# Geochemical consequences of periodic mantle overturns on a stagnant-lid Archaean Earth

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Uniformitarian plate-tectonic scanarios are inconsistent with Archaean litho-tectonic associations, and there are fundamental geochemical differences between modern arc magmas and Archaean calc-alkaline suites. It is proposed instead that the Hadean-Archaean Earth was in unstable stagnant-lid mode until ~2.5 Ga [1]. Stagnant-lid planets are inefficient at evacuating heat and numerical models [2] predict periodic mantle overturns. This hypothesis resolves many paradoxical aspects of Archaean geology, magma-genesis and mantle geochemical and isotopic evolution. Model results and Archaean age patterns suggest that overturns lasted ~100 my and were separated by stagnant-lid episodes lasting ~300-400 my. Overturn upwelling zones (OUZOs) supplied abundant basalt and komatiite, resurfacing and reworking existing crust, creating prominent planet-wide age peaks, and kick-starting continent genesis [3]. Mantle flow drove continental drift and created accretionary orogens [4]. In the NE Superior (NES) craton; age and Nd isotopic data imply most Neo-Archaean granitoids are reworked older felsic plutons, with <50% of older domains surviving this overturn intact. Extrapolating this survival rate into the past implies continental crustal growth rates that are closer to end-member Armstrong models than most current scenarios. Most Archaean basalts are neither MORB-like nor OIB-like, but have flat chondrite-normalized spidergrams with near-CHUR Nd isotopic signatures that suggest extraction from weakly depleted mantle, a signal that hardly changes during the entire Archaean Eon. In explanation, I propose that most Archaean tholeiites were extracted from fertile mantle ascending in OUZOs, creating a complementary, depleted, refractory upper mantle layer. During overturns, ascending fertile mantle would mix with the ephemeral depleted mantle created during the previous overturn, as originally proposed by Stein & Hofmann [5]. Periodic rehomogenization would retard radiogenic isotopic evolution and keep source mantle perched near CHUR. This means that it is not correct to assume that only felsic magmas falling on a depleted mantle trend are juvenile contributions to crustal growth.

[1] Bédard (2018) *Geoscience Frontiers* **9**, 19-39. [2] O'Neill *et al*. (2007) *EPSL* **262,** 552-562. [3] Bédard (2006) *GCA* **70**, 1188-1214. [4] Bédard *et al*. (2013) *Prec. Res.* **229**, 20-48. [5] Stein & Hofmann (1994) *Nature* **372**, 63-68.