European Mineralogical Conference
Vol. 1, EMC2012-638, 2012
European Mineralogical Conference 2012

P-T pseudosection modelling of trondhjemitic gneiss layers within Ky-eclogite from the Caledonian Uppermost Allocthon; Northern Norway

E.J.K. Ravna and P Nasipuri
Department of Geology, University of Tromsø, Norway (pritam.nasipuri@uit.no)

The estimation of pressure-temperature (P-T) conditions of rocks is of fundamental importance for understanding the tectonic processes and large-scale vertical movement of crustal material. P-T conditions can be obtained by applying equilibrium thermodynamics of balanced reactions (classical thermobarometry) or by P-T pseudosection analysis. The application of classical thermo-barometry is dependent on the chemical composition of the observed mineral assemblage. The complete consumption of one or all of the reactant mineral phases also makes it difficult for the application of classical thermobarometry to reconstruct P-T paths. On the other extreme, P-T pseudosection analysis is considered as a convenient tool to document the stable mineral assemblages at different parts of a P-T path. In this contribution we discuss the mineral equilibrium and possible P-T path from the trondhjemitic gneiss from the UHPM Caledonian Uppermost Allochthon, Tromsø, Norway.

The large ($\sim$0.4 km^3) eclogite body at Tromsdalstind, Tromsø contains interlayered bands of amphibolite and trondhjemite. The eclogite and the inter-layered trondhjemite are both cut by granitic and plagioclase-amphibole rich pegmatites. Ky-eclogite is common in the upper part of the body, and Grt-Cpx-Phe-Ky-SiO_2 thermobarometry gives maximum P conditions of 3.0-3.5 GPa at $\sim$750 ˚C. The trondhjemitic rocks consist mainly of plagioclase, quartz, garnet, clinopyroxene and rutile. Locally, minor kyanite, phengite and amphibole are observed. Garnet (X_{Mg} =0.19-0.22, X_{Ca}= 0.11-0.17) porphyroblasts with inclusions of feldspar and quartz indicate the prograde pre-peak P mineral assemblage. Local domains of vermicular omphacitic clinopyroxene (Na_2O up to 6.15 wt%, Al_2O_3 up to 6.21 wt%) and sodic plagioclase indicate that a highly sodic primary omphacite have been present in the rock, pointing to an isothermal decompression from the omphacite stability field. Locally, amphibole overgrows this lower Na-Al Cpx, and staurolite and biotite overgrow garnet. In the absence of suitable mineral assemblages, the Grt-Cpx Fe-Mg exchange thermometer cannot be used to constrain the initial and peak P-T condition.

P-T pseudosection analysis using the whole rock chemical composition of the trondhjemitic layer indicate that Opx (X_{Mg} = 0.34, 10 vol%) is stable with plagioclase (X_{Ca}=0.14) at T >950 ^{0}C and P < 0.5-0.6 GPa with minor ilmenite and quartz. Garnet appears in the rock due to increase in pressure principally by consuming orthopyroxene. The mineral composition of the garnet (X_{Ca}=0.12, X_{Mg}=0.22) indicate that the rock has experienced an increase of pressure up to $\cong$3.5 GPa at 750-800^{0}C. The P-T pseudosection also predicts the presence of 40-45 vol% jadeitic omphacite (Na_2O up to 13 wt%) at the eclogite facies P-T conditions, indicating the breakdown of sodic plagioclase to jadeite and quartz. The retrograde path is marked by the formation of lower-Na Cpx (Na_2O = 8 wt%) and sodic plagioclase at $\sim$700^{0}C and 1.6 GPa pressure. A P-X(H_2O) pseudosection indicate that growth of amphibole occurs at the same P-T conditions due to influx of water. The anti-clockwise P-T path of the trondhjemitic gneiss is consistent with the P-T path and mineral reactions recorded from the adjoining eclogites.

P-T pseudosection indicates the presence of orthopyroxene and omphacite in the initial and peak pressure assemblage respectively, although no orthopyroxene or omphacite has been found in the rock. This study indicates the usefulness of P-T pseudosection analysis complimentary to classical thermobarometry for the reconstruction of P-T paths, where some of the mineral phases have been consumed due to complete reactions.