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Antiquity of the South Atlantic Anomaly: Evidence for top-down influence on the geodynamo

John Tarduno (1,2), Eric Blackman (2), Thomas Huffman (3), Michael Watkeys (4), and Rory Cottrell (1)

(1) University of Rochester, Earth and Environmental Sciences, Rochester, New York, United States (john@earth.rochester.edu), (2) University of Rochester, Physics and Astronomy, Rochester, New York, United States, (3) School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa, (4) School of Geological Sciences, University of KwaZulu-Natal, Durban 4000, South Africa

The dramatic decay of the dipole geomagnetic field intensity during the last 160 years coincides with changes in South Hemisphere (SH) field morphology, including the growth of a reversed core flux patch beneath South Africa and an area of low surface field intensity spanning the southern Atlantic, and southern Africa and South America. The rapid dipole decline relative to ohmic resistance, has motivated speculation that Earth is heading toward a field reversal, but understanding these phenomena within the context of longer term geomagnetic history has been limited by a lack of SH archeomagnetic data. Our studies provide the first archeomagnetic curve from Iron-age sites of southern Africa (ca. 1000-1650 AD). Magnetic directions show rapid changes at ca. 1350 AD, whereas paleointensity data define a sharp intensity drop, at a rate comparable to modern field changes. Here, we propose that the recurrence of low field values reflects flux explusion, promoted by the unusual core-mantle boundary composition and structure beneath southern Africa defined by seismology. Core flow could be driven to small scales such that the magnetic Reynolds number is sufficiently reduced to allow reversed polarity flux bundles to leak up from the core flow in this region.