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"The Planet Earth its Structure and Origin of Earth's Magnetic Field of Measurements"

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Abstract

The geomagnetic field measured at any point on the earth's surface is a combination of several magnetic fields generated by various sources. These fields are superimposed on and interact with each other. Approximate 90% of the geomagnetic field measured is generated internal to the planet in the earth's outer core. This portion of the earth's magnetic field is often referred to as the main field. The earth's main field varies slowly in time and creates a cavity in interplanetary space called the geomagnetosphere, where the earth's magnetic field dominates in the magnetic field of the solar wind. **(Bargatze,L.F.Baker,D. N.1985)[1].** The terrestrial magnetosphere is shaped somewhat like a comet in response to the dynamic pressure of the solar wind.

Introduction

It is compressed on the side toward the Sun to about 10 Earth radii and is extended tail-like on the side away from the Sun to more than 60 Earth radii. The geomagnetosphere deflects the flow of most solar wind particles around the Earth, while the geomagnetic field lines the charged particle motion within the geomagnetosphere. **(Berchem,J.1982)[2].** The differential flow of ions and electrons inside the geomagnetosphere causes variations in the intensity of the earth's magnetic field. These external currents in the ionized upper atmosphere and geomagnetosphere vary on a much shorter time scale than the internal main field and may create magnetic fields as large as 10% of the main field. In recent years, these in situ data have resulted in explosive growth in our knowledge and understanding of solar-terrestrial processes. Nevertheless, the field has had a long history of investigation, starting well before the advent of satellite and rockets. By using analytical data obtained from various magnetometers and satellites. **(Gosling,J.T.,Bame,S.J.1993)[3]** many researchers have shown the various types of solar-interplanetary-terrestrial relationship. These studies are confusing due to lack of definite results, so, it is necessary to define a clear aspect for geomagnetic field disturbances, morphology of different types of geomagnetic storms.

Planet Earth and Structure

Earth is the largest and densest rocky planet, was formed about 4.5 billion years ago. These studies are confusing due to lack of definite results, so, it is necessary to define a clear aspect for geomagnetic field disturbances, morphology of different types of geomagnetic storms and their possible solar and interplanetary causes. **(Chen, J.1998)[4].** Present works deal the solar-interplanetary-geomagnetic coupling process and history of geomagnetic storms in a certain new way, on the basis of various latest theories and mechanism.It is our home planet and looks a beautiful blue and white ball shape from space. **Figure.1.** shows an image of the Earth observed from space.

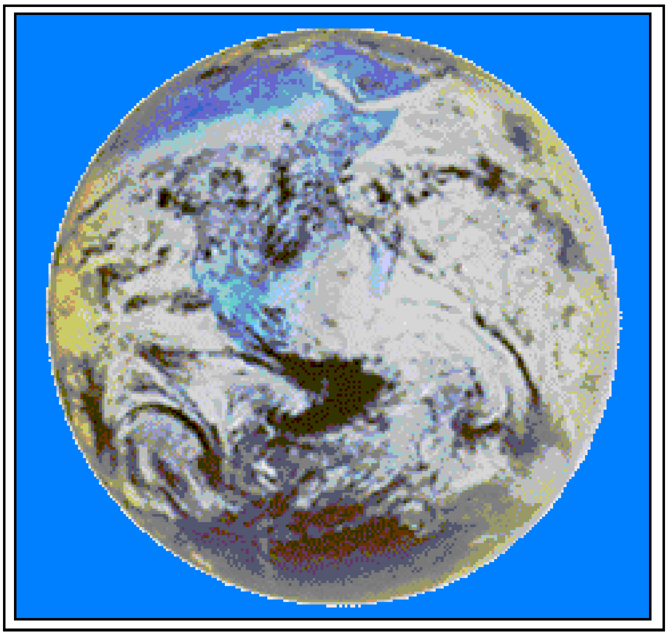

Figure.1.Show an image of the Earth observed from space.

The earth's interior is divided into four layers, and all four layers have different characteristics and are made of different elements and minerals. The first inner core is a solid metal core made by nickel and iron. The second outer core is known as liquid molten core consists of nickel and iron elements. The third mantle is dense and mostly solid silicate rock and, last crust is thin silicate rock material. **(Hewish, A.1988)[5].** The temperature in the earth's core is hotter than the Sun's surface. This intense heat from the inner core causes material in the outer core and mantle to move around. The geomagnetosphere deflects the flow of most solar wind particles around the Earth, while the geomagnetic field lines gush the charged particle motion within the geomagnetosphere.The differential flow of ions and electrons inside the geomagnetosphere causes variations in the intensity of the earth's magnetic field. **(Kahler, S. W.1992)[6].** The movement of material deep within the Earth may cause large plates made of the crust and upper mantle to move slowly over the earth's surface, and generate the earth's magnetic field.**Figure.2** shows an image of earth's atmosphere and its different layers observed.

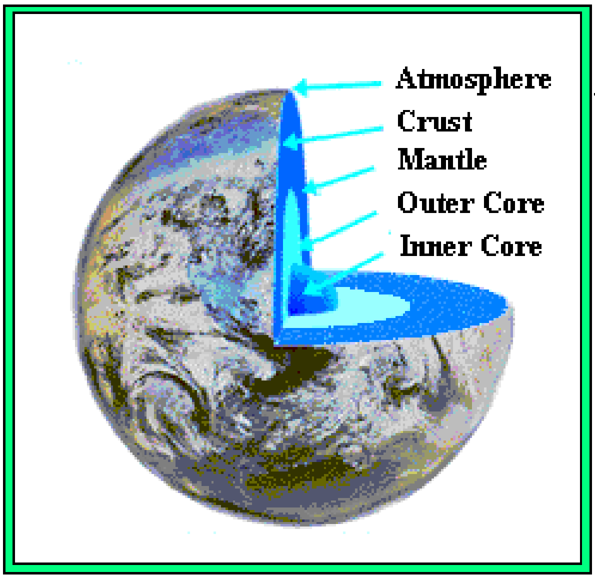

Figure.2.Depicts an image of Earth's atmosphere and its different internal layers.

The earth's atmosphere is composed by nitrogen (78%), oxygen (21%), and other gases (1%) and protects us by blocking out harmful radiations from the Sun. It is mixture of gases that becomes thinner until it gradually reaches space. In this mixture, oxygen is essential to life and some of the oxygen has changed into ozone on upper part. (**Farrugia, C. J.1996)[7].** The ozone layer filters out the Sun's harmful ultraviolet radiation. The earth's outer atmosphere can be divided into five layers depending on how temperature changes with height. These layers are Troposphere, Stratosphere, Thermosphere, Exosphere and Ionosphere. In the troposphere temperature decreases about 10 km altitude. Stratosphere is situated above the troposphere ozone and covers 50 km altitude. This sphere absorbing the ultraviolet solar radiation and temperature starts rising again. Above the Stratosphere radiative cooling creates the mesospheric temperature minimum nearly 80 km. Here temperature starts rising again, now very fast, and a hot thermosphere is formed. The absolute temperature which varies between 700º-2500º K of the thermosphere depends on the solar activity. In the thermosphere radiation ionizes the neutral atmosphere. **(Berchem,J.,and Russell,C.T.1982)[8].** Creating the Ionosphere. The ground and Ionosphere both are better conductors than the atmosphere, so, they formed a special cavity. The density decreases monotonously with altitude, and the composition stays well mixed up to turbopause nearly 100 km altitudes. Above the turbosphere, heterospheric composition starts showing variability with the altitude. The upper heterosphere consists of the light helium and hydrogen particle and its dynamics are expressed in terms of solar wind patterns.The dynamics of the lower thermospheric are expressed in terms of tidal modes and gravity waves originating from below, troposphere and stratosphere.

Origin of Earth's Magnetic Field

The earth's magnetic field originates in a dynamo-action in the earth's interior. The basic requirement is the existence of a fluid medium that is a good conductor of the electricity, and this is satisfied, as in generally agreed, by earth's interior.Postulated two major types of motion of the liquid in the earth's core. (**Burlaga,L.F.1995)[9].**The first type is convective with speed ranging between 0.1-0.5 cm/sec. The cause of the convective motion may be heat production by radioactive materials distributed in the inner core; of course, this is speculative. The second motion is a differential rotation of the earth's core, which is supposed not to rotate as a rigid body. The differential rotation of the inner and outer parts of the earth's core draws out the field lines of an initial poloidal field to produce a torodial field. These torodial fields are important to study of the dynamo theories. A moving field conductor and magnetic field exercise mutual controls to one another. The convective motions are characterized by radial flow pattern to rotate in such a way to converse angular momentum. The core dynamics are governed by Lorentz and Coriolis force, **(Crooker, N. U.1994)[10].** In addition to the origin of the earth's main field by dynamo action, there are another terrestrial and extra-terrestrial sources known to contribute to the geomagnetic field. The daily varying solar winds in the upper atmosphere produce an electric current system at about 100 km height; known as Sq current. The current pattern is approximately fixed with respect to the Sun, and the Earth rotates underneath it once a day.**(Farrugia,C.J.1997)[11].** The complicated current systems are set up above the Earth, when the intense solar plasma impinges on the earth's magnetic field. As a conductive sphere, the earth's reacts to such time-varying magnetic fields, and an induced current is generated within the solid Earth. Geomagnetic fields are generated by both the external and induced internal currents system at ground level.

Measurements of Earth's Magnetic Field

An invisible force, known as earth's magnetic field, surrounds the Earth. The earth's magnetic field originates deep within the Earth and extends many thousands kilometers into space. It acts as a protective shield against solar radiation that might be harmful to life. It is dynamic, sometimes increasing in strength, sometimes decreasing, constantly changing in direction, and sometimes even reversing. Earth's magnetic field is a vector and represented by seven components. **(Akasofu,&Yoshida,S.-I.1967)[12]**. These components are declination (D), inclination (I), horizontal intensity (H), vertical intensity (Z), total intensity (F) and the north (X) and east (Y) components of the horizontal intensity. By convention, declination is considered positive when measured east of north, inclination and vertical intensity positive down, X positive north, and Y positive east. The magnetic field intensity (B) and its component X, Y, Z and H are measured in C.G.S. units called gauss, denoted by Γ. For measuring small changes, a smaller unit, called gamma (γ) or nanoTesla (nT), is often used, where ($1\ \gamma = 1\ \text{nT} = 10^{-5}\ \Gamma$). **(Akasofu,S.-I.1972)[13]**.The component D and I are expressed in radian measure and are usually converted into degrees, minutes and second of arc. **Figure .3.** shows a diagram that represents the direction of above-mentioned components.

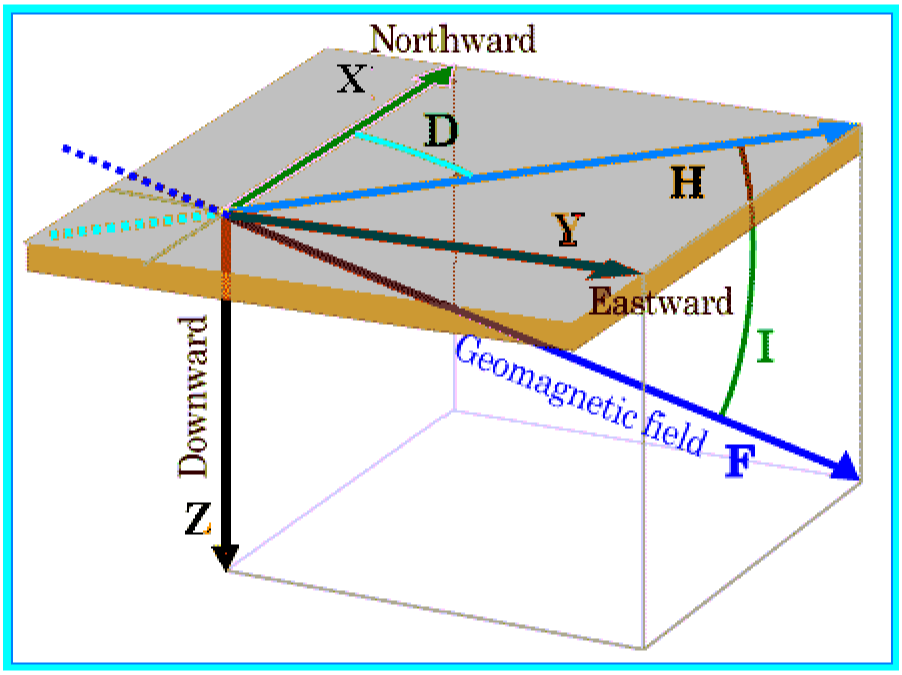

Figure.3. Shows the direction of Earth's magnetic field and its seven components, i.e. declination (D), inclination (I), horizontal intensity (H), vertical intensity (Z), total intensity (F) and the north (X) and east (Y) components.

The interconnections relations between above-mentioned components are represented by **Equation .1.**

$H = B \cos I,$

$X = H \cos D,$

$Y = H \sin D,$

$Z = B \sin I = H \tan I,$

$X^2 + Y^2 = H^2,$

$X^2 + Y^2 + Z^2 = H^2 - D^2 = B^2$ **equation .1.**

Earth's magnetic field has been observed routinely at geomagnetic observatories and recorded as "geomagnetic field data". Geomagnetic field data are essential for research in geomagnetism: for instance, they are indispensable in derivation of geomagnetic indices and geomagnetic field models. Geomagnetic field data that are available into three types: final, provisional and quick look, depending on the accuracy of measurement or delay time on the Data Analysis Centre for Geomagnetism and Space Magnetism. Quick look data are collected via Internet, **(Alan, H.,1994)**[14]**.**Promptness is a top priority, but they are not calibrated. Provisional data are possible to be replaced by more accurate data because they have already checked once or more times. Final data are basically definitive and are average of some geomagnetic observatories situated at different locations on Earth. There is another classification of geomagnetic data, known as digital and analog data. Digital data are recorded electrically in recording devices such as hard disk drives, while analog data are recorded in printing papers or films, **(Axford, W. I.1962)**[15] **.**Which are traditional recording devices since 19th century. Digital data can be sub classified by adding a statement of their time resolution (1-sec, 1-min, 1-hour, and so on). 1-sec digital data are suitable to investigate rapid variations of geomagnetic field, but they are available only for limited number of geomagnetic observatories and limited time periods. 1-min digital data make the primary constituents of digital data,. Available of numerous observatories for recent periods. 1-hour digital data are adequate for analysis of long-term variations of geomagnetic field, because they can be generated by digitization of analog data and are available for periods of about 100 years. Analog data which are also termed, as magnetogram can be sub-classified into normal run magnetogram and rapid run magnetogram depending on their recording speed. Rapid run magnetograms show geomagnetic field variations with shorter time scale than normal run magnetogtrams. Some observatories also provide storm magnetogram, which is low sensitivity for recording severe geomagnetic disturbances. In 1835 Gauss setup the first magnetic observatory at Gottingen.

Conclusion

At present time more than 200 magnetic observatories are well distributed over the earth's land surface. In our country, first geomagnetic observatory has been established by Moos at Coloba in the year 1846. This observatory has been shifted in Alibag. At present seven geomagnetic observatories were setup at Alibag, Annamalainagar, Hyderabad, Kodaikanal, Sabhawala, Trivendrum and Ujjain for the regular measurement of geomagnetic parameters. Their records, **(Feynman.J.1994)[16] .**Supplemented by those made over the oceans from non-magnetic ships and from aircraft, are used to compile the magnetic charts, which is important for navigation.affected during geomagnetic disturbances.The seven La Grande network static var compensators on line tripped one after the other.Many other power utilities in North America experienced problems ranging from minor voltage fluctuations to tripping out of lines and capacitors.

References

1. Bargatze, L. F., Baker, D. N.1985 .J. Geophys. Res.90, 6387.

2. Berchem, J.,1982 *J. Geophys. Res.*, 87, 2108-2114 and Russell, C. T.

3. Gosling, J. T., Bame, S. J.1993.J. Geophys. Res. Lett., 20, 2789-92.

4. Chen, J.,1998 *J. Geophys. Res.*, 103, 69-78 Fritz,T.A., Sheldon, R.B.Spence, H.E. Spjeldvik,

5. Hewish, A.1988. Solar Phys., 116, 195-98.

6. Kahler, S. W.1992 .Annu. Rev. Astron. Astrophys., 30, 113-41.

7.Farrugia,C.J.1996 *EOS, Trans. AUG,* 77(17), Spring Meet. Leeping, R. P.Suppl.S241.Burlaga,L.F.,Szabo,A.,Vassiliadis,D.,Stauning,P.and Freeman. M.P

8. Berchem, J., and Russell, C. T.1982. J. Geophys. Res., 87, 2108-2114.

9. Burlaga,L.F.1995. Interplanetary Magnetohydrodynamics,Oxford Univ. Press, New York.

10. Crooker, N. U.1994 *Nature,* 365 , 595.

11. Farrugia, C. J.1997 *Magnetic Clouds and Quit-Storm effect at* Burlaga,L. F.*the Earth*, in Geophys. Monogr. Series, ed. and Leeping, R. P. by Tsurutani, et al.

12.Akasofu, and Yoshida, S. -I.1967 *Planet Space Sci*., 15, 39-47.

13.Akasofu, S.-I.1972 *Solar Terrestrial Phys.*, Clarendon and Chapman, S. Press, Oxford.

14. Alan, H.,1994 *Proc. of Third SOHO Workshop*, Co. USA, McAllister,pp. 315 318. Dryer, M.,McIntosh, I.,Singer, H.and Weiss, M.

15. Axford, W. I.1962 *J. Geophys. Res.*, 67, 3791

16. Feynman, J 1994 and *J. Geophys. Res.*, 99, 8451.Hundhausen, A. J.