The Importance Of Displacive And Replacive Reactions For Transport Of Fluids And Matter Through Rocks

Håkon Austrheim[1]*, Ane K. Engvik[2], Morgan Ganerød[2] and Mari Roen Velo[1]

[1]PGP, Department of Geosciences, University of Oslo, 0317 Oslo, Norway

[2]Geological Survey of Norway, 7491 Trondheim, Norway

*h.o.austrheim@geo.uio.no

Abstract

The Kongsberg-Bamble sectors of SE-Norway are known as classical high grade metamorphic terrains that have undergone extensive metasomatism with formation of albitites and scapolite rich rock and a number of previously economic important ore deposits including the Kongsberg Silver- and the Modum Cobalt mines. We demonstrate here that the central part of the Bamble sector (Kragerø area) has locally developed low grade metamorphic minerals (prehnite, pumpellyite, analcime and thompsonite) belonging to the prehnite pumpellyite and zeolite facies. Structurally the low grad minerals are found both as fracture fills and in the alteration selvages around fracture where the rock is albitised. The fracture fill and the alteration selvages vary from mm to 1 m in thickness and make a high angle with the regional foliation typically with a horizontal orientation. The fractures with low grade minerals are part of larger fracture systems. The low grade minerals are mostly formed in two textural settings or in a combination of these: 1) together with albite, k-feldspar, quartz, epidote and hydrogrossular as lenses along 001 faces in phlogopite and chlorite leading to bending of the sheet silicates through a displacive reaction mechanism 2) by numerous replacement reactions including the earlier minerals as well as the low grade minerals. As albite, k-feldspar, talc, quartz, actinolite, titanite, calcite and hydrogrossular are found in the same veins and in the same phlogopite grain as the classical low grade mineral it is suggesting that they belong to the low grade assemblage and that some of the albitisation in the region occurred at low grade conditions. Reconnaissance studies at east (Iddefjord terrain) and the northwest (Kongsberg sector) sides of the Oslo rift together with reports of low grad assemblages in south eastern Sweden along the continuation of the rift into Skagerak suggest that the low grade assembles occur in rocks adjacent to the Oslo rift along its full extent. Ar-Ar dating of K-feldspar from the low grade assemblage gave an age of 265.2 ± 0.4 Ma (MSWD = 0.514 and P = 0.766) suggesting that the low grade metamorphism is induced by fluids and heat from the magmatic activity of the Permian Oslo rift which require transport of fluid over distances of several kilometres. The displacive reactions created micro fractures in the adjacent minerals and porosity that enhance fluid flow and low grad minerals formation on a local scale. On a thinsection scale the displacive growth of albite in biotite results in a local volume increase of several 100 %.Whether the displacive reactions played an active role in the formation of the shoulder of the Oslo rift remainunknown.