

## Geodynamo origin to inner core growth: Core chemical evolution traced by paleomagnetism

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New paleomagnetic, radiometric age, and geochemical data support a geodynamo at least as old as 4.2 Ga [1]. The Hadean geomagnetic field may have been driven by core precipitation of MgO [2] and/or SiO<sub>2</sub> [3]. The strength of the field progressively weakened in Archean to Proterozoic times, suggesting a long-term decrease in power for the geodynamo. A critical point was reached at 565 Ma in the Ediacaran period, when the field strength fell to a level 10 times less than that of present-day [4]. Other indicators of the state of the geodynamo reveal a rapid frequency of reversals and high non-dipole fields. These observations suggest the Ediacaran geodynamo neared the “weak-field” state, where core kinetic energy approached that of the magnetic energy. Together with predictions from numerical simulations [5], these data support an Ediacaran age for the onset of inner core nucleation. Collapse of the geodynamo was averted by the new energy source; light elements are rejected during inner core solidification driving compositional convection. The transition to a geodynamo powered by inner core growth was a critical stage in the chemical evolution of the core, enabling continuity of magnetic shielding of the atmosphere from erosion by the solar wind [6].

[1] Tarduno et al. (2015) *Science* **349**, 521-524. [2] Badro et al. (2016) *Nature* **536**, 326-328. [3] Hirose et al. (2017) *Nature* **543**, 99-102. [4] Bono et al. (2019) *Nat. Geosci.*, **12**, 143-147. [5] Driscoll, P (2016) *Geophys. Res. Lett.*, **43**. [6] Tarduno et al. (2011) *Phys. Earth Planet. Inter.*, **233**, 68-87.