# 3500 Ma of crustal evolution in Fennoscandia as seen from Hf isotopes in zircons from granitoids

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The Fennoscandian shield shows a generally younging trend from NE to SW, with regionally important crustal growth events in the late Archaean, late Palaeoproterozoic and early Mesoproterozoic. Zircons separated from granitoids (s.l.) ranging from Archaean to Permian age have been dated by U-Pb and analysed for their Hf isotope composition by laser ablation ICPMS. The crystallisation age of the oldest rock so far recognized is ca. 3.5 Ga, with $\varepsilon_{Hf} \leq +2$, but the rock contains ca. 3.7 Ga old inherited zircons with $\varepsilon_{Hf} < 0$, indicating a crustal prehistory up to >3.9 Ga. Both depleted mantle and Meso- to Palaeoarchaean crust contributed to crust-forming events at ca. 3.2, 2.9 and 2.7 Ga. At 1.86-1.67 Ga, the juvenile Palaeoproterozoic Svecofennian crust was remobilized at a large scale to form $>10^6$ $km^3$ of Transscandinavian Igneous Belt (TIB) granitoids with relatively uniform $\varepsilon_{Hf} = +3\pm3$. The TIB granites did not contain new mantle-derived material, and coeval mafic magmas must have acted mainly as a heat source. In the early Mesoproterozoic, the western margin of the shield grew along a long-lived subduction system. Hf isotopes indicate a significant juvenile input in the western, distal part of the continental arc system ($\varepsilon_{Hf} \approx +12$), and less so in the eastern, proximal part ($\varepsilon_{Hf} \leq +8$). At ca. 1.3 Ga and 1.22-1.21 Ga, the western part of the shield was underplated by depleted mantle material ($\varepsilon_{Hf} \approx +13$). This juvenile component contributed significantly to subsequent granitic magmatism, but its relative influence decreased with time. The late Palaeozoic alkaline magmas of the Oslo Rift are the youngest additions to the Fennoscandian crust. These seem to be mainly derived from a lithospheric mantle source with $\varepsilon_{Hf}$ = +2 to +6, but with contributions from local Proterozoic crust.

# The alteration of zircon and its role in the remobilization of high field strength elements in the Georgeville granite, Nova Scotia

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The structure and composition of metamict zircon from an epizonal A-type granite in the Antigonish highlands, Nova Scotia, was investigated using transmission electron microscopy (TEM), electron microprobe analysis (EMPA), laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS), and Raman micro-spectroscopy. Individual zircon crystals within the granite are variably altered and are comprised of up to four domains, designated A, B, C and D. Each domain is readily distinguished on the basis of texture and composition. Domain A consists of trace element-enriched zircon and zirconium oxide nanocrystals in an amorphous matrix. Coupled dissolution and reprecipitation of domain A in proximity to microfractures produced a relatively trace element-poor zircon (domain B), and Th, U, Y, Yb-enriched inclusions (domain C). Domain D is composed of Hf-enriched, amorphous zirconium silicate that is depleted in Y, Yb, Th and U. Domain D occurs within microfractures together with lesser amounts of thorite and thorianite. Alteration of zircon, which is the dominant accessory phase in the Georgeville granite, resulted in preferential hydrothermal transport and precipitation of the lanthanides. Perturbation of the initial high field strength element and isotopic signature of zircon accounts, in part, for the anomalous chondrite normalized rare earth element patterns and Nd isotopic values reported previously for the Georgeville granite (Murphy and Nance, 2002).

## References

Murphy, J.B. and Nance, R.D., (2002), *Earth Science Rev*. **59.** 77-100.