The Earth's magnetic field remains a charged mystery

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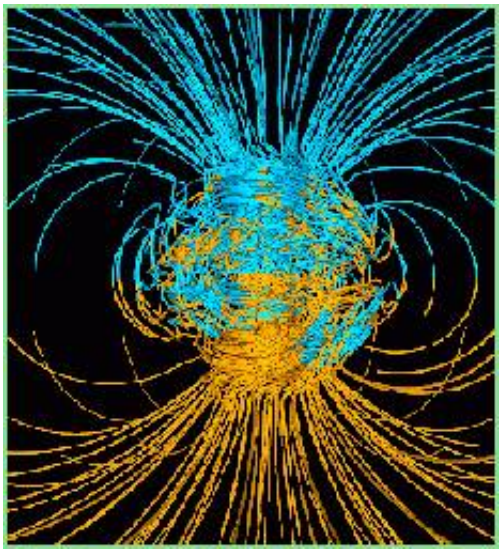

400 years of discussion and we're still not sure what creates the Earth's magnetic field, and thus the magnetosphere, despite the importance of the latter as the only buffer between us and deadly solar wind of charged particles (made up of electrons and protons). New research raises question marks about the forces behind the magnetic field and the structure of Earth itself.

The controversial new paper published in *New Journal of Physics* (co-owned by the Institute of Physics and the German Physical Society),

'Secular variation of the Earth's magnetic field: induced by the ocean flow?', will deflect geophysicists' attention from postulated motion of conducting fluids in the Earth's core, the twentieth century's answer to the mysteries of geomagnetism and magnetosphere.

Professor Gregory Ryskin from the McCormick School of Engineering and Applied Science at Northwestern University in Illinois, US, has defied the long-standing convention by applying equations from magnetohydrodynamics to our oceans' salt water (which conducts electricity) and found that the long-term changes (the secular variation) in the Earth's main magnetic field are possibly induced by our oceans' circulation.

With calculations thus confirming Ryskin's suspicions, there were also time and space correlations - specific indications of the integral relationship between the oceans and our magnetospheric buffer. For example, researchers had recorded changes in the intensity of current circulation in the North Atlantic; Ryskin shows that these appear strongly correlated with sharp changes in the rate of geomagnetic secular variation ("geomagnetic jerks").

Tim Smith, senior publisher of the *New Journal of Physics*, said, "This article is controversial and will no doubt cause vigorous debate, and possibly strong opposition, from some parts of the geomagnetism community. As the author acknowledges, the results by no means constitute a proof but they do suggest the need for further research into the possibility of a direct connection between ocean flow and the secular variation of the geomagnetic field."

In the early 1920s, Einstein highlighted the large challenge that understanding our Magnetosphere poses. It was later suggested that the Earth's magnetic field could be a result of the flow of electrically-conducting fluid deep inside the Earth acting as a dynamo.

In the second half of the twentieth century, the dynamo theory, describing the process through which a rotating, convecting, and electrically conducting fluid acts to maintain a magnetic field, was used to explain how hot iron in the outer core of the Earth creates a magnetosphere.

The journal paper also raises questions about the structure of our Earth's core.

Familiar text book images that illustrate a flow of hot and highly electrically-conducting fluid at the core of the Earth are based on conjecture and could now be rendered invalid. As the flow of fluids at the Earth's core cannot be measured or observed, theories about changes in the magnetosphere have been used, inversely, to infer the existence of such flow at the core of the Earth.

While Ryskin's research looks only at long-term changes in the Earth's magnetic field, he points out that, "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."

On a practical level, it means the next time you use a compass you might need to thank the seas and oceans for influencing the force necessary to guide the way.

Dr Raymond Shaw, professor of atmospheric physics at Michigan Technological University, said, "It should be kept in mind that the idea Professor Ryskin is proposing in his paper, if valid, has the potential to deem irrelevant the ruling paradigm of geomagnetism, so it will be no surprise to find individuals who are strongly opposed or critical."

Source: Institute of Physics