The origin of the continental crust and its impact on the Earth system

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The continental crust is the archive of Earth hisotry and its record of rock units and events is heterogenous with distinctive peaks and troughs of ages for igneous crystallization, metamorphism, continental margins and mineralization. This temporal distribution is argued to largely reflect the different preservation potential of rocks generated in different tectonic settings, rather than fundamental pulses of activity, and the peaks of ages are linked to the timing of supercontinent assembly. In contrast there are other signals, such as the Sr isotope ratios of seawater, mantle temperatures, and redox conditions on the Earth, where the records are regarded as primary because they are not sensitive to the numbers of samples of different ages that have been analyzed.

Models based on the U-Pb, Hf and O isotope ratios of detrital zircons suggest that at least ~60-70% of the present volume of the continental crust had been generated by 3 Ga. This volume contrasts markedly with the <10% of crust of that age apparently still preserved requiring ongoing recycling of early formed crust and subcontinental mantle lithosphere back into the mantle.

Between 1.7 to 0.75 Ga, the tempo of Earth processes was characterized by environmental, evolutionary and lithospheric stability that contrasts with the dramatic changes in preceding and succeeding eras. The period is marked by a paucity of passive margins, an absence of a significant Sr anomaly in the paleoseawater record or in the epsilon Hf(t) in detrital zircon, a lack of orogenic gold and volcanic-hosted massive sulfide deposits, and an absence of glacial deposits and of iron formations. In contrast, anorthosites and kindred bodies are well developed and major pulses of Mo and Cu mineralization, including the world's largest examples of these deposits, are features of this period. These trends are attributed to the combined effects of lithospheric behaviour related to secular cooling of the mantle and a relatively stable continental assemblage that was initiated during assembly of the Nuna supercontinent by 1.7 Ga and continued until breakup of its closely related successor, Rodinia, around 0.75 Ga. Since ~0.75 Ga, modern plate tectonic processes have dominated the Earth system.