EARTH'S MAGNETIC ENERGY PROVIDES CONFIRMATION OF ITS YOUNG AGE

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In previous papers the author applied Maxwell's electromagnetic theory and 130 years of real-time data to a proposed model of the earth's main magnet. The magnetic field was shown to be decaying exponentially with a half-life of only 1,400 years. This fact puts a severe limitation on the age of the earth. The present value of the power loss from the magnet was evaluated at 813 megawatts. This new paper employs those results to compute the total energy which will be lost during the remaining life of the magnet. Because there is no other source of energy, this is an indirect means of computing the total amount of energy in the earth's present magnetic field.

If this theory is valid, an overall check can now be made on the theory by getting an independent evaluation of the total energy in the magnetic field of an idealized "equivalent" magnet. This equivalent magnet, being permanent, does not involve the decay, conductivity, heat loss, etc., associated with the computation about the real magnet. Such a check has been achieved in this paper. This provides an unyielding verification of the decay properties of the earth's field, and of the implications of these facts for the age of the earth.

1. Introduction

In previous papers[1-4] the author proposed the theory of a freely decaying electric current circulating in the conductive core of the earth as the source of the earth's main magnetic field, a dipole field. Maxwell's electromagnetic field theory and more than a century of real-time decay data were applied to this model to deduce a severe limitation on the age of the earth's magnetic field and, by association, a severe limitation on the age of the earth. There has been no valid scientific challenge raised against this basic application of physics to the source of the earth's magnetic field, even though it imposes a ceiling of a few thousand years on the earth's age.

This present paper contains a new and independent quantitative confirmation of this theory of the source of the earth's magnetic field. This is accomplished by evaluating and comparing the total energy in the earth's magnetic field as governed by the proposed theory with that of a reference magnet that is totally independent of the electromagnetic processes involved in our theory.

The reference magnet is an idealized permanent magnet, a uniformly magnetized sphere of the same size as the earth's core and having a magnetic moment equal to the present value of the earth's magnetic moment. The earth's magnet is known to be an *electromagnet* and a decaying one, not a permanent magnet. There has been a measured loss of 14% of the energy in the earth's magnetic dipole field over the 130 year period of real-time observational data.[5]

If our theory is correct then the present total energy in this magnet should check rather closely with the energy in the reference magnet, but not precisely because there is a slight difference in the distribution of flux linkages in the two magnets. We shall show that these two energy values do check to within 9.6%, an amazing overall check on the multiplicity of steps and evaluations contained in our theory.

There is perhaps not one chance in a million for such a close check if our electromagnetic decay theory had not been a valid one. This means that we have established unyielding evidence for this theory for the earth's magnetic field and for the consequent limitation on the age of the earth.

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2. Present Value of Energy in Earth's Magnetic Field

Designating the energy as w and using the definition that power is the rate of flow of energy, one has the calculus equation

$$P = \frac{dw}{dt}$$

It was shown in the previously referenced papers that the solution to Maxwell's equations for this magnetic field contains the decay time constant T (the time for the magnetic field strength to decay to $1/e$th, roughly 37%, of its previous value). Knowing that the *energy* in the magnetic field is proportional to the *square* of the magnetic field strength the following equation is deduced for the rate of dissipation of energy in the earth's core as a function of time t,

$$\frac{dw}{dt} = P_o e^{-2t/T} \qquad (1)$$

where P_o is the present value of power dissipation. Integration of this calculus equation from time zero (the present) to infinite time results in the equation for the total amount of energy that will be lost from now until the magnetic field is gone:

$$W = \frac{P_o T}{2} \qquad (2)$$

All of this energy is lost by the electric heating in the earth's core, produced by the electric current flowing there. Because this electric current is *induced* by the decaying process of the magnetic field, all of this energy comes from the magnetic field. Hence Equation 2 gives the energy w that presently resides in the earth's magnetic field, but which will in time be lost in the earth's core in the form of heat as the magnet decays.

This equation was used to compute the *present value of the total energy in the earth's magnetic field to be* 2.52×10^{19} *joules,* by substituting the present value of power being dissipated by the electric current in the earth's core $P_o = 8.13 \times 10^8$ watts and the time constant $T = 6.21 \times 10^{10}$ seconds into Equation 2.[6]

3. Total Energy in Field of Uniformly Magnetized Sphere

Elementary physics is then used to derive an equation for the total energy in the magnetic field of a uniformly magnetized sphere, to be referred to as the reference magnet. The sphere is an idealized permanent magnet with uniform intensity of magnetization M parallel to the polar axis and has a radius which is labeled a in Figure 1.

The current in a permanent magnet is *amperian* current, a dissipationless current associated with the atomic structure of the material. Amperian current yields the same amount of magnetic flux as an equal amount of real current, so the same equations hold for computing the energy in the magnetic field of the amperian current.

The equation for energy w in the field of a *single* ring or loop of current I that encircles a magnetic flux Φ is

$$W = \frac{\Phi I}{2} \tag{3}$$

The solution to the problem under discussion includes the same basic concept as that in Equation 3, but it is more complex because there is a *distribution* of current, not just one ring of current. In fact the amperian current that yields a uniformly magnetized sphere is a *surface current* that covers the entire surface of the sphere. That surface may be divided up theoretically into a multiplicity of thin circular rings of current. Each ring of current encircles the polar axis, the center of the ring is on this axis, and the current of the ring is on the surface of the sphere.

There is a different amount of flux through each current ring and a different value of current in each ring, but Equation 3 still gives the energy contributed to the field by *each* of these current rings. Specifying that part of the total energy contributed by each ring as dw and that part of the total current contained in each ring as dI, Equation 3 for each ring may be written as

$$dW = \frac{\Phi dI}{2} \tag{4}$$

A summation (integration) of this equation for all of the rings gives the total energy w. To do this integration one needs to express all of the quantities of the right side of the equation in terms of only one variable and that is the reason for the following steps.

The boundary relation[7] between the *magnetization* M and the *amperian surface current density* dI/ds, for this sphere, may be expressed as

$$\frac{dI}{ds} = M \sin\theta \tag{5}$$

where θ is the polar angle and ds is the ring width. Since ds is an *arc length* on the surface of the sphere $ds = a\, d\theta$ and Equation 5 may be written as

$$dI = aM \sin\theta\, d\theta \tag{6}$$

Substituting Equation 6 into Equation 4 results in

$$dW = \tfrac{1}{2}\Phi aM \sin\theta\, d\theta \tag{7}$$

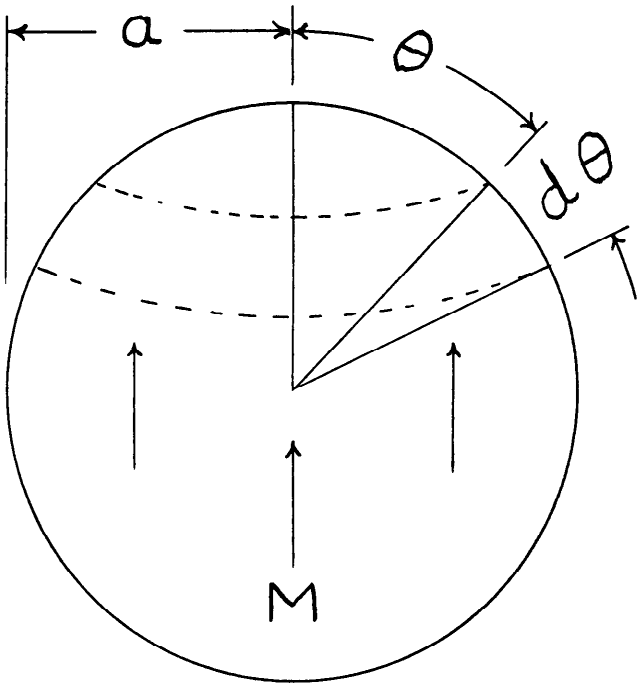

Figure 1. This shows the uniformly magnetized sphere, the magnetism of which is compared to the earth's magnetism. The angle θ corresponds to latitude; or, rather "co-latitude," measured from the North Pole, not from the Equator. The magnetization M is uniform, and in the direction of the axis, pointing North.

Now Φ should be expressed in terms of M. The defining equation for M is

$$M = (B/\mu_o) - H \tag{8}$$

where μ_o is the permeability of free space. In this permanently magnetized sphere H may be neglected and Equation 8 reduces to

$$B = \mu_o M \tag{9}$$

The *flux per unit area* B is constant over the area of every ring. The radius of each ring $r = a \sin\theta$. Hence the flux through each ring is given by the equation

$$\Phi = (\pi a^2 \sin^2\theta) B \tag{10}$$

Substituting Equation 9 and Equation 10 into Equation 7 results in

$$dW = \tfrac{1}{2}\pi a^3 \mu_o M^2 \sin^3\theta\, d\theta \tag{11}$$

Integrating this differential equation over the polar angle limits from $\theta = 0$ to $\theta = \pi$ yields for the total energy

$$W = \tfrac{2}{3}\pi a^3 \mu_o M^2 \tag{12}$$

It is desirable to express this energy in terms of the *magnetic moment* $\mathcal{M}$ instead of the *magnetization* M. In this uniformly magnetized case, the magnetic moment is equal to the volume of the sphere times the magnetization, that is to say

$$\mathcal{M} = \tfrac{4}{3}\pi a^3 M \tag{13}$$

Making use of the fact that $\mu_o = 4\pi \times 10^{-7}$ and substituting Equation 13 into Equation 12 yields

$$W = \frac{3\mathcal{M}^2}{2a^3} \times 10^{-7} \qquad (14)$$

for the total energy in the magnetic field of this reference magnet in terms of the magnetic moment $\mathcal{M}$ and the radius a.

It is now possible to evaluate the total energy in the field of the reference magnet, when the magnet has the same magnetic moment as the present value of the magnetic moment in the earth, namely $\mathcal{M} = 8.015 \times 10^{22}$ ampere meter^2, and has the same radius as the radius of the earth's core, namely $a = 3.473 \times 10^6$ meters. *The total value of the energy in the magnetic field of this reference magnet may be computed to be* 2.30×10^{19} joules.

4. Conclusion

A most rapidly decaying geophysical phenomenon must be given serious consideration as a limiting factor on the age of the earth. The energy in the earth's magnetic dipole field is decaying much faster than any other worldwide geophysical property. Its half-life is only 700 years.[8] An elemental exercise in arithmetic coupled with some sense about a reasonable limit on the initial energy value shows that if the energy in the earth's magnetic field doubled every 700 years backward in time the earth's age could only be in the thousands of years, not millions nor billions. The author has suggested a plausible limit of 10,000 years.[9]

The only rigorous physical explanation of the earth's electromagnet is that of a freely decaying circulatory electric current source in the earth's conductive core, being induced through the decay of the original magnetic field which the author would assume to have been created in the beginning. Applying Maxwell's equations and the observable real-time data to this physical model the author has made the following evaluations of properties in the earth's core:

1) The conductivity of the core of the earth, 4.04×10^4 mho/meter.

2) The electric current density (amperes/meter^2) as a function of any position in the core of the earth at the present time.

3) The total electric current circulating in the core of the earth at the present time, 6.16×10^9 amperes.

4) The present power loss in the core of the earth, 8.13×10^8 watts, all going into heat in the core.

In this present paper the author made use of the above results and, by means of an integration from the present to infinite time, made a forecast of the total heat energy that will be lost by this process in the future. That forecast value turned out to be 2.52×10^{19} joules of heat energy yet to be dissipated. According to the proposed electromagnetic decay theory, all of that energy will come from the present energy contained in the earth's magnetic field. Thus by this indirect route an evaluation was made of the total present energy in the earth's magnetic field, namely 2.52×10^{19} joules.

As an independent check, the total energy in the field of an idealized permanent magnet of like size and magnetic moment was computed for reference. A value of 2.30×10^{19} joules was derived. These two independently determined energy values checked to within 9.6%. That is an excellent check. That much difference could be accounted for by the slight difference in energy that one might expect in the two models, due to their slightly different distributions of flux linkages. Indeed, this independent check does demonstrate unyielding evidence for the proposed theory of the earth's magnetic field and for the consequent limitation on the age of the earth.

References

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[8]Barnes, 1974, *Op cit.*

[9]Barnes, 1973, p. 25.