Episodic Precambrian Subduction

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Peaks in the preserved crustal record at 1.1, 1.9-2.1, 2.7 and 3.5Ga coincide with periods of anomalous tectonism and volcanism. These events do not conform with the supposition of continuous, smooth plate tectonics, and so previous workers have postulated mantle avalanches, superplumes, or exceptional plume activity as their ultimate cause. Here we show in numerical simulations that plate tectonics breaks down under hotter mantle conditions of the Precambrian, and is replaced by an episodic regime characterized by rapid pulses of subduction followed by long periods of relative quiescence. We also reanalyze the Precambrian paleomagnetic record, and demonstrate the existence of large anomalies in apparent polar wander record, coinciding with peaks in crustal production, and consistent with rapid plate motion during these events. These results shed light on the nature and style of Precambrian subduction, and the origin of the anomalous events which dominate the Precambrian geological record.