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Episodic Earth Evolution

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U-Pb ages of zircons from Precambrian granitoids and major rivers are grouped into a series of major peaks at about 2.7, 2.5, 2.1, 1.9 and 1.1 Ga. Recently these peaks have been interpreted as times of enhanced preservation of the continental crust associated with the assembly of supercontinents. An older interpretation, which we support, is that they correspond instead to periods of accelerated crustal growth related to episodic convection of the mantle. In this paper we use fluid mechanics experiments to develop a new model of mantle convection and crustal growth. A dense layer at the base of the mantle persists until 2.7 Ga when it destabilizes and generates large domes that rise into the upper mantle. There they cause a large increase in the rate of subduction which leads to enhanced granite magmatism at convergent margins and thus to a pulse of crustal growth. The domes heat the upper mantle which partially melts at mid-ocean ridges to produce thick oceanic crust that resists subduction. The subsequent period of subdued plate motion is broken by the next generation of mantle domes. Before and after the period of episodic crustal growth, plate tectonics operated quasi-continuously.