

**A SUGGESTED ORIGIN  
OF MAGNETISM  
AND  
IT'S USE TO EXPLAIN  
THE EARTH'S MAGNETIC FIELD**

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In memory of Dr. E.S.T. O'Driscoll, geologist, who long ago challenged me to explain how and why the magnetic field of a bar magnet was as it is.

# INTRODUCTION

This study developed from two earlier empirical studies, viz.,  
 (1) The discovery that if the Earth's inner core is offset as given in section B. below, then "The movement of any *single continental* plate can be plotted back in time to give *latitude, longitude, and rotation* of that plate using published palaeomagnetic poles", and  
 (2) That the Solar System formed by the sequential break-up of a single, differentiated "cold" body in such a manner that most of the lesser planets formed internally differentiated structures and, on ejection, their cores became displaced.

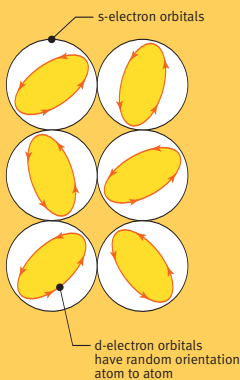
## A. ORIGIN OF MAGNETISM

Magnetite will be used for this discussion. The mineral has a unit cell formula  $Fe_3O_4$ . An atom of iron (Fe) has 6 of 8 possible d-electrons in its M-shell and 2 s-electrons in its outer N-shell. Oxygen (O) has 2 s-electrons and 4 p-electrons in its outer L-shell.

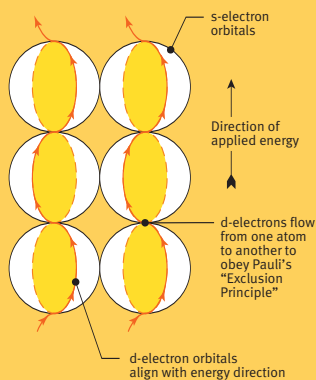
It is believed that the s-electron orbitals are circular, p-electrons ellipsoidal, and d-electrons even more ellipsoidal. For ferrous iron the 2 N-shell s-electrons of Fe fill the 2 valency spaces in the oxygen L-shell, thus giving FeO. A molecule of magnetite is face-centred cubic and so has 6 Fe atoms and 8 O atoms ( $Fe_3O_4$ ). The 8 O atoms require 16 electrons to complete their L-shells but only 12 s-electrons occur in Fe's N-shell. Thus the 4 electron deficiency must be made up by d-electrons of the M-shell. Six d-electrons will be equally available, so on filling the O atoms' outer shells 2 d-electrons remain unattached.

It is suggested here that this surplus of d-electrons is the cause of magnetism, for if the d-electron orbitals can be aligned then the surplus d-electrons will enter an adjacent Fe atom. This results in 3 electrons in two orbitals. But Pauli's "Exclusion Principle" states that only two electrons of opposite spins can remain in an orbital for atom stability and so one of the three electrons is ejected. If energy is applied unidirectionally the result will be for the ejected electron to pass into the adjacent in-line atom and so on. The result: a series of electrons moving in one direction, resulting in magnetism. (Figures 1 and 2.)

**Figure 1 : Natural State**



**Figure 2 : Energy Applied**

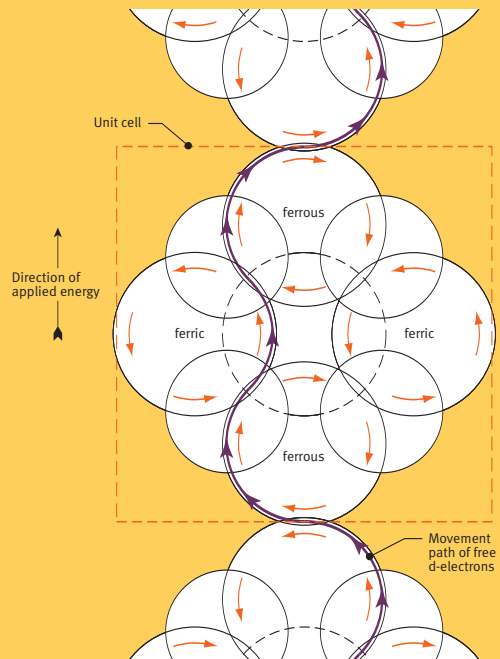


**Figure to explain d-electron flow:**  
 The inner ellipse is highly exaggerated to make clear the d-electron movement

Figure 3 shows the electron movement in magnetite. Figure 4 shows it for pure iron. The structures and electron movements shown require that magnetite should have a magnetic strength 2/5 that of pure iron. Experiments done by Plucker long ago gave 40,227/100,000 – closely 2/5.

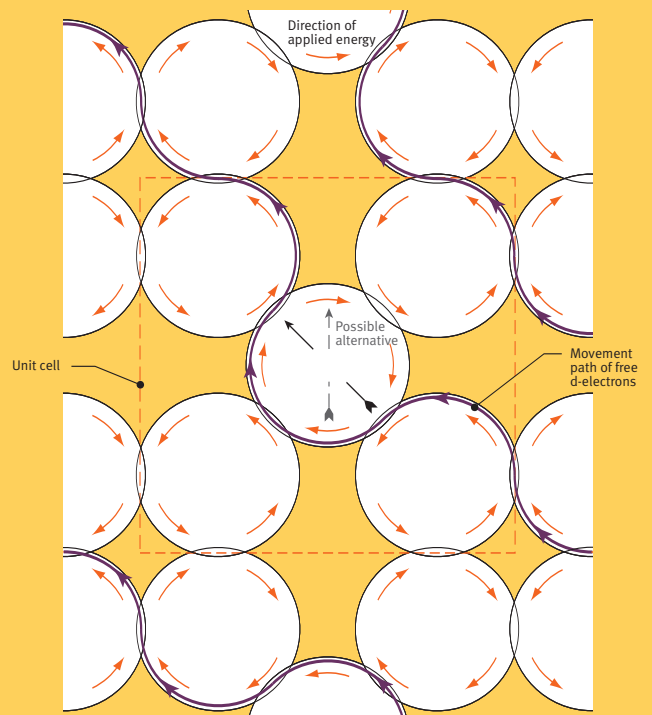
**Figure 3 : Magnetite**

Section along the b-c (= a<sub>2</sub>-a<sub>3</sub>) unit cell plane



**Figure 4 : Iron**

Section along a vertical diagonal plane of a unit cell



## B. EARTH'S MAGNETIC FIELD

Some conclusions from a many-year's study of Earth properties:

1. The Earth's inner core is offset, with its centre on a straight line joining the North and South Magnetic Poles at the point where the line intersects the 6°N latitudinal plane;
2. The inner core exerts an outward spherical pressure on the remainder of the Earth;  
Points 1 and 2 allow the mathematical determination of the stress figure formed within the Earth, giving the three principal axes, three principal planes, and the four shear planes. Figure 5 is a copy of the colour plate Figure 7, opposite p.58, in the paper on Earth seismicity "Inner-Core Anisotropy and Rotation" by J. Tromp in the journal "Annual Review of Earth and Planetary Sciences", vol. 29 (2001). On it are superimposed, in dashed lines, the three principal planes a, b, and c.
3. The offset inner core and probably the outer core consist dominantly of Mg, Fe silicates of great density forms;
4. The core material is in a high pressure, metastable state;
5. The Earth/Moon rotation-retarding couple has acted since almost the beginning of Earth's formation;
6. The Earth's rotation has increased as well as decreased from Earth's separation from protoJupiter to the Present;
7. The magnetic pole axis as defined above has been at closely the same angle to the Earth's rotation for certainly the last 700 million years and almost certainly for the life of Earth.

This inclination was determined in 1989. Some seismic study theorists have since proposed that the axis of the Earth's core is inclined to Earth's rotation axis. See Tromp's paper cited above.

## DISCUSSION

The Moon imposes a retarding couple on Earth and slows the Earth's rotation as at present. The retard is applied externally, so retardation of consecutive shells inwards lag, with greatest lag at the core. Thus the core should be rotating faster than the outer shells. This is known to be so.

Because the centre of the solid inner core is offset and northerly from the Earth's body centre a spiral motion must develop in the outer, fluid core, winding up the inner core surface. (Figure 6.) The average linear movement will be in a near straight line inclined to Earth's rotation axis and so the average direction of imposed energy will be along this line. Under such a regime, d-electrons of atoms (principally Fe??) will parallel this line, i.e. the Magnetic Axis, and if the energy is sufficient d-electron flow will take place to give magnetism. The effect is similar to that resulting from rubbing an ebony rod with a silk cloth.

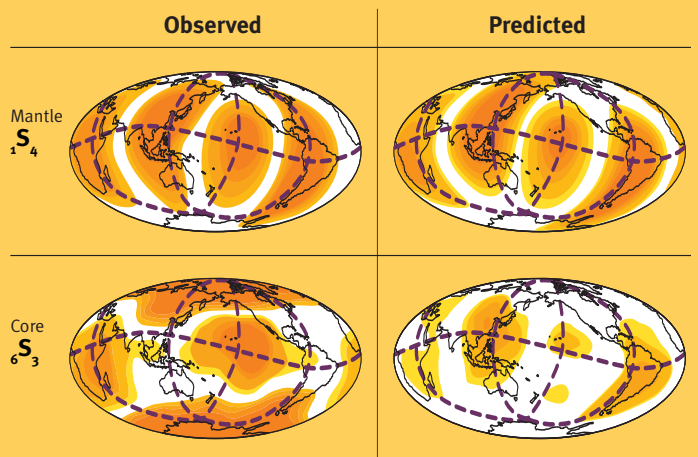
## C. DECREASE AND CHANGE OF POLARITY OF THE MAGNETISM

For a slowing Earth the inner core is rotating faster than the remainder. Assume chemical and/or tectonic forces in the outer layers cause a release of pressure on the inner core. This would cause part of the material of the surface of the metastable core to change to a lower pressure state and become part of the outer core. The result: Earth's moment of inertia factor would decrease slightly.

But the Earth/Moon couple is a sub-force system within that of the Solar System. If the inertia factor decreases then the rotation of Earth must increase (total force after must equal total force before). The result should be a gradual(?) lessening of rotation of the inner core relative to the outer shells.

**Figure 5 : Inner Core Anisotropy and Rotation**

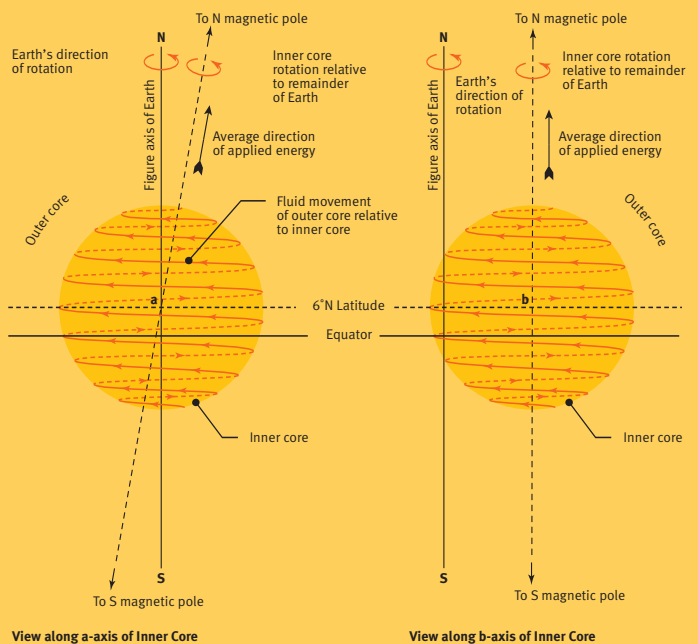
Copy of Figure 7, opposite p.58, in the paper on Earth seismicity by J. Tromp in the journal "Annual Review of Earth and Planetary Sciences", vol. 29 (2001)



Observed (left column) and predicted (right column) splitting functions for mantle-sensitive normal mode  $S_4$  (top row) and inner-core-sensitive model  $S_3$  (bottom row). The predicted splitting function is based upon shear-velocity model SKS12WM13 (Dziewonski et al 1997). The dashed lines are the surface traces of the determined a, b, and c planes of stress resulting from the offset core. Note they agree with "Observed  $S_3$ ".

**Figure 6 : Outer Core Fluid Flow about Inner Core**

View along a-axis and b-axis of Inner Core



Inner core centre is where the straight line through the Earth joining the N and S magnetic poles intersects the 6°N latitudinal plane

If the mechanism persists, a stage is reached where the inner core rotates at a slower rate than the outer shells. *In sum, the Earth's magnetism decreases and, if the mechanism persists long enough, will reverse.* The magnetic axis will retain its angular relationship to the Earth's rotation axis.

When the internal forces decrease and/or cease then, because of the Moon's constant rotation-retarding couple on Earth, magnetism will slowly decrease and ultimately revert to what it is at present. This rotation change explains why it is possible to calculate the rotation of Uranus using that of Earth's. Earth's rotation has, on average, been constant for its whole life.