Episodic versus long term recycling processes within the Archean South African crust

K. KLAMA, Y. LAHAYE, S. WEYER. A. GERDES AND G. P. BREY

Institut für Geowissenschaften, J.W. Goethe Universität Frankfurt; Germany; klama@em.uni-frankfurt.de

The Kaapvaal Craton assembly has originated through a complex combination of magmatic arc formation and accretion of discrete terranes in a time span of 1 Ga year from 3.7 to 2.7 Ga. We have studied the crustal evolution of the Kaapvaal craton by a combination of U-Pb dating and Hf isotope and trace element measurements of detrital zircons by LA-(MC)-ICP-MS. The detrital zircons from modern day sediments provide an isotopic record that reflects the contours of the present surface geology. Two key sampling localities have been selected which represent the lower and upper crust of the Kaapvaal craton (Vredefort Dome and Amalia-Kraaipan terrane resp.). The combined U-Pb and Hf isotopic signature of the detrital zircons shows that the upper crust is affected by at least three recycling episodes around 3.5 Ga (εHf from –2 to +2), 3.1 Ga (εHf from +6 to –4) and 2.9 Ga (εHf from +4 to –2). The restricted range of εHf at 2.9 Ga is best explained by a reworking of the crust without significant input of juvenile crust. The lower crust, in contrast, is affected by a continuous recycling process that can be traced from 3.2 to 2.7 Ga with εHf changing from -2 to -10. Hf model ages were calculated for each zircon using an average crust estimate for $^{176}Lu/^{177}Hf$ ratio of 0.0113 and of 0.0384 for the depleted mantle. They show that the western part of the South African craton formed at two major events around 3.3 Ga and 3.5 Ga. In addition a Hadean crust formation at around 4.1 Ga is indicated by a few exceptional zircons.