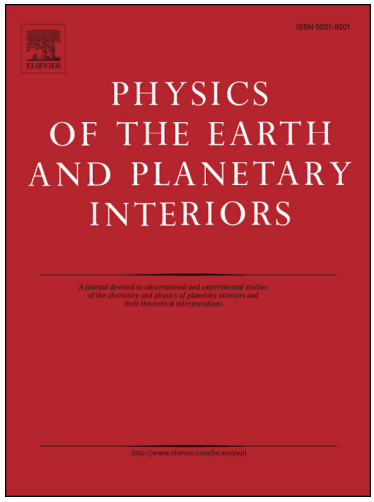

Review

Detecting the oldest geodynamo and attendant shielding from the solar wind: Implications for habitability

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Detecting the oldest geodynamo and attendant shielding from the solar wind: Implications for habitability

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Abstract

The onset and nature of the earliest geomagnetic field is important for understanding the evolution of the core, atmosphere and life on Earth. A record of the early geodynamo is preserved in ancient silicate crystals containing minute magnetic inclusions. These data indicate the presence of a geodynamo during the Paleoarchean, between 3.4 and 3.45 billion years ago. While the magnetic field sheltered Earth's atmosphere from erosion at this time, standoff of the solar wind was greatly reduced, and similar to that during modern extreme solar storms. These conditions suggest that intense radiation from the young Sun may have modified the atmosphere of the young Earth by promoting loss of volatiles, including water. Such effects would have been more pronounced if the field were absent or very weak prior to 3.45 billion years ago, as suggested by some models of lower mantle evolution. The frontier is thus trying to obtain geomagnetic field records that are $\gg$3.45 billion-years-old, as well as constraining solar wind pressure for these times. In this review we suggest pathways for constraining these parameters and the attendant history of Earth's deep interior, hydrosphere and atmosphere. In particular, we discuss new estimates for solar wind pressure for the first 700 million years of Earth history, the compet-

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