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GR Letter

Rapid changes of magnetic Field polarity in the late Ediacaran: Linking the Cambrian evolutionary radiation and increased UV-B radiation

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Highlights

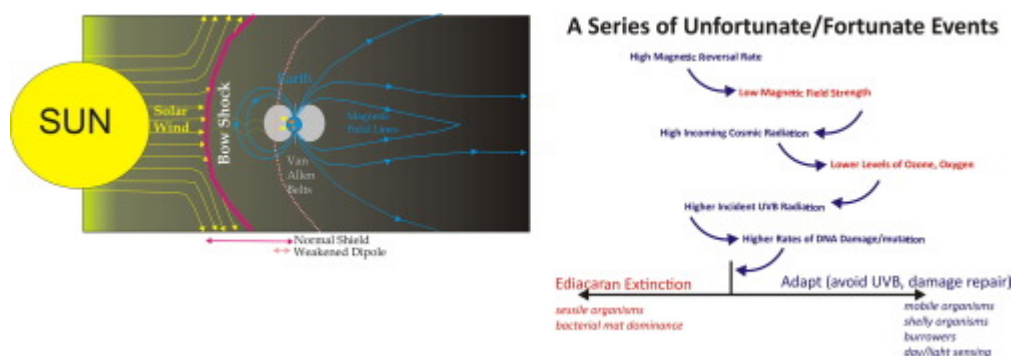
- Magnetic field reversal hyperactivity documented in Late Ediacaran
- Dipole lows associated with hyperactivity reduce distance to magnetopause bowshock

- Destruction of ozone layer and loss of oxygen associated with weaker dipole field
- Ediacaran extinction tied to increased UV-B radiation in the shallow marine environment

Abstract

Novelty in the biological world is the culmination of genetic changes often triggered by the physical environment. The most radical phase of **biological evolution** took place during the **Cambrian** Evolutionary Radiation (CER). Prior to the CER, bacterial matgrounds and associated communities of **Ediacaran** organisms dominated the shallow seafloor. Near the end of the Ediacaran Period, ~ 550 million years ago, many soft-bodied biota went extinct. In the Early Cambrian, animals with the ability to burrow vertically altered the **ecology** of the seafloor and **biomineralization** became commonplace. Here we link the terminal Ediacaran extinction, the Cambrian substrate revolution and the diversification of biomineralizing organisms to changes associated with the reversal frequency of the Earth's **magnetic field**. Beginning around 550 Ma and continuing through much of the Cambrian, the Earth's magnetic field was rapidly reversing. Models, and limited paleointensity studies, indicate that rapid reversals are a feature of an overall weaker dipole. A weakened dipole reduces the dimensions of the **magnetosphere** that provides a barrier to incoming **cosmic radiation**. Here we show that the environmental effects of that collapse include increased dosing of UVB radiation into the shallow marine environment. Increased UVB radiation in the shallow marine environment provided selective pressure favoring organisms that could detect and avoid UVB damage by burrowing vertically, moving up or down in the water column, growing protective shells and other 'flight from light' mechanisms. These changes took place in advance of the CER, but effectively cleared the ecological space for the subsequent changes in the later Cambrian.

Graphical abstract



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