
Pressure, temperature and time constraints on tectonic models for southwestern Sweden

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Abstract

In this work, a number of key localities have been investigated in detail in order to provide precise constraints on models for the tectonic evolution of southern Sweden. The new data presented in this thesis show that there are large differences in terms of pre-Sveconorwegian tectonic evolution between the Eastern and Median-Western Segments situated on either side of the Mylonite Zone, a major shear zone as well as a structural and lithological boundary. This has a direct influence on the possible tectonic scenarios that can be suggested when reconstructing the formation of the south-western part of the Fennoscandian Shield.

At Viared in the central Eastern Segment, Sveconorwegian eclogite facies metamorphism is dated at 0.97 Ga using mainly U-Pb on zircon. This is similar to other localities showing high-pressure granulite or eclogite facies metamorphism in the Eastern Segment and suggests that this high grade event was a regional feature east of the Mylonite Zone.

On the well exposed Nordön Island in the Western Segment, both pre-Sveconorwegian and Sveconorwegian metamorphism and deformation was dated using several isotope methods, including U-Pb SIMS zircon and Sm-Nd garnet dating. In the Median Segment, veining was dated using U-Pb SIMS zircon methods. In addition to age determinations, thermobarometry was done on several samples and the results compared with published data. The results show that Sveconorwegian peak metamorphism reached amphibolite to granulite facies west of the Mylonite Zone at 1.02-1.04 Ga. This is 50-70 Ma before the orogenic activity started in the Eastern Segment.

In the central Eastern Segment, Pre-Sveconorwegian veining is dated at 1.42 Ga, thus belonging to the 1.42-1.46 Ga Hallandian veining found elsewhere in the Eastern Segment. Pre-Sveconorwegian veining and isoclinal folding in the Western Segment is dated at 1.55 Ga. Neither the 1.55 Ga nor the 1.02-1.04 Ga events have been found in the Eastern Segment. Further, the 1.42-1.46 Ga veining event documented in the Eastern Segment has not been found in the Western or Median Segments. Only a few 0.97 Ga zircon U-Pb ages have been found in the Western and Median Segments west of the Mylonite Zone. In the Western Segment, Ar-Ar dating of muscovite related to late Sveconorwegian uplift gives 981 ± 4 Ma, interpreted to reflect the crystallization of muscovite below 400 °C. This indicates that the Western Segment already was exhumed at the time when the Eastern Segment experienced its Sveconorwegian high-pressure peak metamorphism.

Additionally this work shows that there is an age difference between the 1.34 Ga Askim, the 1.30 Ga Göta and 1.31 Ga Kärra granites west of the Mylonite Zone and the 1.38-1.40 Ga granites and monzonites east of the Mylonite Zone, thus disproving the previous concept of “stitching granites” that was used as an argument for a pre-Sveconorwegian correlation between the Eastern and Western Segments. The differences in pre-Sveconorwegian history between the segments east and west of the Mylonite zone suggest that the zone originally formed as a Sveconorwegian first order crustal suture. However, no ophiolites have been found along the zone and no calc-alkaline magmatism related to subduction of oceanic crust slightly before 0.97 Ma has yet been documented. If such features were found it would strengthen the idea that the Mylonite Zone is a crustal suture, however their lack does not preclude it.

Geothermobarometry on retrograde eclogite facies rocks exposed at Viared indicates that those rocks experienced metamorphic conditions of 15.0–16.7 kbar at temperatures of 719 to 811°C. The equivalent burial depth of ~50 km is compatible with metamorphism in a subduction setting. The partial preservation of a high pressure paragenesis indicates rapid exhumation after burial. A two-dimensional model involving continental subduction of the Eastern Segment is proposed to explain the cycle of eclogite and high-pressure granulite facies that took place during the ~0.97 Ga Falkenberg phase of the Sveconorwegian Orogeny.

Keywords: Sveconorwegian, Gothian, Hallandian, U-Pb zircon ion probe dating, Sm-Nd garnet dating, thermobarometry, continental subduction, Eastern Segment, Median Segment, Western Segment