How robust is the crustal evolution information from detrital zircon?

TOM ANDERSEN[12], MARLINA ELBURG[2] AND MAGNUS KRISTOFFERSEN[1]

[1]Department of Geosciences, University of Oslo, Norway tom.andersen@geo.uio.no, magnus.kristoffersen@geo.uio.no

[2]Department of Geology, University of Johannesburg, South Africa marlinae@uj.ac.za

Detrital zircon from sedimentary rocks of the Karoo Supergroup of eastern South Africa comprises three main fractions (1000-1100 Ma, $\varepsilon_{Hf} \approx 0$ to + 10, 500-700 Ma, $\varepsilon_{Hf} \approx$ -12 to +10 and ca. 260 Ma, $\varepsilon_{Hf} \approx$ -5 to +5). Archaean zircon is very scarce, and 500 to 2000 Ma zircon with distinctly more negative ε_{Hf} is a minor component. The Proterozoic fractions are also found in rocks of the Cape Supergroup. The main Karoo Basin of South Africa formed as a retroarc foreland basin in response to the develoment of the Cape Fold Belt (Gondwanide Orogen) in the late Palaeozoic. Detrital zircon data support the idea that recycled material from the Cape Supergroup within the fold belt made a major contribution to the Carboniferous to Jurassic Karoo sediments The material filling the Cape basin in Cambrian to Devonian time was mainly derived from the continental surface of southern Africa and neighbours in the Gondwana supercontinent. Detrital zircon in the Karoo sediments thus reflect the source of a precursor, and a transport regime much older than its own deposition.

U-Pb and Lu-Hf data from detrital zircon have been used with considerable success to trace continental evolution. If we were to use the data from the Cape and Karoo Supergroups blindly to work out a crustal evolution history for the protosource terrane(s), we would find that the earliest crustal growth event was of Palaeoproterozoic age. Mesoproterozoic (Namaqua-Natal belt) and Neoproterozoic (East Arrican Orogen, Damara Orogen, Saldania Belt) events are also obvious from the data. However, this analysis would fail to detect the Archaean Kaapvaal craton as a major feature of the continental crust of southern Africa.

The scarcity of Archaean zircon may reflect palaeogeographic features in the early Palaeozoic that prevented southwards transport of detritus from the Kaapvaal craton. A general point to be learned from this experiment is that a crustal history based only on detrital zircon data may be dangerously misleading. Detrital zircon may be a less robust indicator of large-scale processes of crustal evolution than commonly thought, which should always be used with utmost care and support from geological understanding.