# A continuum of crust formation processes, Eoarchean-Phanerozoic

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The Eoarchean terranes of southwest Greenland comprise the most extensive early rock archive in terms of area (>10,000 km$^2$) and age range (U-Pb zircon rock ages from 3.6 Ga to 3.9 Ga) and as such are key for revealing processes of early crust formation and chemical differentiation. Our integrated geologic, geochronologic and geochemical observations, focussing on low strain regions with best preserved lithologic relationships and geochemical signatures, reveal repeated patterns of formation of juvenile TTG crust and associated mafic and ultramafic rocks in convergent margin settings followed by formation of more evolved granites (e.g. [1]). New zircon Lu-Hf data from rare, youngest 3.6-3.7 Ga tonalites and quartz diorites and oldest 3.89 Ga tonalites, obtained from single component gneisses with simple zircon populations and accurate U-Pb ages, now document juvenile crust formation from a near chondritic Lu-Hf composition mantle source for ~300 myr, between 3.9 Ga and 3.6 Ga. In contrast, the more evolved, granitic rocks show slightly negative initial $\varepsilon_{Hf}$ in accord with crustal reworking of the older (3.8-3.9 Ga) gniesses. This is a pattern similar to that seen in younger terranes. There is no evidence for Hadean material in the sources of the granitoids. The $^{176}$Hf isotope-time patterns are consistent with juvenile crust production from a mantle source that experienced only modest amounts of prior crustal extraction and are distinct from those predicted by reprocessing of an enriched Hadean mafic crust, as has been proposed for this region [2] and for the source of the Hadean Jack Hills zircons (e.g., [3]).

The $^{142\text{-}143}$Nd isotopic time patterns (from 3.6 - 3.9 Ga) are more complex and "decoupled" from $^{176}$Hf. This reflects the interplay between early Sm/Nd fractionation processes that are unrelated to continental crust production, as required by the $^{142}$Nd data and mantle domain mixing.

Taken together with observations from early Archean terranes preserved worldwide, a picture is emerging of episodes of earliest Archean and Hadean(?) crust formation in arc-like settings, which we further speculate is accompanied by continental amalgation and ultimately break-up in a form of an early Archean Wilson Cycle [4].

[1] Nutman, Bennett and Friend, (2013) *Amer. Jour. Sci.* **313**, 877-911. [2] Naeraa et al., (2012) *Nature* **485**, 627-631. [3] Kemp et al., (2010) *EPSL* **296**, 45-56. [4] Nutman, Bennett and Friend, *Amer. Jour. Sci.* in press.