Variable styles of crust evolution recorded in oldest (3.7-3.85 Ga) rock and (>4.0 Ga) mineral suites?

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Combined field, geochronological and chemical studies of the Eoarchaean rocks of West Greenland continue to reveal "new" old terranes, narrowing the age gap between the oldest rock and oldest (>4.0 Ga) mineral records. We have now identified several mafic/ultramafic rock suites and tonalite localities with ages of ca. 3.85 Ga on the islands in the vicinity of Nuuk. The best preserved 3.85 Ga tonalites are monophase gneisses; they contain oscillatory zoned igneous zircons with simple age populations. Tonalite chemistry e.g. HREE depletions, suggests high temperature formation (>750˚c) by melting of amphibolite with residual garnet. Initial ε_{Nd} from both mafic suites and tonalites are homogenous with a narrow range of positive values requiring derivation from depleted mantle sources. Intensive ion probe searches (>3000 grains at ANU alone) have not identified >3.9 Ga inherited zircons in either the oldest tonalites or metasediments. Precise trace element compositions determined for ca. 3.8 Ga mafic suites from both the Isua and Nuuk regions show affinities to modern arc magmas providing evidence for convergent tectonics in generating the earliest preserved crustal suites.

In contrast, the image of crustal evolution in the early Earth emerging from investigations of >4.0 Ga detrital zircons (Western Australia) is of evolved, low temperature granites, and highly heterogenous initial isotopic (ε_{Hf}) compositions, requiring both large amounts of older crustal inheritance and an extreme degree of early mantle depletion.

These contrasts are a focus of some debate but need not be neccessarily conflicting. One possiblity is that the currently limited early Earth sample simply represents two different components of crust formation; the preserved 3.7-3.9 Ga record is dominated by juvenile tonalite crust formation, whereas the >4.0 Ga zircon record samples more evolved granites Alternatively, the period between ca. 4.2 Ga and 3.85 Ga may represent a dramatic global change in lithosphere generation, from granite to TTG dominated continental crust, i.e. low temperature to high temperature melts, major crustal reworking to progressive crustal growth, with the former a Hadean relict of early differentiation, the latter a form of modern convergent processes dominated by slab dehydration/melting which became dominant during the Archaean.