Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24527

A long-lasting tenuous Ediacaran geodynamo: potential linkages with the evolution of animal life

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Paleointensity studies define a geodynamo on the verge of collapse [1,2,3], 10 to 30 times weaker than present-day, when macroscopic animals of the Ediacaran Fauna diversified. New single crystal paleointensity results from ca. 590 Ma dikes of Canada yield field strength of hundreds of nanoteslas (or less) suggesting that the dynamo may have ceased entirely for periods lasting 2 to 100 kyr during the Ediacaran. For times when the field was present, use of solar wind evolution models based on solar analogs [4] suggests steady-state magnetopause standoff distances <4.5 Earth radii (re) at 565 Ma and <4.2re at 591 Ma, compared to the present-day value of ~10.7re. During extreme coronal mass ejection events, these distances could have been as low as 1.6re. Decreased standoff distances can lead to enhanced hydrogen escape because the polar cap area of open field lines expands, and this is where non-thermal H+ loss occurs. Estimates of these losses to space suggest they could result in a few percent change of atmospheric oxygen (PAL). This might represent a perturbation or crossing of a threshold, allowing Ediacaran animal diversification.

[1] Bono et al., (2019) *Nat. Geosci.* 12, 143-147. [2] Zhou et al. (2022) *Nat Commun*. 13, 4161 [3] Huang et al. (2024) *Commun. Earth Environ.* in review. [4] Tarduno et al. (2010) *Science* 327, 1238-1240.