The beginning and end of Archaean-style continental growth

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Reconstructions of the continent mass vs. age curve reflect the extent of mantle depletion in lithophile elements (or isotopes). The most sensitive system is U/Pb because continental crust is extremely enriched in both elements whereas depleted mantle correspondingly impoverished.

The difference in Pb-isotope composition between N-MORB and crust composites does not permit a constant mass of continental crust since the Hadean. In conjunction with the Hf-isotope record of Hadean vs. Archaean zircon, this evidence points to a major crustal recycling event at ca. 3.9 Ga. Here I will provide new evidence that giant impact-induced volcanic resurfacing, including mantle-melting, contributed to the demise of the Hadean crust.

At the beginning of the Archaean, little crust existed that had a composition similar to modern average continents, which carry a strong 'arc' signature. This is most easily shown with the near-chondritic Nb/Th ratio of Palaeoarchaean basalts. In agreement with the geological record, the mass of Archaean continental crust increased until 2.6 Ga, by which time the Nb/Ta ratio of juvenile basalts had increased from 8 to ca. 12.5. A gradual increase in continental mass is consistent with Pb- and Nd-isotope records.

A major uncertainty in crust mass reconstructions exists for the time period after 2.6 Ga, for which many proxies show much subdued net growth in mass, if not a decline. The Pb-isotope record of 1.9 Gas old juvenile basalts is apparently less depleted than the 2.6 Ga mantle [1]. This could reflect recycling and net loss of continental mass but here I propose an alternative explanation, namely that the mass of the depleted mantle increased substantially. Thus, refertilisation of the depleted mantle source was not caused by crustal recycling but by replenishment from less depleted mantle.

The physical rationale for this proposal is the collapse of a mantle transition zone barrier, which may have persisted since the magma ocean stage or may have been a transient [2] feature of the Archaean mantle [3]. Regardless, the collapse of the barrier at 2.6 Ga changed the thermal structure of the mantle, diminished its potential to create komatiite melts and increased the mass of the mantle available for depletion. Until the history of lower-upper mantle transfer is understood, the continental extraction history cannot be reconstructed.

[1] Babechuk and Kamber (2011), *Prec. Res.* **189**; 114– 139. [2] Breuer & Spohn (1995), *Nature* **378**, 608-610. [3] Davies (2008), *Earth Planet Sci. Lett.* **275**, 382-392.