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A Mid-Palaeozoic Dipole Low related to True Polar Wander?

Louise Hawkins (1), Andy Biggin (1), Sheikerra Thomas-Cunnigham (1), Patipan Saengduean (2), Edward Sage (1), and Elliot Hurst (1)

(1) Geomagnetism Laboratory, University of Liverpool, Liverpool, UK (l.hawkins@liv.ac.uk), (2) Department of Geophysics, Colorado School of Mines, Colorado, USA

Since it was first described nearly 30 years ago, a number of studies have corroborated the Mesozoic Dipole Low (MDL), a period of at least ∼80 million years (Myrs) where the average strength of the geomagnetic field was about a third of that of the present day field (∼80ZAm^2). The MDL is thought to end at the onset of the Cretaceous Normal Superchron (CNS) and may have started at the end of the Kiaman Superchron, ∼50Myrs earlier than first reported. Both that reversals occur throughout the MDL and that comparatively high field values have been reported during the two superchrons are in agreement with the expected relationship between reversal frequency and dipole moment determined from numerical geodynamo models. Previously, there were insufficient data to determine if this relationship held further back in the Phanerozoic, however recent palaeointensity studies from Siberia produce field values similar to or lower than those of the MDL during the Devonian (the majority of sites give field strength values $\leq$40Am^2). To determine if this is part of a longer period of weak field, similar to the MDL, two new Scottish palaeointensity localities are presented; one older (the Strathmore at ∼415.5-410Ma) and one younger (the Kinghorn at ∼337.5-326.4Ma) than the Siberian localities. These localities have both previously been used for determining the position of Baltica (the poles have Q values of 7 and 6 respectively) and are consistent with the palaeodirections from the palaeointensity sites. Results of rock magnetic and SEM analyses from these sites are also consistent with the samples carrying a primary Thermal Remanent Magnetisation (TRM). These values, combined with the Siberian sites, show an apparent Mid-Palaeozoic Dipole Low (MPDL) spanning the Devonian to the Early Carboniferous (∼80-90Myrs), with an average field strength of ∼43ZAm^2. Q_{PI} analysis performed on these, and all of the sites dated between 200-500Ma from the PINT database, shows that the recent studies and many of the sites from the Siberian P-T traps gave high Q_{PI} values of 4-8, suggesting the weak field values before and after the Kiaman are reliable. The higher field values of the Kiaman Superchron are considered less reliable, with the majority of the sites scoring $\leq$3, suggesting further work may be needed to confirm that the field was strong during this Superchron. However, the similarities between these two extended periods of weak field (MDL and the MPDL) suggest a potential control on the long-term (10-100's of Myrs) variation of the geomagnetic field. Geodynamo modelling suggests that this is likely to relate spatial variation in heat flow across the Core-mantle boundary, relating to mantle convection. Several attempts have been made to link Phanerozoic palaeomagnetic variation to different mantle processes, such as plumes and subduction flux. Another possibility that could explain the Phanerozoic palaeomagnetic record, including the MPDL, comes from the effects of True Polar Wander on equatorial CMB heat flow, which are modelled and shown to inversely correlate with the Phanerozoic palaeointensity record presented here.