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## NEWS

Jun 14, 2009

# Earth's magnetic field perturbed by 'electric oceans', claims researcher

Electric blue: origin of magnetic north has never been proven

In a radical rethink of accepted geophysics, new research in the US links variations in the Earth's magnetic field with the ebb and flow of the world's oceans. Given the practical importance of these field variations in navigation and atmospheric modeling, the implications of this new research extend far beyond academia. However, the idea has already faced strong criticism from some researchers in the geophysics community.

> I consider this paper extremely important, although I expect violent opposition from the experts
>
> Alex Kostinski, Michigan Technological University

The origin and mechanism of the Earth's magnetic field are amongst the biggest unsolved questions in the earth sciences. Most geophysicists agree however that the main component of the field — which defines the magnetic poles — is a dipole generated by the convection of molten iron deep within the Earth's interior. We know, from studying the way magnetic minerals align in volcanic rocks, that this dipole has flipped its orientation every million years or so throughout Earth history.

Given these huge time-scales, sailors and Scouts need not

worry about the North Pole suddenly becoming the South, but there is another shorter-term threat to old-fashioned navigation caused by slight drifting of the magnetic field over years-to-centuries. The origin of this "secular variation" is also thought to originate in the molten iron core, due to fluctuations in the established convection pattern. And, although small in comparison with the main dipole field, secular variation can be difficult to predict with effects substantial enough to prompt a revision of the International Geomagnetic Reference Field every five years.

## Electric sea salts

Now, Gregory Ryskin of Northwestern University, Illinois, is offering an alternative explanation for the origin of this secular variation. Ryskin believes that electric currents induced in dissolved salts — as ocean waters circulate through the Earth's magnetic field — can generate secondary magnetic fields strong enough to shift the orientation of the original field. Comparing his own calculations with public geophysical data, Ryskin links circulation in the North Atlantic with observed trends in secular variation over Western Europe.

Scientists have long since known that salt in the ocean can conduct electricity, leading to secondary fields, as the waters chop and change in the presence of the Earth's magnetic field. In practice, however, it is difficult to gauge the scale of these fields — partly due to the incompleteness of data and the limited precision of computations. Ryskin also suggests that previous measurement of these fields have been somewhat biased by standard theories. "Researchers work backwards — they begin with the assumption that secular variation comes from the core when this is still only a hypothesis."

Taking a different approach, the physicist looked specifically at the North Atlantic in isolation from other models of the Earth's field. He calculated the expected variation in magnetic fields between 1995 and 2000 using equations of solute transport and magnetic diffusion, and ocean circulation data from ECCO — a global reference point funded in part by NASA and the National Science Foundation (NSF).

## Out of the blue

Ryskin then compared these figures with recorded secular variations in the International Geomagnetic Reference Field (IGRF) — a publicly available resource derived from satellites, observatories and surveys around the world. Publishing his findings in *New Journal of Physics*, Ryskin finds strong temporal and spatial correlation between his calculated secular variation and the IGRF figures between 1995 and 2000.

The reason this theory is so controversial is that it directly

challenges one of the strongest pieces of evidence in the standard model of the Earth's magnetic field. Secular variation caused by fluid motions in the earth's outer core is taken by geophysicists as confirmation that the main field also emerges from this region known as the "geodynamo". As Ryskin asserts in his paper: "If secular variation is caused by the ocean flow, the entire concept of the dynamo operating in the Earth's core is called into question: there exists no other evidence of hydrodynamic flow in the core."

Alex Kostinski, an atmospheric physicist at Michigan Technological University told *physicsworld.com*: "I consider this paper extremely important, although I expect violent opposition from the experts."

Indeed, some geophysicists believe there are fundamental limitations in this research. "[Ryskin] should compare the required electric currents for the theory with the amplitudes of electric currents that have been measured in the ocean," said Robert Tyler, an ocean electrodynamics researcher at the University of Washington. Tyler also criticizes the way Ryskin has modeled the spreading of magnetic fields through sea waters. "In a thin conducting shell like the ocean, the diffusion is not through the ocean but along the top/bottom boundaries."

Despite Ryskin's bold claims, he is also careful to note that — although he sees strong correlation in his results — this does not prove beyond doubt that all secular variation is due to ocean flow. "In fact, a definitive proof may never be possible, but as the accuracy and completeness of the data continue to improve, and further computations are carried out, sufficient clarity on the issue should be achieved soon," he writes.

About the author
James Dacey is a reporter for *physicsworld.com*



## 4 COMMENTS

Add your comments on this article

CDMGSDAD
Jun 14, 2009 3:07 AM
HUNTINGTON, United States

1

"I consider this paper extremely important, although I expect violent opposition from the experts."

"violent opposition"--Sounds like some "experts" are too emotionally involved (or is it that they feel their careers are threatened?) to make rational evaluations.

This sort of pettiness (so common in science) tends to detract from claims that "science" is the quest for truth.
*Edited by CDMGSDAD on Jun 14, 2009 3:09 AM.*

Reply to this comment ▸ Offensive? Unsuitable? Notify Editor ▸

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Oliver K. Manuel
Jun 14, 2009 4:56 AM
United States

2

VIOLENT OPPOSITION TO NEW IDEAS

Quote:

> Originally posted by CDMGSDAD
> "I consider this paper extremely important, although I expect violent opposition from the experts."
>
> "violent opposition"--Sounds like some "experts" are too emotionally involved (or is it that they feel their careers are threatened?) to make rational evaluations.
>
> This sort of pettiness (so common in science) tends to detract from claims that "science" is the quest for truth.

You are exactly right. Science is one path to truth. Science and religion share a common spiritual foundation: "Truth is victorious, never untruth." [Mundaka Upanishad 3.1.6; Qur'an 17.85]

Violent opposition to new ideas and to unexpected experimental data arise from those who have drifted away from the spiritual basis of science, back into the ego cage of a two-year old child.

Dr. Dwarka Das Sabu and I were shocked when we encountered this level of immaturity from leaders of the geophysics community* at the 1976 AGU meeting in Washington, DC.

But we let the data guide us and today I am pleased to report that we took the right path because: "What is, is."

With kind regards,
Oliver K. Manuel
www.omatumr.com...

PS - Dr. Marvin Herndon's suggestion of a reactor at the core of Earth received a similar reaction from members of the Geophysics Division of NAS.
*Edited by Oliver K. Manuel on Jun 14, 2009 4:58 AM.*

Reply to this comment ▸ Offensive? Unsuitable? Notify Editor ▸

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lacsilva
Jun 14, 2009 12:10 PM
France

3

Good work but...
This paper talks about ocean contributions to the observable magnetic field at Earth's surface. Indeed, oceans contribute to the magnetic field and this contribution is taken into account in all recent models (see the site www.geomag.org for some papers about it). I would be very

much interested in seeing how tis model compares to models as GRIMM (Lesur et al., 2008) and CHAOS (Olsen et al.,2006).
You make a fundamental flaw when saying that there are no other evidences for a hydrodynamic core flow then variations of the magnetic field. This is not true. In fact, the biggest proof we have comes from the observation of the length of day and Earth wobbling that cannot be explained by the ocean and atmosphere variations in angular momentum.
Furthermore, if the oceans are the cause of all the secular variation then, apart from the oceanic and external contributions the main field should be static. What mechanism do you propose for generating a static, large scale field that, from time to time, reverses polarity?
I would really like to hear your comments on these issues.

Reply to this comment ▸ Offensive? Unsuitable? Notify Editor ▸

Oliver K. Manuel
Jun 14, 2009 8:54 PM
United States

4

EARTH'S AND SUN'S MAGNETIC FIELD ARE COUPLED
Earth moves in orbit through the outer layer of the Sun, the heliosphere.

Earth's magnetic field is therefore perturbed by changes in the magnetic field of the Sun.

This was noted in an earlier Physics World discussion on the Earth's magnetic field.

physicsworld.com...38822

With kind regards,
Oliver K. Manuel
myprofile.cos.com...manuelo09

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