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# Hf isotopic evidence for the gradual onset of Earth's mobile-lid tectonic regime

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Constraining the timing and mechanism of early continental crust growth on Earth is critical for the geosciences as continents exert a first-order control on many Earth processes. We have compiled and evaluated the lutetium-hafnium isotope compositions of globally distributed detrital zircons >3.2 Ga [1]. Different trends are revealed by the Hf isotope data (Fig. 1) for zircons older than ~3.8 Ga relative to those younger than ~3.6 Ga, characterized by a shift from unradiogenic Hf isotope compositions, consistent with a long-extant Hadean source to the input of relatively juvenile Hf isotope compositions across this interval. Zircon and co-existing whole rock geochemical signatures recovered from well-characterized, meta-igneous rocks of the 4.02 to 2.9 Ga Acasta Gneiss Complex of northern Canada exemplify trends in the global detrital zircon dataset, defining an interpretive template. The global zircon Hf isotope data record a transition from an early stagnant-lid tectonic regime, in which continental crust was formed by repeated re-melting of ancient mafic crust that, unlike in the present-day, persisted at the surface for long periods of time, to the widespread inception of mobile-lid tectonics and associated crust production processes ~3.8-3.6 Ga, with some regions transitioning before others.

[1] Bauer, A. M., Reimink, J. R., Chacko, T., Foley, B. J., Shirey, S.B., Pearson, D.G. (2020) Hafnium isotopes in zircons document the gradual onset of mobile-lid tectonics. Geochemical Perspectives Letters 14: doi:10.7185/geochemlet.2015.

**Fig.1** Initial epsilon Hf binned in 50-Myr intervals from 4.25 to 3.25 Ga for the compilation of detrital and igneous zircons [1]. The labels at right indicate the change-point analysis shift in each terrane, which occur heterogeneously between ~3.8 and 3.6 Ga, documenting a change from reworking of Hadean-aged material to input of more juvenile (more radiogenic Hf) magmas.

**Figure 1**