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Hadean to Eoarchean stagnant lid tectonics and convection tracked by zircon paleomagnetism

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Paleomagnetism can be used to distinguish between mobile and fixed lithospheres, but studies have been impeded by the high-grade metamorphism and deformation that makes most rocks older than Paleoarchean in age unsuitable for analysis [1]. However, select detrital zircons can preserve primary magnetizations [2] providing an opportunity to investigate this issue. The zircon paleomagnetic history recovered from Western Australia provides evidence for near constant paleolatitudes between ca. 3.9 and ca. 3.4 Ga [3]. A recent test of this record using select zircons bearing primary magnetic inclusions from South Africa, yield magnetizations consistent with this history. The simultaneous recordings of the magnetic field by zircons from two continents with vastly different Phanerozoic geologic histories provide further support for the primary record of the zircon magnetizations, and for a pre-Paleoarchean stagnant lid regime of Earth. Herein, we further consider how stagnant lid convection might reconcile the quasi-continuous record of magmatism represented by zircon ages of the Jack Hills. Our preliminary numerical modelling results suggest long-lasting stable mantle plumes that could potentially explain both zircon ages and the paleomagnetic record indicating latitudinal stasis.

[1] Tarduno et al. (2011) Phys. *Earth Planet. Inter*. 233, 68-87. [2] Tarduno et al. (2015) *Science* 349, 521-524. [3] Tarduno et al. (2020) *PNAS 117*, 2309-2318.