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Meso- and Neoproterozoic thermotectonic evolution of south-western Baltica: Insights from P/T studies, U-Pb zircon geochronology and $^{40}Ar/^{39}Ar$ thermochronology

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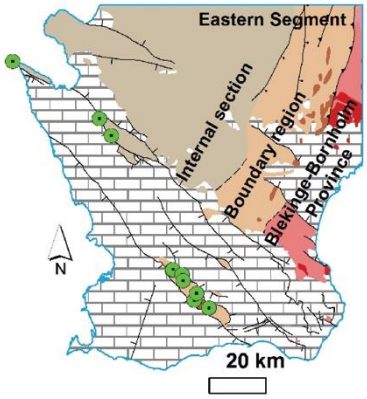
The southernmost exposures of the Baltic Shield in Sweden include the Blekinge-Bornholm Province, reworked during the 1.47-1.38 Ga Hallandian orogeny, and the Sveconorwegian Province, reworked during both the Hallandian and the 0.99-0.92 Ga Sveconorwegian orogeny. Protoliths are mainly igneous rocks formed at 1.7 Ga, 1.5-1.4 Ga and 1.2 Ga.

This study covers a transition from the internal section of the Eastern Segment of the Sveconorwegian Province and its boundary region to the Blekinge-Bornholm Province. The internal Eastern Segment is dominated by granitic to quartz-monzonitic, variably migmatitic gneiss and garnet amphibolite, as well as metagabbroic layers and lenses. This part was deformed and metamorphosed at upper amphibolite to high-pressure granulite facies conditions, at 0.98-0.97 Ga. The boundary region is dominated by granitic gneisses and partly well-preserved granitic to syenitoid metaintrusions, subordinate paragneisses, and amphibolite layers and lenses. It experienced lower amphibolite or greenschist facies metamorphism only during the Sveconorwegian orogeny. Hallandian upper amphibolite facies metamorphism affected both the internal Eastern Segment and the boundary region at 1.47-1.44 Ga.



In the boundary region, U-Pb SIMS analysis of zircon show that paragneiss and young granite contain complex zircon with inherited 1.70 Ga igneous cores and high-U secondary rims and single grains, the latter dating metamorphism and associated granitic magmatism at 1.45 Ga. The zircon system shows no signs of Sveconorwegian reworking. Petrography, bulk and mineral geochemistry and pseudosection modelling of the paragneisses show that they underwent prograde staurolite-sillimanite-grade metamorphism reaching granulite-facies temperatures (700-750°C) at low pressure (4-5 kbar), with the formation of Crd + Sil + Grt + K-fsp + Ilm + Melt ± Bt. The rocks followed a clockwise P-T path. Later stages involved the formation of Sil + Bt at the expense of Grt and Crd. Local low-temperature and fluid-assisted retrogression also caused the formation of Chl and Ms at the expense of Crd. The P-T evolution demonstrates burial and exhumation in a high T/P environment, with coeval granitic magmatism, suggesting an accretionary orogenic setting for the Hallandian event.

Hornblende, biotite and muscovite from different rocks along a 130 km NW-SE traverse over the internal section and the boundary region record consistent $^{40}Ar/^{39}Ar$ ages of biotite and muscovite, ranging from 900 to 890 Ma. In the NW, hornblende ages are similar to the biotite and muscovite ages. To the SE, however, Sveconorwegian hornblende ages are lacking and instead disturbed heating spectra with ill-defined plateaus 1500-1300 Ma are recorded. One hornblende sample gave a $^{40}Ar/^{39}Ar$ plateau age of 1387±4 Ma. Also biotite in amphibolite records older ages, ≥ 1100-1000 Ma. The 900-980 Ma $^{40}Ar/^{39}Ar$ ages in the west reflect cooling after the Sveconorwegian orogeny. The older ages in the boundary region are interpreted to reflect Hallandian metamorphism and incomplete resetting associated with low-grade Sveconorwegian metamorphism.