Geophysical Research Abstracts
Vol. 15, EGU2013-10911, 2013
EGU General Assembly 2013

Evolution of quartz microstructures and textures during thrusting of the Kalak nappe complex

Sina Marti (1), Nicola Kern (1), Holger Stünitz (2), Rüdiger Kilian (1), Renée Heilbronner (1), and Luca Menegon (3)

(1) Department of Environmental Sciences, Basel University, Switzerland (sina.marti@stud.unibas.ch), (2) Department of Geology, Tromsø University, Norway, (3) Department of Earth Sciences, Plymouth University, U.K.

The Kalak nappe of Northern Norway shows penetrative Caledonian shear deformation related to the Scandian collison. Deformation took place under retrograde metamorphic conditions of amphibolite to greenschist facies and locally preserved low strain lenses show relics of pre-Caledonian granulite facies assemblages. Thus, the Kalak nappe represents a detached segment of pre-Caledonian lower crust.

Along the E6 at Langfjord and Altafjord south of the Seiland Igneous Province, a transect through the lower part of the Kalak nappe and the contact to the underlying parautochthonous (PA) unit is studied. While the Kalak units consist of metapelites, mafics, metapsammites, and metagranitoids, the PA units consist largely of low grade micaschists and carbonates.

We analyzed dynamic quartz microstructures and textures in conjunction with the metamorphic gradient from the PA across the thrust into higher nappe units. From the structurally higher units down towards the thrust contact, dominant recrystallization mechanisms change from grain boundary migration recrystallization (GBM) to grain boundary migration accompanied with subgrain rotation recrystallization (GBM+SGR) to subgrain rotation recrystallization (SGR). Corresponding mean recrystallized grain sizes decrease from $\sim$ 340 μm (GBM) to $\sim$ 180 μm (GBM+SGR) to $\sim$ 60 μm (SGR). In the lowest grade rocks, domains are found where SGR recrystallization overprints an earlier GBM microstructure. Changes in quartz [c]-axis pole figures accompany the change in dominant recrystallization mechanism from distinct maxima in the y-direction for the GBM regime to peripheral maxima (with large angles to the foliation) in the SGR regime.

Together with the fabric changes, the Kalak nappe shows a retrograde metamorphic evolution from $\sim$ 700 to 570 $^{\circ}$C, 1.2 to 0.9 GPa and dominant GBM recrystallization to GBM+SGR at $\sim$ 580 - 500 $^{\circ}$C, 1 to 0.9 GPa to dominant SGR below 500 $^{\circ}$C, 0.7 GPa and increasing strain localization during nappe thrusting.

Within the PA the dominant recrystallization mechanism is SGR (recrystallized grain sizes $\sim$ 60 - 40 μm). Temperatures increase from $\sim$ 340 to 440 $^{\circ}$C towards the thrust. Pressures are at 0.5 – 0.7 GPa.

Along the metamorphic gradient from higher units in the Kalak nappe down to the base of the PA, calculated flow stresses increase with decreasing temperatures from $\sim$ 8 MPa (GBM) up to $\sim$ 70 MPa (SGR), but calculated strain rates remain in the range of 10^{-13} - 10^{-12} s^{-1}(flow law of Hirth et al., 2001).

Microstructures such as overprinted fractures indicate a prograde path for the PA, whereas overprinting microstructures and changes in CPO indicate a retrograde path for the Kalak nappe.

References:

Hirth, G., Teyssier, C., Dunlap, W.J., 2001. An evaluation of quartzite flow laws based on comparisons between experimentally and naturally deformed rock. Int. Journal of Earth Sciences 90 (1), 77-87.