Exploring the potential relation between the length of the day and the Earth's magnetic field over the last 3000 years.

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Résumé

The length of the day (LOD), i.e., the time it takes for the Earth to complete one rotation around itself, is not a constant value, it has variations with periods ranging from years to thousands of years. Historical records concerning luni-solar eclipses and star occultations provide valuable insights into the evolution of the length of the day over the last 3,000 years. The main influence on the LOD is the tidal friction force, the gravitational effect of the Earth-Moon system which is gradually decelerating the Earth's spin at a rate of 2.4 milliseconds per century while the moon suffers an acceleration and an increase in its orbital radius. However, within this overall trend, there is an oscillatory component with a period of approximately 1,300 years that cannot be solely explained by tidal effects or other effects such as post-glacial rebound or sea level variations. It requires an explanation involving a form of interaction between the Earth's mantle and core. Various mechanisms have been proposed, including electromagnetic coupling wherein the Earth's magnetic field plays an active role. The geomagnetic field is generated by the motions of the fluid in the Earth's outer core, it is therefore reasonable to assume that changes in these flows can be reflected in both the geomagnetic field and the Earth's rotation system. In this study, we have explored the possibility that variations in the LOD are linked to the energy of the Earth's magnetic field. To achieve this, we have conducted a frequency domain analysis in both the non-tidal observations in LOD and geomagnetic field energy, derived from the most recent palaeoreconstructions of the global magnetic field spanning the last 3,000 years and correlation test between the two signals. As a result, we have found a shared 1,300-year period in the LOD and energy of the non-axial terms of the Earth's magnetic field. These findings are interesting and open a possibility for further research in this field to validate and enhance our understanding of the nature and underlying causes of this potential connection between the Earth's magnetic field and the temporal variability in the LOD.

Mots-Clés: Geomagnetism, Earth's rotation, Length of the day, Frequency analysis

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