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Implications of metasomatism for geochronology and P-T estimates: evidence from the Western Gneiss Region (WGR), Norway

J. C. Vrijmoed and H. Austrheim

Physics of Geological Processes, University of Oslo, Oslo, Norway (j.c.vrijmoed@fys.uio.no / Fax: (+47) 22 85 51 01 / Phone: (+47) 22 85 69 26)

Pressure (P) – Temperature (T) estimates and geochronology are used to constrain geodynamic models of metamorphic terrains. In metamorphic rocks we can assume that minerals in contact are in equilibrium. In metasomatic systems where minerals are grown from a fluid by dissolution-precipitation mechanisms this assumption may need re-examination.

The orthopyroxene-eclogites of the WGR ultra-high pressure (UHP) terrain has previously been shown to have elevated initial $^{87}Sr/^{86}Sr$ ratios (Griffin and Brueckner, 1985), suggesting open system behaviour. We document here that the Svartberget garnet peridotite (Fe-Ti type) is strongly metasomatised with initial $^{87}Sr/^{86}Sr$ ratios ranging from 0.723 in the least altered rock to 0.735 for the most altered rock. Like many of the (ultra-) mafic bodies of the WGR the Svartberget body contains garnetite veins, which in this case are part of a conjugate set of fractures. Along these fractures a metasomatic column developed, dominated by garnet-websterite and garnetite. Based on detailed mapping eleven different metasomatic zones can be recognized. From wall rock to core these are: 1) olivine-garnet websterite 2) clinohumite bearing olivine-garnet websterite 3) coarse grained phlogopite-orthopyroxene-garnet websterite 4) coarse-grained phlogopite clinopyroxene-garnet websterite 5) phlogopite garnet-websterite 6) garnet-websterite 7) inclusion rich garnetite 8) garnetite 9) amphibolite 10) clinopyroxene-plagioclase rock 11) plagioclase-amphibole pegmatite.

In the least altered part olivine forms a network and the texture suggest that it is a

remnant from what once was a more olivine rich rock. Garnet is veined with small but significant and abrupt differences in Fe-Mg contents. Olivine disappears towards the garnet veins and is probably consumed by the reaction with the infiltrating fluid to form pyroxenes. Orthopyroxene formed during reaction between olivine and a metasomatising fluid will have its composition including Al content controlled by the fluid composition. Due to the different solubilities of minerals the different minerals may precipitate at different time. If no significant re-equilibration between minerals in contact took place, these minerals can not be used directly in standard P-T calculation. In the case of Svartberget abrupt compositional changes in the garnet suggest limited re-equilibration. Sm-Nd garnet-clinopyroxene isochron ages yield 381 $\pm$ 6 Ma and 393 $\pm$ 3 Ma, for the fracture and wall rock respectively. These ages are usually taken as cooling ages. This is in conflict with the lack of diffusion suggested by the abrupt changes in garnet composition. These ages may either represent the timing of the metasomatic event or be meaningless. The recognition that the peridotites are altered by metasomatism gives reason to re-examine the meaning of a) standard P-T estimates b) Sm-Nd mineral ages, both important input parameters in the existing geodynamic models for the WGR.

Griffin, W. L. and Brueckner, H. K., 1985. Ree, Rb-Sr and Sm-Nd Studies of Norwegian Eclogites. *Chemical Geology,* **52**, 249-271.