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Scientific Basis and Geophysical Consequences of Geomagnetic Reversals and Excursions: A Fundamental Statement

J. Marvin Herndon[1*]

[1]*Transdyne Corporation, 11044 Red Rock Drive, San Diego, CA 92131 USA.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Short Communication

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ABSTRACT

Convection in Earth's georeactor sub-shell is responsible for generating the geomagnetic field and for maintaining the critical balances necessary for stable sub-core nuclear fission. External factors capable of disrupting sub-shell convection are trauma at Earth's surface, for example by meteorite impact, and electrical energy transfer via Faraday's electromagnetic induction into the georeactor by changes in the solar wind or in the magnetospheric ring current. Reduced sub-shell convection not only leads to decreased geomagnetic field intensity, but to increased uranium settling out into the sub-core where it undergoes uncontrolled nuclear fission until sub-shell convection is reestablished. Periods of uncontrolled georeactor nuclear fission are responsible for causing geophysical phenomena at Earth's surface that are associated with geomagnetic reversals and excursions. Anticipated consequences of sub-shell convection collapse include increases in volcanic activity, increases in the number and intensity of earthquakes, warming of the oceans, and diminishment of atmospheric convection resulting in global warming at the surface. The most worrisome potentiality is triggering the eruption of the Yellowstone super-volcano. Changes in solar wind flux, too small to cause geomagnetic field collapse, however, may cause increases in earthquakes and volcanic eruptions. The understanding described here potentially provides a basis for the development of earthquake and volcanic eruption prediction methodologies.

**Corresponding author: E-mail: mherndon@san.rr.com;*

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1. INTRODUCTION

Tantalizing reports in the literature seem to suggest a possible connection between geomagnetic reversals and major geophysical events, species extinctions, continent separation, basalt floods, and sea-level changes [1-4]. Until recently, however, making sense of the fragmented and incomplete records of geophysical events in the Earth's past, has been impossible. Why? Because there has been widespread misunderstanding of the interrelationships between Earth's origin, composition, geomagnetic field generation, and geodynamic behavior.

Scientists tend to take at face value long-standing geo-topical ideas that originated in the 1930s-1960s as distinct entities, and rarely question their validity, although their origins may have changed in light of subsequent discoveries. Moreover, geoscientists are typically specialists trained in depth in only one narrow area of Earth science. Consequently, their perception of the Earth as a whole is akin to the descriptions of an elephant by blind men, according to an ancient Indian parable. In that parable a number of blind men attempt to describe an elephant as they touch particular parts of its body. The blind man who touched only its leg said, "It is like a pillar." Each proffered a different description based upon the body-part touched (Fig. 1).

Scientific specialization is advantageous if the underlying science is sound, securely anchored to the properties and behavior of matter and radiation. But, until recently, Earth science has been neither sound nor securely anchored. Individual components of the Earth, such as the fluid core, were examined by narrowly focused specialists figuratively emulating the blind men in the above ancient parable. Over a period of more than forty years I have advanced theoretical considerations that provide a sound basis for understanding.

My discoveries, logically and causally related, include recognizing that Earth's early formation as a Jupiter-like gas giant makes it possible to derive virtually all geological and geodynamic behavior of our planet, including origin of continents and oceans, ocean floor topography, origin of mountains characterized by folding, primary initiation of fjords and submarine canyons, internal Earth compositions, two previously unanticipated potentially variable energy sources including a Terracentric nuclear fission reactor (known as the georeactor), origin of the geomagnetic field and the reasons for geomagnetic field variability, origination of petroleum and natural gas deposits, particulate pollution as the main cause of global warming, connections between Earth's origin and similarities and differences of other planets, thermonuclear ignition of stars, and why the multitude of galaxies display just a few prominent patterns of luminous stars [5-40].

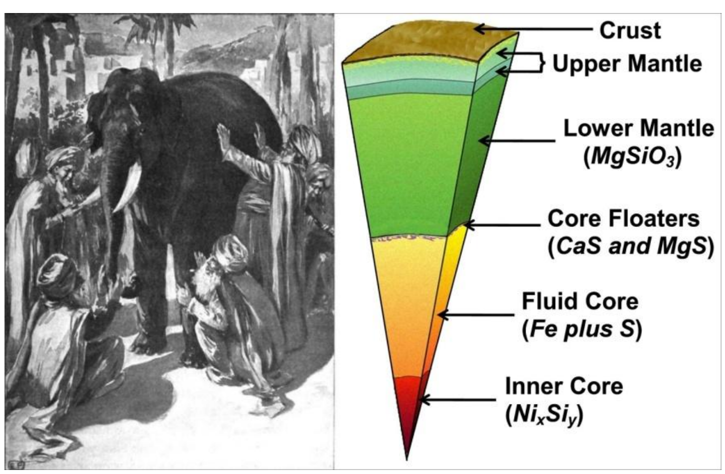

Fig. 1. Blind men, from the ancient Indian parable, attempting to describe an elephant based upon body-part examination shown with major body-parts of "elephant" earth

In the following I describe, from the properties and behavior of matter, the conditions in nature which make possible stable nuclear georeactor operation, hence stable geomagnetic field generation. Next I describe circumstances in nature which can disrupt stable georeactor operation, leading to excursions or reversals of the geomagnetic field. Then I describe potential geodynamic events which might arise as consequences of disrupted georeactor operation.

2. STABILITY MECHANISMS OF EARTH'S TERRACENTRIC GEOREACTOR

Earth's internal components are layered on the basis of density. Uranium, being the densest substance, resides at the planet's center and is capable of sustained nuclear fission chain reactions. In other words, uranium in that location acts as a nuclear reactor. As noted previously [36] and in a review article [26], I described with specificity the background, basis, feasibility, structure, evidence, and geophysical implications of a naturally occurring Terracentric nuclear fission georeactor. For a nuclear fission reactor to exist at the center of the Earth, all of the following conditions that must be met *are* met:

- Originally there was a substantial quantity of uranium within Earth's core.
- There is a natural mechanism for concentrating the uranium at the Earth's center.
- The isotopic composition of the uranium at the onset of fission was appropriate to sustain a nuclear fission chain reaction.
- The reactor is able to breed a sufficient quantity of fissile nuclides to permit operation over the lifetime of Earth to the present.
- There is a natural mechanism for the removal of fission products.
- There is a natural mechanism for removing heat from the reactor.
- There is a natural mechanism to regulate reactor power level.
- The location at Earth's center provides containment and prevents meltdown.
- There are logical, causally related mechanisms that account for geomagnetic reversals and excursions.

Earth's nuclear fission georeactor has one unique feature that separates it from all other putative planetary energy sources, including radioactive decay. Nuclear fission is an energy source that not only is potentially variable, but it can even stop and restart. Nuclear fission can be slowed or stopped by separating the uranium components from one another or by mixing into the uranium neutron absorbers, sometimes called reactor poisons.

The left portion of Fig. 2 is a schematic representation of the georeactor, located at the center of Earth in a microgravity environment. The georeactor consists of two parts, the nuclear fission sub-core consisting of uranium that settles out of the georeactor sub-shell. The sub-shell consists of a repository for uranium, fission products, and other impurities. The neutron absorbers in the sub-shell prevent nuclear fission from occurring in that portion of the georeactor. The right side of Fig. 2 represents the balances that must be maintained for stable georeactor operation.

Heat produced by nuclear fission chain reactions in the uranium sub-core causes thermal convection in the sub-shell. This convection is not only responsible for generating the geomagnetic field by dynamo action involving Earth's rotation, but is the key to maintaining balances necessary for stable georeactor operation.

Convection efficiently transfers sub-core produced heat to Earth's inner core, a massive heat-sink that is surrounded by an even more massive heat-sink, its fluid core, which removes the georeactor produced heat and maintains the adverse temperature gradient (top cooler than bottom) necessary for stable convection [41]. Sub-shell stirring by convection in this microgravity region is the principal mechanism for maintaining georeactor stable operation.

Sub-core heat produced by nuclear fission keeps most of the uranium repository mixed with neutron absorbers, preventing fission in the sub-shell. Uranium settles out from the convecting neutron-absorbing mixture in the sub-shell to form the sub-core where nuclear fission takes place. Reduction in sub-core generated heat, caused by uranium burn-up, decreases convective stirring which allows additional uranium to settle out from the sub-shell. This is a self-regulating mechanism.

Although details are obscure, there must exist some material exchange between sub-core and sub-shell, not only to remove fission product reactor poisons from the sub-core, but to

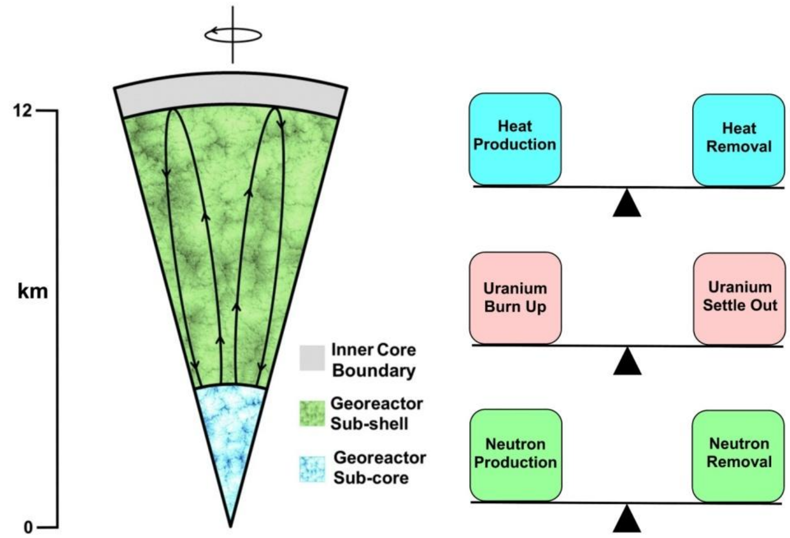

Fig. 2. Schematic representation of Earth's georeactor, not to scale, with non-resultant planetary and fluid motions indicated separately (left) and (right) representations of the balances that must be maintained for stable georeactor operation

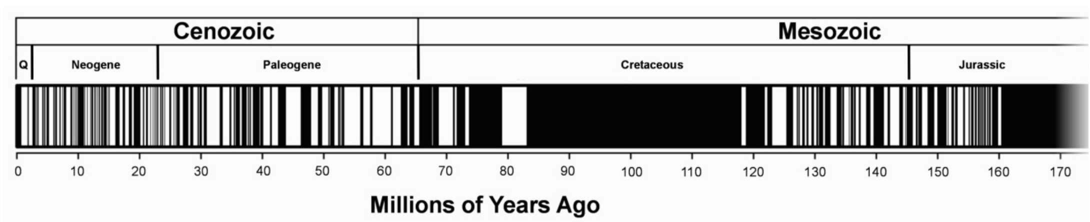

Fig. 3. Geomagnetic polarity since the middle Jurassic. Dark areas denote periods where the polarity matches today's polarity, while light areas denote periods where that polarity is reversed. From published data [44,45]

exchange nuclear fuel bred in the sub-core with the uranium repository in the convecting sub-shell. The exchange rate is presently unknown and, presumably, decreases as the uranium inventory is consumed [12].

The geomagnetic field has been stable, without reversals, for periods longer than 20 million years [42,43]. More frequent polarity reversals and excursions do occur (Fig. 3) and are indicative of external events that disrupt convection in the georeactor sub-shell.

3. INSTABILITY MECHANISMS OF EARTH'S TERRACENTRIC NUCLEAR GEOREACTOR

The georeactor mass is about one ten-millionth that of Earth's fluid core, consequently, major trauma at Earth's surface, such as a meteorite impact, could disrupt sub-shell convection in the georeactor.

Sub-shell convection could also be disrupted by energy from the solar wind transferred via the geomagnetic field into the georeactor by Faraday's law of electromagnetic induction [46]. A simple apparatus, illustrated schematically in Fig. 4, demonstrates the principle of electromagnetic induction.

When the switch in Fig. 4 is closed, the galvanometer displays only a momentary pulse. When the switch is opened, the galvanometer displays a momentary pulse in the opposite direction. Only a changing electrical current can be transferred through electromagnetic induction. The blue boxes in this figure illustrate components in nature that correspond to the schematic electrical components indicated.

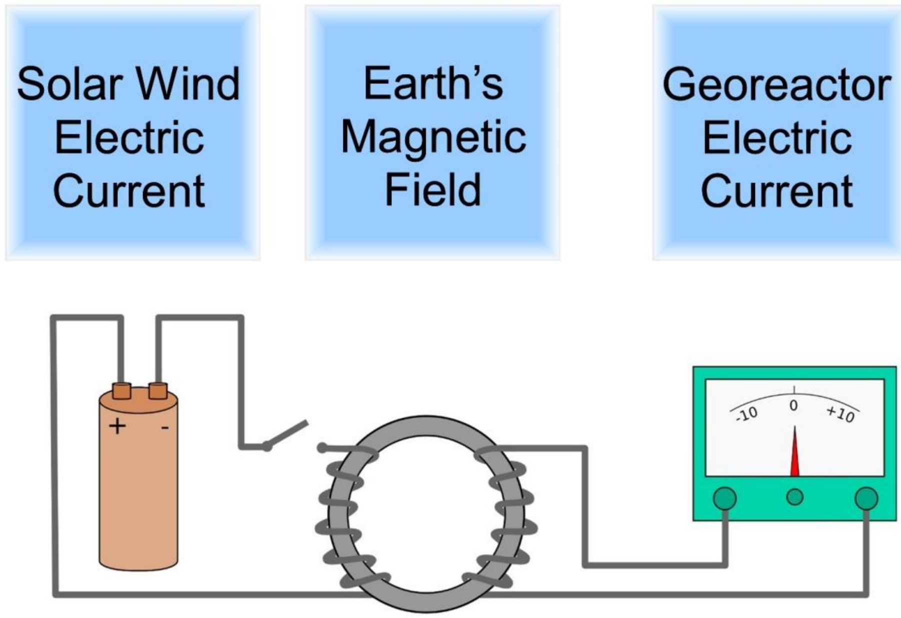

Fig. 4. Schematic diagram of an apparatus for demonstrating the principle of electromagnetic induction and their corresponding components in nature

The solar wind comprises an electrical current of charged particles that stream from the Sun. If the solar wind were constant, no electrical current would be induced into the georeactor. Exceptionally large changes in the solar wind or in the ring current of charged particles trapped in Earth's magnetosphere, however, will cause electrical current to be induced into the georeactor sub-shell producing ohmic heating, diminishing sub-shell convection, and potentially leading to geomagnetic field collapse with concomitant magnetic excursion or reversal.

4. CONSEQUENCES OF DISRUPTED GEOREACTOR SUB-SHELL CONVECTION

Sustained sub-shell convection, as discussed above, regulates georeactor activity including its energy production. What happens when convection is disrupted by trauma to the Earth or through induced electrical current from changes in the solar wind or in the magnetospheric ring current (Fig. 5)?

Disrupted sub-shell convection allows individual sub-shell components to settle out, to layer based upon their respective densities. Uranium, being densest, accumulates at Earth's center, the location of the sub-core, resulting in uncontrolled nuclear fission chain reactions before ultimately reestablishing sub-shell convection. Energy release from the runaway nuclear fission potentially has major geophysical ramifications and provides a logical, causally related basis for understanding the association of geodynamic phenomena with geomagnetic reversals.

Georeactor-produced heat, transferred through Earth's inner core to its fluid core, is either channeled directly to Earth's surface or replaces a portion of the lost heat of planetary compression which facilitates whole-Earth decompression dynamics (WEDD) [14,15,37].

Heat Channeling: Thermal structures, sometimes called mantle plumes, lie beneath the volcanic islands of Hawaii and Iceland whose basalt contains traces of helium with high $^3He/^4He$ ratios, relative to that in air, the signature of georeactor production [12]. As imaged by seismic tomography, these thermal structures extend all the way to the top of the fluid core [47,48], further reinforcing their georeactor-heat origin. Similarly, high $^3He/^4He$ ratios are measured in lavas associated with the East African Rift System [49] and the Yellowstone volcanic complex in the United

States [50]. One potential consequence of the runaway nuclear fission spike, resulting from sub-shell convection-disruption, is to trigger volcanic eruptions, including the Yellowstone super-volcano.

WEDD Facilitation: Protoplanetary energy of compression, from Earth's formation as a Jupiter-like gas giant, remained trapped in the rocky portion of Earth (compressed to about 2/3 of present diameter) after primordial gases and ices were stripped away. Decompression necessitates replacing the lost heat of protoplanetary compression. Georeactor nuclear fission energy replaces the lost heat of compression thereby facilitating planetary decompression. As described by whole-Earth decompression dynamics (WEDD) [14,37], virtually all geodynamics is the consequence of Earth's decompression, including continent splitting with ocean basin development [15], formation of mountain ranges characterized by folding [23], and primary initiation of fjords and submarine canyons [51].

Two examples serve to illustrate some geophysical consequences of runaway georeactor nuclear fission resulting from diminished sub-shell convection during geomagnetic reversals.

The Permian-Triassic species extinction that occurred 250 million years ago [52] was associated with a geomagnetic polarity reversal [53-55], massive basalt extrusion in Siberia containing traces of helium with the high $^3He/^4He$ ratios [56] that are characteristic of georeactor production [12], and a drop in mean global sea level (Fig. 6) indicative of new ocean basin opening.

The Cretaceous-Tertiary species extinction that occurred 65 million years ago [52] was associated with a geomagnetic polarity reversal [63-65], massive basalt extrusion in Western India containing traces of helium with the high $^3He/^4He$ ratios [66] characteristic of georeactor production [12], and a drop in mean global sea level (Fig. 6) indicative of new ocean basin opening. Might the meteorite impact event that some people think killed the dinosaurs [67] have caused the geomagnetic polarity reversal by disrupting sub-shell convection?

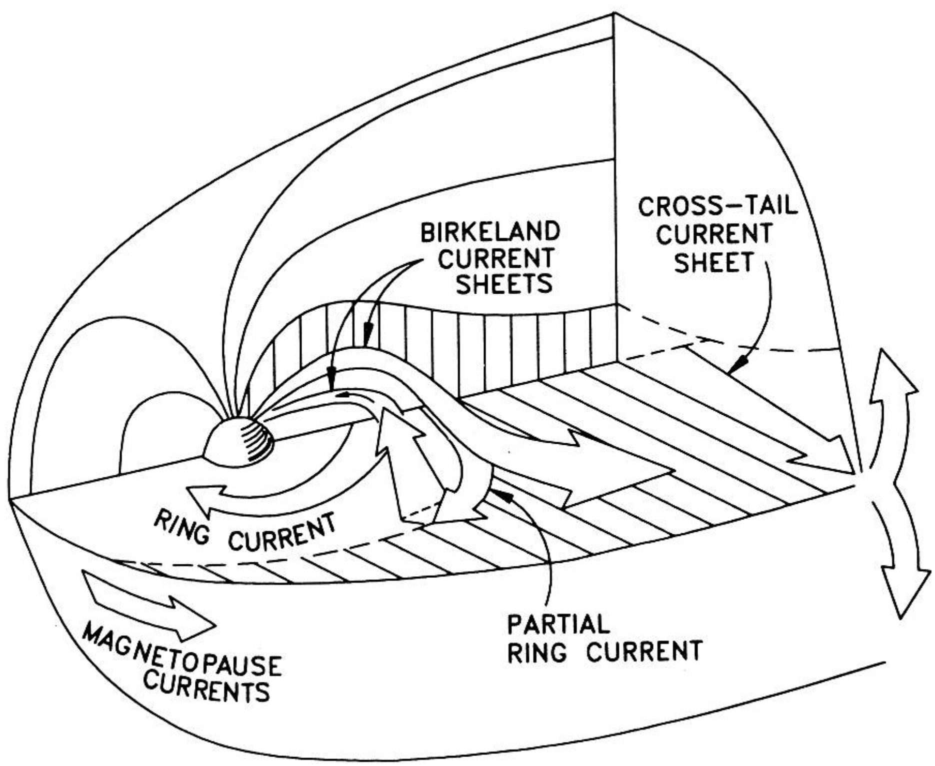

Fig. 5. Schematic representation of the ring current system in earth's magnetosphere

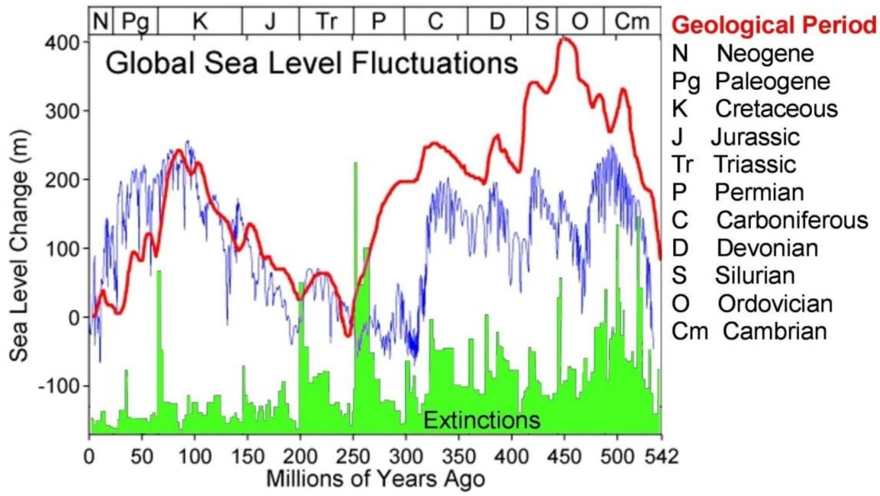

Fig. 6. Spikes in seawater levels (red and blue) appear to correlate with spikes in species genus extinction intensity (green), and they correlate as well with boundaries of major divisions of geological time, abbreviated at top of graph. For details and data, see [1,52,57-62]

Over geologic time, not all geomagnetic reversals were as spectacular as these two examples. Some might have been relatively benign, while others might have had devastating geophysical consequences, presumably when Earth was less decompressed, its uranium repository was greater, and sub-shell disruption occurred more quickly and/or more completely. What might be expected to occur during the next geomagnetic reversal or excursion?

5. SPECULATIONS ON THE NEXT GEOMAGNETIC FIELD COLLAPSE

The time of the next georeactor sub-shell collapse is unknown. However, recent dip-pole movements [68] and decreasing geomagnetic intensity [69,70] suggest that it "might be sooner rather than later" [33]. It is useful, therefore, to point out the following unanticipated, potentially adverse geophysical consequences:

- Volcanic regions heated directly by georeactor produced heat, characterized by high $^{3}He/^{4}He$ ratios, may expect increased eruptions during sub-shell collapse. These include the East African Rift System, Hawaii, Iceland, and Yellowstone. Of these, Yellowstone poses the greatest potential danger as it is thought to be a super-volcano in the making [71-74].

- Earthquakes will increase in number and intensity as uncontrolled nuclear fission occurs during sub-shell collapse and facilitates whole-Earth decompression. Volcanic activity along surface-plate margins likewise will increase.

- Heat emplaced at the base of the rigid crust, due to compressing ongoing decompressing mantle material (called mantle decompression thermal tsunami) [16] will heat the oceans and melt polar ice.

- Increased atmospheric particulates from volcanic ash and atmospheric water condensate will inhibit atmospheric convection, thereby limiting surface heat loss, and causing global warming [32].

These geophysical consequences are in addition to the harm that collapse of the geomagnetic field will inflict on our technologically-based infrastructure, as described by Williams [75]: "*Widespread communications disruptions, GPS blackouts, satellite failures, loss of electrical power, loss of electric-transmission control, electrical equipment damage, fires, electrocution, environmental degradation, refrigeration disruptions, food shortages, starvation and concomitant anarchy, potable water shortages, financial systems shut-down, fuel delivery disruptions, loss of ozone and increased skin cancers, cardiac deaths, and dementia. This list is not exhaustive. It is likely that a geomagnetic field collapse would cause much hardship and suffering, and potentially reverse more than two* *centuries of technological infrastructure development.*"

6. VARIATIONS OF SOLAR WIND INFLUENCE ON EARTHQUAKES AND VOLCANIC ERUPTIONS

One thrust of this Short Communication pertains to potential disasters attendant with geomagnetic field collapse due to sub-shell convection-disruption caused by electromagnetic induction from major changes in the solar wind flux. Changes in georeactor heat output are potentially amplified and affect the surface by release of the stored energy of protoplanetary compression. The principles involved may apply to less-severe changes in the solar wind flux, which potentially provide an explanation for observed increases in earthquakes [76-78] and volcanic eruptions [79-81] that are associated with increased solar activity. This explanation therefore may provide a legitimate basis for the development of earthquake and volcanic eruption prediction methodologies.

7. CONCLUSIONS

Convection in Earth's georeactor sub-shell is responsible for generating the geomagnetic field and for maintaining the critical balances necessary for stable sub-core nuclear fission. External factors capable of disrupting sub-shell convection are trauma at Earth's surface, for example by meteorite impact, and electrical energy transferred via Faraday's electromagnetic induction into the georeactor by changes in the solar wind or in the magnetospheric ring current.

Reduced sub-shell convection not only leads to decreased geomagnetic field intensity, but to increased uranium settling out into the sub-core where it undergoes uncontrolled nuclear fission until sub-shell convection is reestablished. Periods of uncontrolled georeactor nuclear fission are responsible for causing geophysical phenomena at Earth's surface that are associated with geomagnetic reversals and excursions.

Anticipated consequences of sub-shell convection collapse include increases in volcanic activity, increases in the number and intensity of earthquakes, warming of the oceans, and diminishment of atmospheric convection resulting in global warming at the surface. The most serious potentiality is triggering the eruption of the Yellowstone super-volcano.

Changes in solar wind flux, too small to cause geomagnetic field collapse, however, may cause increases in earthquakes and volcanic eruptions. The understanding described here potentially provides a basis for the development of earthquake and volcanic eruption prediction methodologies.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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