ARE MODERN PLATE TECTONIC CYCLES INHERITED FROM HADEAN MANTLE CONVECTION?

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Earth's oldest preserved crustal archive, the Jack Hills zircons of Western Australia of 4.4-billion-year-old antiquity, have been controversial to interpret in terms of the onsets of both crustal growth and plate tectonics. Debate is not likely to abate anytime in the immediate future, nonetheless progress is being made constraining hypotheses and conducting both empirical and theoretical tests. Here we conduct time series analysis on hafnium isotopes of the Jack Hills zircons and discover an array of significant cycles that are reminiscent of modern mantle convective cycles, which have typically been considered reflective of "modern" plate tectonics, i.e., subduction. At face value, such ancient evidence of mantle convective cycling on time scales typically associated with plate tectonics may suggest early Earth conditions similar to today—the uniformitarian "day one" hypothesis. On the other hand, in the context of expected secular changes due to first-order planetary evolution and geologic observations, one can also interpret the presence of ancient convective cycles to instead imply that modern plate tectonic subduction inherited convective harmonics already facilitated by an early phase of stagnant-lid delamination—the "lid-to-plates" hypothesis. Predictions of both hypotheses are considered.