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Core history from paleomagnetic data: Potential changes in stratification but no evidence for a Mesoproterozoic inner core age

Aleksey Smirnov (1,2), John Tarduno (3,4), Evgeniy Kulakov (5), Suzanne McEnroe (6), and Richard Bono (3)

(1) Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, USA (asmirnov@mtu.edu), (2) Department of Physics, Michigan Technological University, Houghton, USA, (3) Department of Earth and Environmental Sciences, University of Rochester, Rochester, USA, (4) Department of Physics and Astronomy, University of Rochester, Rochester, USA, (5) Centre for Earth Evolution and Dynamics, University of Oslo, Oslo, Norway, (6) Department of Geology and Mineral Resources Engineering, Norwegian University of Science, Trondheim, Norway

Data on the long-term evolution of Earth's magnetic field intensity are crucial for understanding the mechanisms of the geodynamo and planetary evolution. However, the paleointensity record in rocks may be adversely affected by a plethora of physical processes which must be taken into account when analyzing the paleointensity database. Recently, a statistical analysis of the Precambrian paleointensity database was used to claim that the solid inner core formed in the Mesoproterozoic, and that this onset time constrains the thermal conductivity in the core to "moderate" values. Here, we demonstrate that the data selection criteria used in this analysis failed to filter out data that significantly overestimate the true paleofield strength due to the presence of non-ideal carriers of paleointensity signals and/or viscous re-magnetizations. Moreover, the use of site-mean data led to an additional statistical bias by giving equal weight to time-averaged and non-time-averaged data. When the paleointensity overestimates are removed, and the study-mean data are used instead of site-mean data, the Precambrian database does not indicate a robust change in geomagnetic field intensity during the Mesoproterozoic. Our analyses indicate that the presently available paleointensity data of Mesoproterozoic age are insufficient in number and quality to constrain the timing of solid inner core formation, or the outstanding problem of core thermal conductivity. More promising available data sets that reflect long-term core structure are geomagnetic reversal rate and field morphology. The latter suggests changes that may reflect differences in Archean to Proterozoic core stratification, whereas the former suggest an interval of geodynamo hyperactivity at ca 550 Ma.