



Onset of the Sveconorwegian orogeny: 1220-1130 Ma bimodal magmatism, sedimentation and granulite-facies metamorphism

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The Grenville orogen of Laurentia and the Sveconorwegian orogen of Baltica are generally interpreted as long-lived, hot, collisional orogens resulting from collision of a possibly joined Laurentia-Baltica margin with another major plate, possibly Amazonia. Here we report new mapping, petrologic and SIMS U-Pb geochronological data from S Norway, to address the pre- to early-Sveconorwegian evolution between 1220 and 1130 Ma. The Sveconorwegian belt includes from west to east the Telemarkia terrane characterized by 1520-1480 Ma magmatism and the Idefjorden terrane characterized by Gothian active margin 1660-1520 Ma magmatism. The Idefjorden terrane is thrusted eastwards onto the parautochthonous Eastern Segment. The Kongsberg and Bamble are two small terranes between the Idefjorden and Telemarkia terranes. They have a strong N-S and NE-SW structural grain, respectively, and are thrust westwards on top of the Telemarkia terrane. Basement metavolcanic and metaplutonic rocks in the Kongsberg terrane range from c. 1534 to 1500 Ma (5 new samples) and in Bamble from c. 1572 to 1460 Ma, overlapping with both the Telemarkia and Idefjorden terranes.

New and published data show the following: (1) In Telemark, a c. 1200 Ma granitoid from the Flåvatn complex and a c. 1195 Ma granite sheet in the bimodal Nissedal supracrustals demonstrate that 1220-1180 Ma comparatively juvenile magmatism is the dominant rock type over much of southern part of Telemark. (2) A rhyolite dated at 1155 Ma complement available data showing low grade bimodal mafic-felsic volcanism interlayered with immature clastic sediments in central Telemark between 1169 and 1145 Ma (the ex-Bandak group). These supracrustals are intruded by c. 1153-1144 Ma A-type granite plutons. (3) Ten samples of foliated commonly porphyritic granitoid and one granite dyke in gabbro collected in Kongsberg and along the Kongsberg-Telemark boundary demonstrate that c. 1171-1147 Ma bimodal plutonism occurred in Kongsberg. This indicates that Kongsberg was linked to Telemarkia, before 1147 Ma and before their final tectonic juxtaposition. A similar pattern is known between the Bamble and Telemarkia terranes, indicating similar relations. (4) The classical medium pressure granulite-facies metamorphism in Tromøy-Arendal, Bamble, was redated. Three granulite samples show metamorphic zircon at 1147 +/- 18 and 1132 +/- 7 Ma. Protolith ages between c. 1553 and 1544 Ma demonstrate a Gothian low-K calc-alkaline orthogneiss protolith and question recent interpretations representing the Tromøy complex as an early Sveconorwegian oceanic volcanic arc accreted to the Bamble terrane. (5) A granulite-facies domain was discovered north of Kragerø in Bamble, in an area generally assigned to amphibolites-facies metamorphism. Geothermobarometry and pseudosection calculation using the Grt +Opx +/-Cpx +Pl +Qtz assemblage yield an estimate of about 1.15 GPa and 800°C for peak granulite facies metamorphism. Late clinopyroxene and garnet zoning are consistent with an anticklockwise P-T path and suggest magma loading and heating of the crust. Soccer ball zircon dates this metamorphism at 1144 +/- 6 Ma. (6) C. 1193-1183 Ma A-type granite plutonism is reported in the Caledonian Middle-Allochthon Risberget Nappe and c. 1221-1204 Ma syenite plutons are known along the Sveconorwegian Frontal Deformation Zone. C. 1220-1130 Ma magmatism is however entirely lacking in the Idefjorden terrane.

Using these constraints, we envisage the 1220-1130 Ma pre- to early-Sveconorwegian event in a trans(?)-tensional continental setting at the margin of Baltica, before final continental collision. The Telemarkia terrane was possibly located in a back arc position above an east dipping subduction system. Abundant magmatism is possibly a consequence of subduction of an oceanic ridge. Inversion took place after 1130 Ma leading to westwards thrusting of the Bamble and Kongsberg terranes.