# Geodynamic evolution of the Mesoarchean Fiskenæsset anorthosite complex, SW Greenland

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The Mesoarchean Fiskenæsset Complex, southern West Greenland, consists of an association of ca. 550-meter-thick layered anorthosite, leucogabbro, gabbro, and ultramafic rocks. The complex was intruded by tonalite, trondhjemite, and granodiorite (TTG) sheets (now orthogneisses) during thrusting that was followed by several phases of isoclinal folding. Despite polyphase deformation and amphibolite to granulite facies metamorphism, primary cumulate textures and igneous layering are well preserved throughout the complex. Trace element abundances of the Fiskenaesset Complex and associated volcanic rocks are consistent with a supra-subduction zone geodynamic setting.

The Fiskenæsset anorthosites, leucogabbros, gabbros and ultramafic rocks yield a Sm-Nd isochron age of 2973±28 Ma (MSWD=33), with an initial εNd = +3.3, consistent with a long-term depleted mantle source. Regression of Pb isotope data defines an age of 2945±36 Ma (MSWD=44); and the regression line intersects the average growth curve at 3036 Ma.

Complex internal structures in zircon from TTGs reveal several episodes of zircon growth and recrystallization between ca. 3200 and 2650 Ma. Zircon ages peak at about 3200, 3100, 3000, 2950, 2820, and 2750 Ma. The 3200-3000 Ma zircon cores are interpreted as inherited xenocrysts from older reworked crustal rocks. The 2950 Ma is considered as an approximate intrusion age of TTGs. The 2940-2650 Ma ages are attributed to metamorphic overgrowth and recrystallization in response to multiple tectonothermal events that affected the Fiskenæsset region.

On the basis of recently published trace element data, and new Nd and Pb isotope and U-Pb zircon age data, a three-stage geodynamic model is proposed to explain the evolution of the Fiskenæsset Complex. Stage 1 represents the formation of depleted shallow mantle source > 3000 Ma (εNd = +3.3) for the complex. Stage 2 corresponds to the development of an intra-oceanic island arc between 3000-2950 Ma. Stage 3 is characterized by the collision of the island arc with either a passive continental margin or with an older arc between 2950-2940 Ma.

# Evolving conditions of quartz cementation: *In situ* microanalysis of $\delta^{18}O$ across single overgrowths

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Stable isotope ratios of the basal Cambrian Mt. Simon sandstone in the Illinois basin have been analyzed *in situ* and reveal information about the evolving chemical and thermal conditions of post-depositional mineral growth and thus of porosity and permeability. Recent studies show a correlation of depth and $\delta^{18}O$ in quartz cements from samples that have been buried as deeply as 4000 m [1], but little variability in cements from near surface samples [1-3]. While basin-wide trends may provide information about broad-scale processes such as burial history or fluid migration, the variability of $\delta^{18}O$ in single overgrowths has not been studied previously.

Traverses across individual syntaxial quartz overgrowths were analyzed for $\delta^{18}O$ using 10 $\mu$m and 3 $\mu$m spots on an IMS-1280 ion microprobe. $\delta^{18}O$ zonation was measured in 71 individual overgrowths from 17 rocks. The variability within a given 100 $\mu$m overgrowth is up to 10.4‰; most samples decrease in $\delta^{18}O$ with continuing growth. Deeper samples have larger gradients and have wider ranges of $\delta^{18}O$ values ($\delta^{18}O$=15-25‰ VSMOW) than more shallowly buried samples ($\delta^{18}O$=20-25‰). The fine-scale zonation measured within single overgrowths yields information about how conditions changed and also the relative timescales over which these changes occurred. Because direct measurements of age and growth rate are not possible in quartz, we examine changes in $\delta^{18}O$ of quartz with normalized distance in the overgrowth. The slope of these curves of $\delta^{18}O$ versus distance allows estimation of the relative durations of varying quartz forming conditions. Assuming a fluid-dominated system with $\delta^{18}O$ ($H_2O$)=1.5‰, equilibrium calculations indicate that cements grew from 80-150°C at depths of ~4000 m, consistent with published [4] temperatures from fluid inclusions and vitrinite reflectance in the Illinois Basin.

[1] Pollington *et al*. (2010) *AAPG Annual Convention Technical Program*. [2] Kelly *et al*. (2007) *Geochimica Cosmochimica Acta* **71**, 3812-3832. [3] Chen *et al*. (2001), *Geology* **29**, 1067-1070. [4] Rowan *et al*. (2002), *AAPG Bulletin* **86**, 257-277.