Geophysical Research Abstracts,
Vol. 11, EGU2009-12342-1, 2009
EGU General Assembly 2009

Microstructural and textural evidences for mechanisms of grainsize reduction during syn-kinematic K-, Na- and Si- metasomatism in mylonites from the Paleoproterozoic granitic mylonites in the Loftahammar-Linköping Deformation Zone (SE-Sweden)

S. Cao (1,2), A. Vollbrecht (1), B. Leiss (1), J. Liu (2), and A.M Kerkhof (1)

(1) Geoscience centre(GZG),University of Goettingen, Goettingen, Germany (scao@gwdg.de) , (2) State Key Laboratory of Geological Processes and Mineral Resources (GPMR), China University of Geosciences, Beijing 100083, China

The "Loftahammar-Linköping Deformation Zone" (LLDZ) in SE-Sweden is a prominent NW-SE striking dextral transpression zone within the Paleoproterozoic of the Baltic Shield. Amphibolite to greenschist facies ductile deformation within the LLDZ affected different kinds of felsic and mafic rocks and generated a wide variety of mylonites. "Augen mylonites" with intensive deformation shown by e.g. complex polyphase folding, extreme boundinage of mafic layers and intensive dynamic recrystallization are characteristic of the deformation zone. The mylonites are macroscopically characterized by fine-grained dark matrix containing pink feldspars, which display extreme variations of ductile deformation ranging from nearly undeformed coarse-grained megacrysts, over porphyroclasts with recrystallized rims and tails, to completely recrystallized aggregates or fine-grained ribbons. Different criterias (e.g. sigmoidal- and delta- porphyroclasts) from the mylonites consistently indicate bulk dextral shearing along the deformation zone.

Metasomatism microstructures are widely distributed in the mylonites. An early K-metasomatism is indicated by widespread distribution of left-over grains of plagioclase in the marginal zones of the K-feldspar megacrysts. Optically, the relics have similar preferred crystallographic orientations, indicative of their origin from the same parent grain. On the other hand, the outermost rims of the megacrysts are subsequently replaced by sodium-rich plagioclase, e.g. albite. The widespread occurrence of myrmekite along the rims of the megacrysts and in in the matrix implies the importance of Na-enriched replacement. Such replacement results in a large amount of fine plagioclase grains in the matrix. The Na-metasomatism is also proven by microprobe mapping and cathodoluminescence variations of the different parts of megacrysts and matrix grains. Si-metasomatism is suggested by the occurrence of quartz diablastic or sieve fabrics in biotite and hornblende grains.

The mylonitc rocks are formed due to high temperature shearing which is indicated by the following characteristics. 1) Quartz grains have irregular grain boundaries implying strong grain boundary migration. 2) Feldspar grains occur as deformed relics in fine grained matrix. The latter is either due to dynamic recrystallization or, in addition, myrmekite generation due to metasomatic replacement. Most of the porphyroclasts show microstructures indicative of intensive crystalline plasticity, e.g. undulose extinction and twinning. Within quartz ribbons, relic grains of feldspar occur as mineral fishes, indicative of high temperature shear strain. 3) Other mineral phases also show microstructures for strong high temperature shearing. Pyroxene grains are broken down into several different minerals, including calcite, biotite, iron oxide and quartz. The latter three minerals are distributed in strain fringes of calcite aggregates.

Neutron texture measurements carried out on almost completely recrystallized fabric domains, reveal pronounced texture patterns for quartz, K-feldspar, plagioclase and biotite, which are mostly asymmetrically arranged with respect to the mylonitic foliation and lineation. In accordance with the observed macrostructures, these asymmetries point to a complex polyphase deformation history with varying orientations of the kinematic axes. The type of textures for both quartz and feldspars point to dominant slip systems that are attributed to high-temperature deformation regimes.

Dynamic recrystallization is the dominant process for the occurrence of the fine grained matrix. Some of the fine grains are, however, generated by synkinematic K-, Na- or Si- metasomatism. Amongst them, Na-metasomatism is the most important process that forms the widespread distribution of fine grains of myrmekites in the matrix.

For the related metasomatic fluids possible external and internal sources have to be considered. At regional scale, K-, Na-rich fluids were possibly produced in meta-siliciclastica of the nearby Västervik Formation by a metasomatic replacement of feldspars by quartz (Vollbrecht & Leiss 2008). Due to the continuous deformation, the LLDZ probably formed an open system for these fluids. Internal sources for short-range mass transfer can be deduced from replacement reactions at microscale described above (e.g. mobilization of K^+ from the replacement of biotite by quartz and generation of silica by break-down of pyroxene). Taking all replacement features into account, a multiphase influx of fluids of varying compositions has to be assumed with a tendency from early K- to late Na- predominance.