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Three distinct reversing modes in the geodynamo

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Abstract

© 2016, Pleiades Publishing, Ltd.The data that describe the long-term reversing behavior of the geodynamo show strong and sudden changes in magnetic reversal frequency. This concerns both the onset and the end of superchrons and most probably the occurrence of episodes characterized by extreme geomagnetic reversal frequency (>10–15 rev./Myr). To account for the complexity observed in geomagnetic reversal frequency evolution, we propose a simple scenario in which the geodynamo operates in three distinct reversing modes: i—a “normal” reversing mode generating geomagnetic polarity reversals according to a stationary random process, with on average a reversal rate of ~3 rev./Myr; ii—a non-reversing “superchron” mode characterizing long time intervals without reversal; iii—a hyper-active reversing mode characterized by an extreme geomagnetic reversal frequency. The transitions between the different reversing modes would be sudden, i.e., on the Myr time scale. Following previous studies, we suggest that in the past, the occurrence of these transitions has been modulated by thermal conditions at the core-mantle boundary governed by mantle dynamics. It might also be possible that they were more frequent during the Precambrian, before the nucleation of the inner core, because of a stronger influence on geodynamo activity of the thermal conditions at the core-mantle boundary.

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