THE EVOLUTION OF THE CONTINENTAL CRUST: THE ZIRCON ARCHIVE AND IMPLICATIONS FOR PROTEROZOIC SUPERCONTINENTS

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ASBTRACT: The continental crust is the key archive of Earth history. The development of precise radiometric age dating is the basis for determining the ages of events in the geological record. Fundamental questions remain over how and when the continental crust was generated, and the extent to which it provides a representative record. Much of the discussion is about how best to interrogate the geological record, and dramatic advances have resulted from the development of in situ analytical techniques. Zircons offer robust records of the magmatic and crust-forming events preserved in the continental crust, and perhaps unexpectedly the continental crust is characterised by peaks in the distribution of U-Pb crystallization ages, and in the ages of rocks that reflect new continental crust. Such peaks may reflect periods of high magmatic activity, and as such they might be due to magmatism associated with deep-seated mantle plumes. However, the bulk composition of the crust is similar to that generated in destructive plate margin settings, and the peaks in ages also mark the times of supercontinent formation. This contribution explores new ways in which U-Pb, Hf and O isotopes in zircon can be used to constrain the isotope ratios of new crust, and to evaluate how and when the continental crust was generated, and the tectonic setting in which detrital zircons were deposited. It argues that the apparent peaks of magmatic activity reflect the preservation potential of magmatism in different tectonic settings, rather than fundamental pulses of magmatic activity. A key debate is over the extent to which the sedimentary record is biased by preferential sampling of relatively young material in their source terrains. The implication is that there were greater volumes of continental crust in the Archean than might be inferred from the compositions of detrital zircons and sediments. It explores links between the rates at which new crust is generated and the rates of crustal growth, and why the inferred rates of crustal growth in the Archean are similar to the rates at which new crust has been generated in the recent geological past. We also outline the implications of this work for unravelling the rock and mineral deposit record associated with the Nuna and Rodinia supercontinents.