**Earth’s Magnetic Field**

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The Earth’s magnetic field has been protecting our planet from solar radiation since its inception. This magnetic field is a gigantic invisible shield that extends from the Earth’s poles to surround our planet. In order to better understand the origin of Earth’s magnetic field we would need to start by overviewing some basic electricity and magnetism concepts from physics.

Originally electricity and magnetism were considered as two different forces however, in 1873 James Clerk Maxwell proved that electricity and magnetism go hand in hand and called it the electromagnetic theory. This theory has paved the way for the future of science since. According to Maxwell’s theory change in magnetic flux produces a current and similarly a current, movement of electrical charges, results in a magnetic field.

Thus according to the theory whenever charged particles move they create a magnetic field similar to that generated by a magnet. By early 1940s physicists postulated that there are three conditions vital for the generation of a magnetic field in a planet. Firstly, one requires a large volume of electrically charged fluid that is rich in iron. Secondly, one requires a process whereby heat is transferred from the bottom to the top, which in our planet’s case is provided by the convection of the metallic fluid. Lastly in order for a magnetic field to be generated there needs to be some sort of a rotation. The rotation of our planet through the coriolis effect deflects the rising fluid inside the core. Even though the source of Earth’s magnetic field is not completely understood but in as mentioned above is related to the electrical currents produced by both the convection and rotation of the outer liquid metallic core of our planet which is rich in both iron and nickel.

Due to this reason of the liquid metallic core differs form that of a bar magnet because Earth’s magnetic field keeps changing resulting in the Earth’s north and south pole to switch positions. Currently the Earth’s magnetic north pole is said to drifting from Northern Canada towards Siberia with the present acceleration rate of 10 kilometers per year from the beginning of the 20th century to 40 kilometers per year measured in 2003 and still continues to accelerate. However these changes in the magnetic field take several hundred thousand years that make the use of compasses for navigation still viable. According to NASA the Earth’s pole reversal takes place once every 200,000 years to 300,000 years. Evidence of the reversal of Earth’s magnetic poles can be found in sediment cores taken from the oceanic floors. The most recent Earth’s magnetic pole reversal known as the Brunhes-Matuyana reversal is estimated to have occurred around 780,000 years ago. According to wired, Even though the reversal of the Earth’s magnetic field sounds like a significant dramatic event however there is no evidence that it would cause any harm to life on our planet.

The Earth’s magnetic field, also called the Geomagnetic field extends form the Earth’s center to where it meets with the solar winds. The magnitude of the Earth’s magnetic field at the surface is estimated to range from 25 to 65 microteslas. Currently the Earth’s magnetic dipole is tilted at an angle of 10 degrees with respect to the rotational axis.

The Earth’s magnetic field produces a magnetic flux and covers the area called the magnetosphere. The magnetosphere is responsible for protecting the Earth from radioactive particles emitted by the Sun. The magnetosphere as opposed to the field from the bar magnet is quite distorted. This can be attributed to the immense solar winds emitted by the stream of charged particles leaving the Sun’s corona at speeds ranging from 200 to 1000 kilometers per second. These solar winds exerts significant pressure on the Earth’s magnetic field as a result of which the distance of the magnetosphere from the Earth towards the side of the sun is about 10 Earth radii, however at the opposite side the magnetosphere may extend beyond 200 Earth radii.

The Earth’s magnetic field has shown evidence of becoming weaker. It is estimated that over the last 150 years the strength or intensity of the Earth’s magnetic field has deteriorated by 10-15%. According to a recent article published by Laura Dattaro the Earth’s magnetic field is weakening much faster than initial expectations. The data collected from the recently launched European Space Agency satellites indicate that the Earth’s magnetic poles will switch sooner than previous anticipations.

The Earth’s magnetic field has shielded our planet from significant amounts of Solar radiation without which life as we know it would have ceased to exist. Even though our planet’s geomagnetic field is changing and experiencing pole reversal – we can remain confident that it would continue to protect our planet for many years to come.

Reference:

Dattaro, L. (2014, July 10). *Earth's Magnetic Field Is Weakening Fast*. Retrieved July 16, 2014, from

http://www.weather.com/news/science/earths-magnetic-field-weakening-fast-20140710

Gary A. Glatzmaier and Peter Olson (2005, June16). *Probing the Geodynamo*. Retrieved July 16, 2014, from

http://www.scientificamerican.com/article/probing-the-geodynamo-2005-07

Wikipedia. (n.d.). Earth's magnetic field. Retrieved July 16, 2014, from http://en.wikipedia.org/wiki/Earth's\_magnetic\_field

University of Tennessee. (n.d.). The Earth's Magnetic Field. Retrieved July 16, 2014, from http://csep10.phys.utk.edu/astr161/lect/earth/magnetic.html

Quirin Schiermeier and Nature magazine. (2013, Novemmber 21). *Mission to Map Earth's Magnetic Field Readies for Takeoff.* Retrieved July 16, 2014, from http://www.scientificamerican.com/article/mission-to-map-earths-magnetic/

Wei, Y. (2012, March 8). *Earth's magnetic field provides vital protection.* Retrieved July 16, 2014, from http://www.esa.int/Our\_Activities/Space\_Science/Earth\_s\_magnetic\_field\_provides\_vital\_protection

National Aeronautics and Space Administration. (2003, December 29). *Earth's Inconstant Magnetic Field*. Retrieved July 16, 2014, from

http://science.nasa.gov/science-news/science-at-nasa/2003/29dec\_magneticfield/