



Metamorphic constraints on the Caledonian Upper Allochthon of Central Norway – the Gula Complex staurolite-garnet-kyanite mica schist

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Petrological studies of staurolite-garnet-kyanite-biotite schist and garnet-muscovite schist of the Gula Complex provide constraints on the metamorphic evolution of the Caledonian Upper Allochthon in the eastern Trondheim Region, Central Norway. The biotite schist contains conspicuous porphyroblasts of Fe-rich staurolite ($Mg\# = 0.21-0.24$), garnet ($Alm_{64-71}Prp_{13-19}Grs_{3-11}Sps_{7-20}$) and kyanite, set in a fine-grained, well foliated matrix of biotite ($Mg\# = 0.57-0.62$), quartz, minor plagioclase (An_{19-31}) and locally muscovite. The muscovite schist is fine to medium grained with a muscovite-quartz dominated matrix, including garnet ($Alm_{54-70}Prp_{10-14}Grs_{12-25}Sps_{1-11}$), biotite ($Mg\# = 0.56-0.57$), minor plagioclase (An_{31-45}) and clinozoisite.

P-T modeling based on thermobarometric calculations and construction of P-T pseudosections illustrates that significant mineralogical heterogeneity in the high grade mica schists arise from only modest geochemical heterogeneities in the original pelitic rocks. Based on garnet \pm staurolite \pm kyanite \pm muscovite + biotite + plagioclase + quartz-assemblages, peak metamorphism reached 680 °C with pressures estimated to 1.01 \pm 0.11 GPa for the garnet-muscovite schist, and 0.86 \pm 0.12 GPa for the staurolite-garnet-kyanite-biotite schist. A clockwise P-T path is constrained by secondary mineral reactions; the replacement of kyanite to fibrous sillimanite indicates decompression below 0.65 GPa at elevated temperatures. Growth of foliation-parallel chlorite reflects cooling below 640 °C. Chlorite formation proceeded during cooling and decompression towards 550 °C and 0.4 GPa. Peak metamorphic conditions are associated with a strong N-S trending regional foliation, and the initial uplift continued within the same strain regime. The documented high grade metamorphism and subsequent decompression and retrogression of the Gula Complex metapelites prevailed during the mid-Silurian continent-continent collision and Caledonian burial and exhumation of the Upper Allochthon in Central Norway.