

Technical University of Denmark



Gyre-driven decay of the geomagnetic dipole

Finlay, Chris; Aubert, Julien; Gillet, Nicolas

Published in:

Program and Abstract Volume - 14th international symposium on Study of Earth's Deep Interior (SEDI)

Publication date:

2014

Document Version

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):

Finlay, C. C., Aubert, J., & Gillet, N. (2014). Gyre-driven decay of the geomagnetic dipole. In Program and Abstract Volume - 14th international symposium on Study of Earth's Deep Interior (SEDI) [609]

DTU Library

Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Gyre-driven decay of the geomagnetic dipole

Christopher C. Finlay¹, Julien Aubert², Nicolas Gillet³

¹ Division of Geomagnetism, DTU Space, Technical University of Denmark, Denmark
(cfinlay@space.dtu.dk)

² Dynamique des Fluides Géologiques, Institut de Physique du Globe de Paris, Sorbonne Paris Cit,
Université Paris Diderot, UMR 7154 CNRS, F-75005 Paris, France

³ Equipe Godynamo, ISTERre, Université Grenoble 1, CNRS, Grenoble CEDEX 9, France

Direct observations show that the magnitude of the Earth's magnetic dipole has steadily decayed over the past 170 years; it is now more than 10% weaker than it was 1840. Here, we explore the possibility that a planetary scale gyre in the outer core, previously revealed by core flow inversions, plays an important role in dipole decay with its meridional arms simultaneously transporting reversed flux poleward and strong normal flux equatorward. We present simple kinematic experiments that demonstrate the basic mechanism together with results from frozen-flux, quasi-geostrophic, core flow inversions that display similar characteristics. Moving to a more realistic scenario, we present initial investigations of dipole decay in a 3D, convection-driven, numerical dynamo with an Earth-like magnetic Reynolds number. This allows for the evolution of the magnetic field by both advection and diffusion processes. The numerical dynamo model studied naturally generates a planetary scale quasi-geostrophic gyre (Aubert et al., 2013) and is initialized to be in a state consistent with the observed core surface magnetic field (Aubert, 2014). We find that this system can reproduce the general characteristics of current dipole decay episode, and that advection by the planetary scale gyre plays an important role.

References

- Aubert, J., Finlay, C. C., Fournier, A. (2013) Bottom-up control of geomagnetic secular variation by the Earth's inner core, *Nature* 502, 219-223, 2013, doi: 10.1038/nature12574.
- Aubert, J. (2014) Earth's core internal dynamics 1840-2010 imaged by inverse geodynamo modelling, *Geophys. J. Int.* 197, 1321-1334, 2014, doi: 10.1093/gji/ggu064.