Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27498

Archean tectonics: are we converging on a consensus?

MICHAEL BROWN

University of Maryland

Based on geological relationships and Th–Nb systematics, purported Archean 'ophiolites' do not represent oceanic crust and subduction-related rocks are shown to be rare before the Proterozoic. Furthermore, Archean crust is characterized by a unimodal distribution of metamorphic *T/P* and an absence of orogenic eclogites. By contrast with the Proterozoic, much of the extant Archean crust was likely generated by plumes, with limited lithospheric extension and convergence, and short-lived drip-like subduction. From the perspective of petrology active-lid (plate) tectonics probably became global during the late-Archean–early-Paleoproterozoic, certainly before the aggregation of cratons to form the supercontinent Nuna/Columbia. What then was the convective mode of the mantle in the Archean? Venus is believed to be in a plume tectonics mode with some evidence of lithospheric mobility but without clear-cut plate boundaries; it is commonly referenced as an analog for Archean tectonics on Earth. However, paleomagnetic data from several Archean cratons require periods of lithospheric mobility at rates like those in the Phanerozoic as well as prolonged periods of stasis and brief periods of rapid mobility (up to tens of cm/yr). This includes recent reports of differential motion between the East Pilbara and Barberton in the early Paleoarchean and during the late Neoarchean assembly of the Superior and Wyoming Cratons. Differential motion requires active tectonic boundaries between the cratons involved. This apparent contradiction between a plume origin for cratonic crust and periods of lithospheric mobility can be reconciled if tectonic units were larger than individual cratons, active tectonic boundaries were extracratonic and mobility was episodic. In a global episodic-lid, mantle overturns drive short-lived periods of subduction of the whole lithosphere generating rapid motion. However, given lithospheric heterogeneity due to the presence of cratons, loss of all lithosphere is unlikely; if overturns occurred, they were likely localized events. Alternatively, local mobility could have been driven by plumes (shown in some models of Archean tectonics), or sluggish subduction (expected on a hotter Earth), or possibly in some cases by impact events. Although the specific driver(s) of mobility remains uncertain, by looking outside cratons to consider their global tectonic context is a consensus in reach?