Sr-isotope compositions and trace element concentrations in plagioclase from the 0.92 Ga Sveconorwegian Hakefjorden complex in SW Sweden – implication for the origin of massif-type anorthosite

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Massif-type anorthosites are restricted to the Proterozoic and are known to form through polybaric crystallisation with deep crustal cumulation of megacrystic anorthosite and subsequent rise of crystal rich magma to shallower crustal levels. The origin of these magmas from the mantle or crust remains debated [1,2], as well as the extent of magma-crust interaction. The 0.92 Ga late orogenic Hakfjorden complex in SW Sweden contains norite hosted massif anorthosite in response to orogenic collapse of the Sveconorwegian (Grenvillian) orogen. Plagioclase megacryst compositions in the anorthosite suggest a polybaric origin, with megacrystic plagioclase crystallising in lower crust before final emplacement at <6 kbar [3,4]. Megacrysts have lower Sr- ad Ba concentrations than matrix plagioclase, most likely reflecting crystallisation from an evolving magma. Despite a polybaric magmatic evolution, with intrusion through felsic, highly radiogenic crust, plagioclase within the intrusion defines a homogoneous mean $^{87}Sr/^{86}Sr_i$ = 0.7050 (±2SD =0.0002; n =112). Crustal assimilation during emplacement is limited to the marginal zone of the intrusion with $^{87}Sr/^{86}Sr_i$ up to 0.7078, and with the hightest values in the centre of a grain and down to 0.7054 towards the margin and in matrix plagioclase. A mantle origin of the parental melt would require ~40-50% assimilation of lower crust and complete equilibration prior to crystallisation in order to explain the homogeneity of the data followed by complete lack of interaction with crust en route to emplacement. In contrast, melting of ultramafic lower crustal rocks might more readily explain observations.

[1] Schiellerup *et al*. (2000) Nature 405, 781–784. Ashwal & Bybee (2017) Earth Science Reviews 172, 307-330. [3] Årebäck & Stigh (1997) GFF **119**, 97-101. [4] Årebäck & Andersson (2002) Norsk geologisk tidsskrift, **82**, 29-44.