A zircon perspective on the evolution of the continental crust: insights from combined Hf and O Isotopes

CHRIS HAWKESWORTH[1] AND TONY KEMP[2]

[1]Department of Earth Sciences, University of Bristol, Bristol, BS8 1RJ UK (c.j.hawkesworth@bristol.ac.uk)
[2]Department of Geological Science, Niigata University, Niigata, 950-2181 Japan
(tony.kemp@geo.sc.niigata- u.ac.jp)

Models for the evolution of the continental crust need to reconcile the crust formation ages of material whose isotope ratios reflect involvement in the sedimentary cycle, and those that do not. Such data are now available from in situ O and Hf isotope ratios on well-dated zircons. Detrital zircons encapsulate a more representative record of igneous events than the exposed geology and their hafnium isotope ratios reflect the time since the source of the parental magmas separated from the mantle.

A number of studies have highlighted striking global peaks in juvenile igneous activity at 2.7, 1.9 and 1.2 Ga, perhaps implying rapid crustal generation in response to the emplacement of mantle 'super-plumes'. An initial study on samples from the Lachlan Fold belt revealed sharp peaks in zircon crystallization ages at 0.5 and 1.0 Ga, and ages that range back to 3.4 Ga. The Hf isotope model ages range from 1.4 to 3.6 Ga, but those with ^{18}O of < 6.5 per mil are restricted to two peaks at 1.9 Ga and 3.3 Ga. It is argued that crust generation in this part of Gondwana was limited to major pulses at 1.9 Ga and 3.3 Ga, and that the zircons crystallised during repeated magmatic reworking of crust formed at these times.

The present data indicate that from the late Archaean continental crust has been generated in pulses of relatively rapid growth. The sedimentary record shows no such pulsed evolution, and one interpretation is that it can take up to one billion years for new crust to dominate the sedimentary record. It appears that the generation of new crust may have been less linked to the development of mountainous areas susceptible to preferential erosion, than was previously envisaged.