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Sveconorwegian underplating and granitic magmatism in the Baltic Shield: LAM-ICPMS Hf isotope evidence

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The Baltic Shield consists of Archaean to Paleoproterozoic domains in the N and E, and progressively younger crustal domains towards the SW. Important events of crustal growth related to convergent plate margins have been recognized at ca. 1.7-1.9 Ga, and at ca. 1.5-1.6 Ga.

The southwestern part of the shield has been the site of repeated anorogenic magmatism from ca. 1.48 to 0.92 Ga [1]. Geochemical data on the youngest group of intrusive rocks (0.92-0.95 Ga) indicate that mixing of mantle-derived material and material with Paleoproterozoic crustal material is required, but the residence-time of the mantle-derived component within the deep crust has not been supported by data. There is clear evidence of crustal rejuvenation at ca. 1.50-1.48 Ga [2], but whether new, mantle-derived material was introduced into the lower crust in Sveconorwegian (Grenvillian) time has been debated [1,2,3]. New LAM-ICPMS Lu-Hf isotope data on single zircons from *(a)* 1.19-1.22 Ga granodiorite and granite, and *(b)* the 0.966 Ga Vrådal granite in central Telemark (southern Norway) demonstrate that juvenile material was indeed introduced into the deep crust of the Baltic Shield at ca. 1.2 Ga, and that this component later contributed to the petrogenesis of the late, anorogenic granites in the region. These data help identify a hitherto unknown event of mafic underplating in the region. They provide new and important constraints for the crustal evolution of the SW part of the Baltic Shield, and indicate the presence of a geochemical component in the deep crust that must be considered when modelling the petrogenesis of the 0.92-0.95 Ga anorgogenic magmatism in the region, which includes both A-type granites and AMCG-type intrusions.

References

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Contribution of crustal and mantle sources in the genesis of Early Proterozoic post-collisional granitoids

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A wide variety of granite types can be generated at post-collisional setting. The crust overthickened by collision is unstable and subsequent extension and lithospheric delamination facilitate underplating of mantle-derived magmas. Consequently post-collisional granitoids can bear features of involvement of mantle-derived and reworked crustal material in their genesis.

An extended belt of Early Proterozoic granitoids marks the Archean basement inliers along the present-day southwestern margin of the Siberian craton. The granitoid emplacement during a narrow time interval (1.87-1.84 Ga) postdated the collisional metamorphism. The granitoids intruded Later Archean granulite-gneiss complexes in the northwest and Early Archean grey gneisses and greenstones in the southeast. The available geochemical data indicate a compositional diversity of granitoids ranging from diorite, tonalite and granodiorite to quartz syenites and high-K subalkaline granites. The high-Ca granitoids with high Al_2O_3 and Sr, low Y and high La/Yb and Sr/Y ratios share many features with Archean TTG suites. The high-K subalkaline granites and quartz syenites are characterized by high FeO/(FeO+MgO), LREE and HFSE and show similarity to A-granites. The high-Ca granitoids appear to have been derived at high pressures by melting of an older diorite or tonalite source in the bottom of a thickened crust. The high-K granites are probably products of the partial melting of tonalitic protoliths.

All post-collisional granitoids, irrespectively of their geochemical features, have negative epsilon Nd values ranging from –3.1 for tonalites to –7.5…-3.2 for high-K granites, which is evidence for significant crustal contribution to granite genesis. The hosted gneiss complexes show more radiogenic Nd isotopic composition than granitoids. Crustal epsilon Nd values range from –4.0…-8.0 in the northwest to –19.0…-24.0 in the southeast. The estimated contribution of juvenile mantle-derived material in high-K granite genesis ranges from 30% in northwest to 50% southeast. High-Ca granitoids seem to have a minor (20%) input of mantle-derived material during their formation. Thus, the compositionally variable post-collisional granitoids are products of ancient crust remelting. Their isotopic composition evidences for a contribution of juvenile mantle-derived material. The underplating of mantle-derived melts in the bottom of crust could serve as a heat source inducing the melting of the ancient continental crust.