

Regional vs. anorthosite-related contact metamorphism of granulite facies paragneisses of the Rogaland sector, Norway: evidence from calculated PTX phase diagrams

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Paragneisses are exposed in the proximity of the Rogaland Complex, Norway. The rocks underwent regional metamorphism during the Sveconorwegian orogeny (M1; c. 6-8 kbar, 700-800°C; Jansen et al., 1985) at c. 1000 Ma (Möller et al., 2002), prior to the intrusion of the anorthosite massif at c. 930-920 Ma (Schärer et al., 1996). An up to 20 km wide contact-thermal aureole is proposed to surround the Rogaland Complex (M2; c. 3-5 kbar, 750-1000°C; Jansen et al., 1985).

Rocks were sampled along a N-S trending profile, 3-20 km from the intrusive contact with the anorthosite, inside (< 4 km) and outside the osumilite isograd. Migmatitic paragneisses occur as discontinuous layers in Grt-bearing charnockites (820 ± 70°C, 6.5 ± 0.5 kbar). Geothermobarometry combined with calculated PTX phase diagrams in the Na₂O-CaO-K₂O-FeO-MgO-Al₂O₃-SiO₂-H₂O (NCKFMASH) system allowed to model the mineral reaction history and detailed P-T paths of the metapelites. For samples outside the osumilite isograd clockwise P-T paths are constrained, with very similar peak-conditions as calculated for the orthogneisses. In the metapelites early biotite and sillimanite were partially replaced via melt-producing reactions by garnet-K-feldspar assemblages during heating to peak-conditions of c. 850 ± 50°C / 6.8 kbar. Decompression to P < 6 kbar led to the formation of cordierite. Cooling to T < 700°C is recorded by the replacement of garnet by biotite. A Grt-Opx gneiss, 5 km distant to the anorthosite, displays a similar clockwise P-T path, but higher peak-temperatures, testifying to a local disturbance of the regional geotherm. In this sample porphyroblastic garnet is replaced by peak-metamorphic Opx (Al₂O₃: 8.3-8.9 wt.%) - Spl-Pl symplectites during near-isobaric heating to UHT conditions of c. 950 ± 50°C / 6.8 kbar. Decompression to 4.5 kbar/900°C is recorded by the subsequent growth of cordierite. Cooling to T < 600°C led to a re-growth of garnet around spinel and orthopyroxene. Osumilite gneisses, sampled in 3 km distance to the anorthosite, record a distinct P-T path. The peak-assemblage of garnet, orthopyroxene (Al₂O₃: 7.1-8.4 wt.%), and osumilite formed at lower temperatures of 850-900°C and lower pressures of < 5 kbar, compared to the nearby Grt-Opx gneiss.

The deduced clockwise P-T paths and consistent peak conditions of 820 ± 70°C, 6.5 ± 0.5 kbar of rocks sampled outside the osumilite isograd suggest that the granulite facies assemblage formed through regional metamorphism during the Sveconorwegian orogeny at c. 1000 Ma. Osumilite samples from inside the isograd, on the other hand, display peak-conditions of c. 850-900°C at < 5 kbar which are related to a contact-thermal overprint during the intrusion of the Rogaland Complex at 930-920 Ma.

References

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