The inner core nucleation of the Earth and its paleogeographic implications

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For the age of the onset of the Earth's inner core, widely varying estimates have been presented, due to varying quality of data and poor knowledge of geothermal parameters. The advent of new paleointensity data, however, allows a robust investigation on the topic.

To determine the behaviour of the Earth's dipole moment during the Precambrian, our study applies 320 entries from the PINT paleointensity database, with newly assigned Q_{PI} data reliability values. Based on the availability of data, we have divided paleointensity values into timeslots of 3500-2400 Ma, 2400-1400 Ma and 1300-500 Ma. The mean dipole moment obtained from the early and middle intervals is smaller, and statistically distinct from that of the late interval, thus implying an abrupt increase of field intensity in late Mesoproterozoic when the chemical convection began to dominate the dynamo process which was previously run by vigorous thermal convection. However, the field of 1300-500 Ma appears rather similar to that of the last 300 Ma, indicating that the chemical dynamo process still continues.

Our analysis suggests that the Earth's inner core was formed at 1500-1000 Ma coincide with the time when the Nuna supercontinent disintegrated. In addition, the global paleomagnetic record of 1500-1200 Ma was characterized by an anomalously large proportion of low inclinations potentially associated with the presence of zonal multipolar geomagnetic fields between periods in which the Geocentric Axial Dipole (GAD) model appears valid. Therefore, a readjustment of paleogeographic models may be necessary in this period, which is likely to be associated with the shift of the long term geomagnetic field from a stable to a less stable state as observed in the paleosecular variation data.