation.

Textural evidence and crystallographic orientation data indicate that the transition from spinel- to garnet-facies conditions was assisted by intense shearing and deformation. Pyroxene porphyroclasts in garnet clinopyroxenites show well-developed crystallographic preferred orientation (CPO), high frequency of low-angle misorientations, and non-random distribution of the low-angle misorientation axes. These features indicates that pyroxene porphyroclasts primarily deform by dislocation creep on the (100) [010] slip system. Dislocation creep is accompanied by subgrain rotation recrystallisation, which promotes the formation of new, smaller and equant pyroxene grains around porphyroclasts. The grain size reduction promotes a switch in the deformation mechanism from grain-size insensitive creep (i.e. dislocation creep) in the porphyroclasts to grain-size sensitive (GSS) creep in the small recrystallised grains. The switch from dislocation to GSS creep is accompanied not only by grain size reduction of pyroxenes, but also by the formation of garnet exsolutions in pyroxenes and garnet crystallisation along foliation. We suggest that garnet crystallisation triggers the pinning of the recrystallised matrix, stabilising the fine-grained microtexture for GSS creep process, and finally contributes to the rheological weakening of pyroxenites.

Pyroxenites and peridotites of Ulten Zone thus offer a unique opportunity to investigate the

effects of mantle deformation and weakening on the processes that control the material exchange between crust and mantle at subduction zones.

Morten, L., & Obata, M. (1983). Bulletin de Minéralogie, 106(6), 775-780.

Nimis, P. & Morten, L. (2000). Journal of Geodynamics, 30(1-2), 93-115

Obata, M., & Morten, L. (1987). Journal of Petrology, 28(3), 599-623.