Zircon perspectives on the evolution of the continental crust

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One of the Earth’ s unique features among the known terrestrial planets is the presence of a chemically evolved massive crust –the continental crust. It is generally accepted that the modern continental crust has an andesitic bulk composition and is vertically stratified in terms of lithological and chemical compositions–from lower portions dominated by mafic rocks to upper portions dominated by granitoids. Yet there is considerable debate as to when and how the continental crust has evolved to its present form. In this presentation, we explore perspectives on the evolution of the continental crust emerged from the zircon U–Pb age and Hf isotope data with supplementary zircon O isotope data.
Zircon, a common accessory phase in granitoids, can be precisely dated by the U-Pb system. Zircon Hf isotopic composition is a function of crustal residence time of the magmatic protolith, whereas the O isotopic composition is a sensitive record of reworking of mature sediments such as pelite. An integration of U-Pb, Lu-Hf and O isotopic data for detrital zircons from modern large rivers indicates that: (1) granitoid magmatism has played a significant role in the crustal differentiation and crustal reworking over geologic history, (2) the supercontinent cycle has controlled the evolution of the continental crust by regulating the rates of crustal generation and intra-crustal reworking processes and the preservation potential of granitoid crust, and (3) ~25% and ~80% of the preserved continental crust would be formed by 2.5 Ga and 1.0 Ga, respectively. Given that the continental growth is a combined result of the addition of new continental crust and recycling of continental crust into the mantle, the actual net growth of continental crust could be remarkably earlier than this. Taking into account the crustal residence times of continental crust recycled back into the mantle, we propose a continental growth model that stable continental crust was firstly established in the Paleo- and Mesoarchean and significantly grew in the Paleoproterozoic.

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