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Water-Induced Mantle Overturn Provides a Unifying Explanation for Palaeomagnetic Records and Formation of Archean Continents

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As a consequence of the evolution of the water-bearing basal magma ocean, water-induced mantle overturn can well account for many puzzling observations in the early Earth, such as the formation of the Archean continents and the boundary of the Archean and Proterozoic. The upwelling of the hot basal magma ocean during the mantle overturn also significantly affects the thermal state of the core-mantle boundary and the geomagnetic field. This study models the thermal evolution of the core-mantle boundary to investigate the effects of mantle overturn on the geomagnetic field. Our results demonstrate that mantle overturn substantially accelerates the cooling of the core and increases the heat flow across the core-mantle boundary. This enhanced heat flow strengthens the geomagnetic field, which well explains the high virtual dipole moments at ~3.5-2.5 Ga. The palaeomagnetic records and the formation of the Archean continents generate a concordant picture on the evolution of the water-induced mantle overturn. Additionally, the Earth's mass redistribution driven by the mantle overturn provides a novel mechanism for triggering true polar wander in the Archean. Therefore, the recorded apparent polar wander at 3.34-3.18 Ga may not result from plate tectonics.