



The Vaasa migmatitic complex: the birth, growth and death of a thermal dome

Francis Chopin (1), Annakaisa Korja (1), Pentti Hölttä (2), Olav Eklund (3), and Osmo Tapani Rämö (1)

(1) Department of Geosciences and Geography, P.O. Box 68, FI-00014 University of Helsinki, Finland, (2) Geological Survey of Finland GTK, P.O. Box 96, FI-02151 Espoo, Finland, (3) Department of Geology and Mineralogy, Åbo Akademi University, FI-20500 Turku, Finland

The Vaasa migmatitic complex, or Vaasa dome, is cored by diatexite migmatites and S-type granitoids and gradually mantled by metatexite migmatites and mica schist with thin metabasite-andesite intercalations. Previous geochemical studies have demonstrated that the metasediments are the sources of the melted core: it has been suggested that the complex has been formed by in-situ melting of a basin.

Field work studies highlight the formation of a gently dipping metamorphic fabric with a lateral increase of the in-situ melt content towards the core of the dome (D1). This early layered and partially melted fabric is then affected by a regional N-S shortening forming km- to outcrop-scale E-W striking folds and new sub-vertical foliation (D2). Late sub-vertical shearing is visible along the dome border and within the diatexitic zone (D3). No late detachment structures have been observed.

In the metamorphic belt, the grade increases from medium-T amphibolite facies to low-P granulite facies towards the core of the dome. Pseudosections in the MnNCKFMASHTO system have been performed in one mica schist ($\text{Grt}+\text{Bt}+\text{Pl}+\text{Qz}\pm\text{Std}+\text{Sill}+\text{And}$) and one metatexite migmatite ($\text{Bt}+\text{Liq}+\text{Crd}+\text{Pl}+\text{Kfs}+\text{Grt}+\text{Qz}\pm\text{Sill}+\text{And}$). The metamorphic peaks are bracketed at 560°C at 5 kbar and 750-770°C at 4.5-5 kbar, respectively. The retrograde condition is situated at 540°C and <3 kbar for both lithologies. This implies an isobaric increase of the metamorphic grade towards the core of the dome. An isothermal decompression for the schist and a retrograde PT path for the migmatites are observed.

Existing and new U/Pb monazite ages from mica schists, migmatites and clustered at 1860–1865 Ma whereas U/Pb ages from metamorphic and magmatic zircons are older and clustered at 1875 Ma. The latter might represent the peak of melting process and associated metamorphism whereas monazite ages might be related to the cooling of the orogenic middle crust. It has to be noticed that few monazites from metamorphic rocks of the dome mantle gave ages similar to those of upper crustal pegmatites, i.e. about 1800 Ma.

The formation of the Vaasa dome might be the result of thickening during a persistent high-temperature thermal anomaly. It forms a layered middle crust with a strong lateral increase of in-situ melt (D1), followed by a regional N-S horizontal shortening (D2). The culmination of the thickening and the associated metamorphism takes place at 1875 Ma. Exhumation and concomitant cooling of the dome along subvertical shear zone is bracketed at 1860–1865 Ma. This might be correlated with the geodynamic setting of the Svecofenian orogen. After its formation in a back-arc setting at around 1910 Ma, the basin is thickened within a fore arc system in front of a pre-existing arc. An orogenic scale N-S shortening, possibly associated with the formation of an orocline at 1870–1860 Ma might be responsible for the final configuration of the orogen. The origin of the thermal anomaly in the Vaasa dome is still disputed. Heat source inherited from the back-arc basin, radioactive decay, thickening, magma underplating in lower crust and/or delamination might have generated the thermal positive anomaly.