Geophysical Research Abstracts
Vol. 17, EGU2015-13733, 2015
EGU General Assembly 2015

Revisiting models of crustal growth; the role of preservation and destruction

Nick Roberts and Christopher Spencer
NERC Isotope Geosciences Laboratory, British Geological Survey, Nottingham, United Kingdom (nirob@bgs.ac.uk)

The rate of growth of the continental crust remains a topic of much debate. Individual continents and cratons show apparent episodic magmatic activity and associated continental growth. Because our archive of Earth's history is locked up in the continental crust, most records of Earth history similarly have an episodic nature to them. One long-standing model has been that these episodes of continental growth are related to both large mantle upwelling and mantle overturn events. Another model that has been in and out of favour, is that continental growth was rapid in the early Earth history, and that net growth has been near-zero since at least the Mesoarchaean. Crustal growth rates based on modelling of isotopic systems tend to feature an increasing volume through time, with a faster rate up to the Meso- to Neoarchaean.

As well as being derived from the mantle, continental crust can also be returned to the mantle. The net continental growth rate is a balance between this addition and loss. A problem with many crustal growth models is that they are based on the record preserved today. Although attempts have been made to account for intra-continental recycling, continental loss back into the mantle is generally unaccounted for. For this reason, many crustal growth curves can be considered a minimum. With an approach using Hf and O isotopes in zircon, it can be shown that at least 50% of the current volume of continental crust was formed by 3 Ga, and that of this current volume, at least 45% has been recycled intra-crustally.

Current estimates of crustal mass-balance suggest that continental addition is similar to rates of continental loss. But how far back in time has this been the case? If plate tectonics and deep subduction have been around since the late Archaean, then it is likely that rates of reworking have been high since this time also. The hotly debated question: what style of plate tectonics and continental growth mechanisms existed throughout the Archaean, remains critical for understanding how the balance of continental addition and loss may have varied early in Earth history.

Continental addition and loss are controlled by regional geodynamic environments. Thus, the formation of supercontinents since the Proterozoic, and perhaps late Archaean, plays an important role in controlling global continental growth rate. Additionally, the supercontinent cycle affects the varying preservation potential of different portions of continental crust. This bias is partly responsible for the episodic nature of the Earth's history. De-convolving the preservation and loss of continental crust from our current record remain pertinent to understanding Earth evolution.