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The Mesoproterozoic Hallandian event
- a region-scale orogenic event in the Fennoscandian Shield

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ABSTRACT

The Sveconorwegian Province occupies the southwestern part of the Fennoscandian Shield. The easternmost tectonic unit of the Province is the 1710-1660 Ma parautochthonous Eastern Segment, which bears the imprint of at least two metamorphic events; the 1460-1380 Ma Hallandian and the 1150-970 Ma Sveconorwegian. However, the nature and extent of the Hallandian event have been difficult to access due to the Sveconorwegian, effectively masking earlier metamorphic assemblages, structures and relations between rock units.

This thesis aims to characterize the Hallandian event by investigating pre-Sveconorwegian deformation and metamorphism in an area of the Eastern Segment that largely escaped later Sveconorwegian reworking. These results are then considered in a regional perspective and related to ~1.45 Ga magmatism and metamorphism observed elsewhere in Fennoscandia. Considering the compiled data from this time period, it now appears that the Hallandian event indeed was a true orogenic event that affected a large portion of the Fennoscandian Shield.

In the study area, located within the Protogine Zone in the eastern part of the Eastern Segment near Jönköping, Sveconorwegian reworking is restricted to discrete, N-S trending shear-zones. Between these shear-zones, structures, mineral assemblages and geochronological information from pre-Sveconorwegian events are preserved. The first paper provides field, mineral and chemical characteristics, as well as a baddeleyite U-Pb crystallization age of 1455±6 Ma for the Jönköping Anorthositic Suite which is abundant across the study area as small intrusive bodies. In these plagioclase-porphyritic and equigranular anorthositic rocks, deformation is restricted to thin, E-W-trending shear-zones. In the second paper we investigate the deformed country-rocks and date metamorphism and the development of the E-W to SE-NW trending gneissic fabric at 1450-1400 Ma, using U-Pb secondary ion mass spectrometric (ion probe) analysis of complex zircons. The folding event is bracketed between 1440 and 1380 Ma, corresponding to the ages of leucosome formation and the emplacement of a cross-cutting aplitic dyke. In the third paper, the gabbroic Moslätt dolerites are dated at 1269±12 Ma using the U-Pb system in baddeleyite. These have well-preserved magmatic parageneses in contrast to nearby metamorphosed mafic dykes of the 1450-1420 Ma Axamo Dyke Swarm. This precludes the Sveconorwegian event from having caused amphibolite facies metamorphism in the area. In the fourth paper, the first estimate of Hallandian pressure and temperature conditions is obtained from mineral assemblages in one of the E-W-trending shear-zones. Pressure-temperature estimates and hornblende microtextures collectively suggest deformation under conditions of 7-8 kbar and 500-550°C. In the fifth paper we constrain the age of the gneissic fabric in the granitoid country-rock at around 1422 Ma by dating a member of the syn-kinematic felsic Axamo dykes, using the U-Pb ion probe technique. It is suggested that the mafic and plagioclase-porphyritic members of the Axamo Dyke Swarm were emplaced coeval with the Jönköping Anorthositic Suite.

This thesis is the first contribution which recognizes the Hallandian as a regional scale orogenic event, acknowledging all the major features of that age in the Fennoscandian Shield. These features include ~1460 Ma rifting, deposition of clastic sediments and extrusion of continental basalts in central Fennoscandia, 1460-1440 Ma emplacement of I- to A-type granitoids in southern Fennoscandia, 1450-1420 Ma deformation and metamorphism in southern Sweden and on Bornholm, and 1410-1380 Ma post-kinematic pegmatite dykes and intrusions of granite, monzonite and charnockite in the Eastern Segment.

The spatial and temporal trends of these features suggest a tectonic model in which the rifting and mafic magmatism to the north are the far-field effects of north-eastward subduction of an oceanic plate, with the subduction zone located to the southwest of present-day Fennoscandia. Collision with an unknown (micro-) continent led to crustal shortening as Fennoscandia overrode this unknown continent. Post-collisional collapse triggered decompressional melting of heated continental crust, resulting in the emplacement of post-kinematic dykes and plutons.

Keywords: Fennoscandian Shield, Hallandian orogeny, Eastern Segment, Protogine Zone, U-Pb geochronology, zircon, baddeleyite, Nd-isotopes, Hf-isotopes, tectonic model.