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Timing, rates and geodynamical conditions of continental crust generation, destruction and reworking

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The timing, rates and the geodynamical conditions of continental crust generation, destruction and reworking remain a topic of considerable debate. Around 7% of the present-day exposed crust consists of rocks of Archaean age, yet models of continental growth suggest that 20-100% of the present-day volume of the continental crust had formed by the end of the Archaean. Continental growth models rely on understanding the balance between the generation of new crust and the reworking of old crust, and how these have changed with time throughout Earth's history. For that purpose, the variations in radiogenic isotope ratios in detrital rocks and minerals are a key archive.

Two different approaches are considered to model the growth of continents: (1) the variation of Nd isotopes in continental shales with various deposition ages, which requires a correction of the bias induced by preferential erosion of younger rocks through an erosion parameter 'K'; and (2) the variations in U-Pb, Hf and O isotopes in detrital zircons sampled worldwide. These two approaches independently suggest that the continental crust was generated continuously, with a marked decrease in the continental growth rate at ca. 3 Ga. The $>$4 Ga to $\sim$3 Ga period is characterised by relatively high net rates of continental growth ($\sim$3.0 km^3.a^{-1}), which are similar to the rates at which new crust is generated, and destroyed, at the present time. Since 3 Ga the net growth rates are much lower ($\sim$0.8 km^3.a^{-1}), and this may be attributed to higher rates of destruction of continental crust. The inflexion in the continental growth curve at $\sim$3 Ga indicates a fundamental change in the way the crust was generated and preserved. This change may be linked to onset of subduction-driven plate tectonics and discrete subduction zones.