

# Dinosaur Demise and Species Extinction Generally: Role of Whole-Earth Decompression Dynamics

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## ABSTRACT

Since 1979, fundamental scientific contradictions are systematically ignored and the scientific community continues to assume without legitimate basis that previous, underlying ideas are correct even though refuted and shown to be no longer viable. Consequently, for decades, members of the geoscience community have attempted unsuccessfully to reconcile major species extinctions with geophysical phenomena based upon false assumptions. I describe briefly the false assumptions that have impeded understanding, and demonstrate how logical, causal relationships related to species extinction follow from my new geoscience paradigm called *Whole-Earth Decompression Dynamics*. The mechanism for triggering whole-Earth decompression episodes, related to geomagnetic changes, is as a multi-stage amplifier that involves disruption of georeactor sub-shell convection either by trauma or by a change in solar flux impinging on Earth's magnetic field. Disruption of sub-shell convection results in extra uranium settling-out, which causes a burst of nuclear fission energy, which replaces some of the lost heat of protoplanetary compression, which causes a burst in whole-Earth decompression, which results in a burst of heat emplacement at the base of the crust and/or Earth's surface experiencing decompression-driven movement, the extent of which is a function of the degree of sub-shell convection disruption. The geomagnetic mechanism for triggering whole-Earth decompression episodes of major-scale provides a logical, causally-related explanation of species extinction connected to magnetic reversals and excursions that involves splitting the continental crust, opening new ocean basins, lowering sea-levels, toxifying oceans, as well as major volcanic eruptions, earthquakes and environment devastation.

## INTRODUCTION

In 1980, Alvarez et al. [1] published a scientific article entitled "*Extraterrestrial Cause for the Cretaceous-Tertiary Extinction*" which the captivated news-media enthusiastically proclaimed caused the demise of dinosaurs. Several articles followed [2-7] that provided seemingly compelling evidence that a large asteroid impact caused the mass extinction at the end of the Cretaceous period. Alvarez et al. [1] had discovered high iridium values in a narrow clay layer dispersed worldwide that marked the end of the Cretaceous period and included the geomagnetic field reversal designated 29R. Subsequently, other evidence was accumulated including the discovery of the Chicxulub impact structure in the Yucatán Peninsula of Mexico that some considered "the smoking gun" [8]. The publicity surrounding this new theory on the demise of dinosaurs prompted much scientific debate and further discoveries. One discovery, in particular, did much to stimulate research on volcanism as the possible culprit for major species extinctions. The massive basalt flood in the Western Ghats mountains of India, called

the Deccan traps, was found, not only to have occurred rapidly, but at the same 29R geomagnetic reversal [9] that was observed in the clay layer at the K-T boundary studied by Alvarez et al. [1].

The link between volcanism and species extinction is quite well-documented [10-14], however, temporal coincidence does not establish a causal link. Moreover, there are other seemingly associated phenomena that have not yet been shown to be logically and causally related. For example, lowering of sea-level is associated with mass species extinction events, with particularly pronounced regressions associated with the late Ordovician and the end Cretaceous extinctions [15]. For another example, ocean anoxia is associated with certain mass species extinctions, but its causally-related origin has not yet been disclosed [16-19]. For yet another example, various ideas have been set forth attempting to relate species extinction as consequences of geomagnetic reversals [20-24], but these ideas appear to be unconnected to other relevant geophysical parameters.

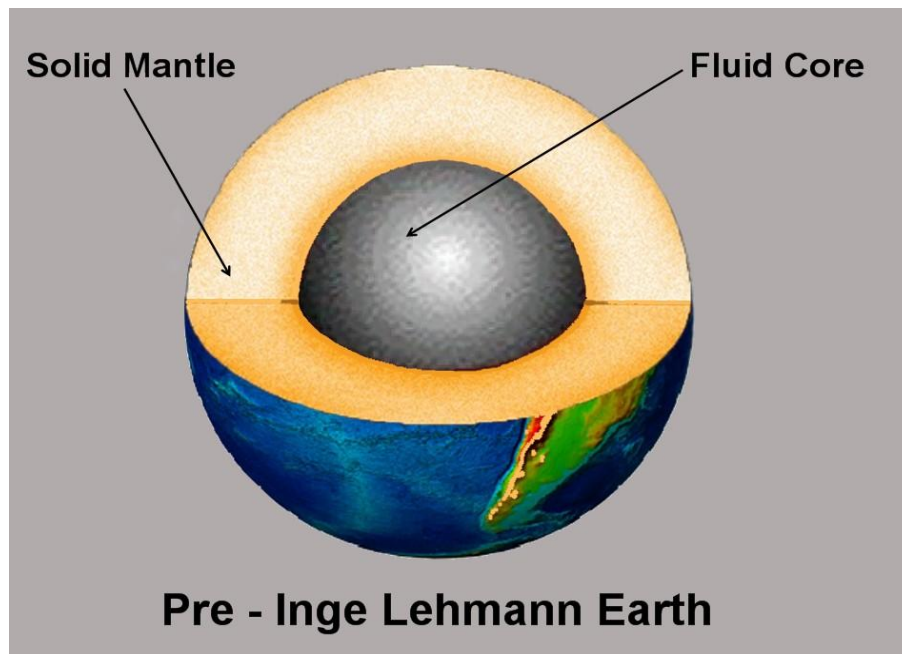
So here we are. Decades of efforts by well-intended geoscientists have not yielded logical, causal relationships specifically connecting geophysical phenomena including continental splitting, ocean basin opening, asteroid impacts, massive basalt floods, sea-level regressions, ocean anoxia, and geomagnetic reversals – all of which appear to play some role in species extinction. The reason, I submit, is that the geoscience community has been operating under false assumptions.

Science is the process of replacing less precise ideas with more precise ideas. When a new contradiction arises to an important scientific idea, there should be debate and discussion. If unable to refute the contrary new idea, the new idea should be cited in subsequent relevant literature. But since 1979, fundamental contradictions are systematically ignored and the scientific community continues to assume without legitimate scientific basis that previous, underlying ideas are correct even though refuted and shown to be no longer viable. For example, the geoscience community clings to Birch's 1940 idea that the inner core is partially crystallized nickel-iron metal, that Earth's interior resembles an ordinary chondrite meteorite, that the geomagnetic field is produced by a convection-driven mechanism in the fluid core, and that geodynamics as described by plate tectonics theory is valid.

Here I describe briefly the false assumptions that have impeded understanding, and then demonstrate how logical, causal relationships related to species extinction follow from my new geoscience paradigm called *Whole-Earth Decompression Dynamics* [25, 26].

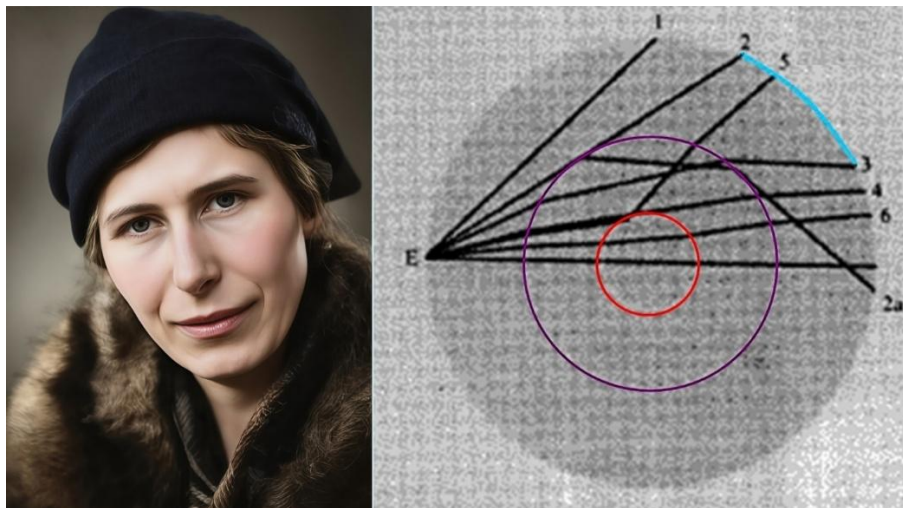
### FUNDAMENTAL BASIS OF GEOPHYSICS

In 1906, Oldham through seismological measurements discovered Earth's iron metal core whose boundary lies about half way to the planet's center [27] (Figure 1). By 1930, its dimensions were well established and the core was found to be liquid [28]. A simple picture of Earth's interior emerged: An iron alloy core surrounded by a silicate-rock mantle and topped with a very thin crust (discovered by Mohorovičić in 1909 [29]). Then complications arose. Earthquake waves from a large New Zealand earthquake, instead of being shadowed by the core, were actually observed at the surface in the shadow zone. This posed a great geoscience mystery.



**Figure 1: The simple picture of Earth's interior as understood in 1930.**

In 1936, the Danish seismologist, Inge Lehmann, solved this great mystery by correctly deducing that within the fluid core there must be a solid inner core that would reflect earthquake waves into the shadow zone, thus explaining seismic observations [30]. Lehmann's reasoning was of such great precision that her inner core concept was accepted as fact even though confirmatory evidence was not available until the 1960s. Figure 2 shows her discovery diagram.



**Figure 2: Restored photograph of Inge Lehmann (1888-1993) and a drawing from [30] illustrating her discovery of the inner core. I colorized that drawing for clarity.**

Studies of Earth's rotation and earthquake waves can provide information on the distribution of mass-layers within the planet. The chemical composition of those layers, however, must be deduced from studies of meteorites. In the 1930s and 1940s, Earth was thought to resemble

an *ordinary chondrite* meteorite, called ordinary because of their great abundance. If heated sufficiently in the laboratory, the elements of an ordinary chondrite separate into two components, an iron alloy beneath silicate-rock, a configuration reminiscent of Earth's then understood composition before Lehmann's inner core discovery [30] (Figure 1). In ordinary chondrite meteorites, nickel is *always* found alloyed with iron metal; all of the elements heavier than iron and nickel, even combined together, could not comprise a mass as great as the inner core. So what is the composition of the inner core?

In 1940, Birch [31] thought he had the answer. Birch *assumed*, without corroborating evidence, that the inner core is iron metal in the process of solidifying (freezing) from the liquid iron-alloy core (like an ice cube in a glass of ice-water). If Birch were correct, one could determine the temperature at the inner core boundary by measuring the solidification temperature of iron at the respective pressure. That is what many have done since the 1940s [32-34], but there is a fatally flawed assumption. For 39 years Birch and other geoscientists had no reason to believe the inner core composition was other than partially frozen iron (or nickel-iron) metal.

When Birch [31] and others imagined that Earth resembles an ordinary chondrite meteorite, they ignored a different possibility, an *enstatite chondrite*, one of the much less common chondrite meteorites whose matter had formed under oxygen-starving conditions and even contains some minerals not found on Earth's surface. Because of their rarity and seemingly inexplicable oxygen-starved minerals, enstatite chondrites were simply ignored as candidates for Earth's interior composition.

In 1976, Hans E. Suess and I [35] discovered that the oxygen-poor composition of enstatite chondrites' parent matter could be understood as a consequence of condensation at high-pressures, high-temperatures from a gas with the composition of the sun, provided the condensate was isolated from further reactions with the gas at lower temperatures. In that medium, at high-pressures substances condense at high-temperatures, but the reaction that makes oxygen available is independent of pressure and limits the availability of oxygen at high-temperatures.

Because of the oxygen-starvation of enstatite chondrite parent matter, a portion of their elements which have an affinity to combine with oxygen, occur in part in the iron alloy portion instead of residing entirely in the silicate-rock portion. These elements include calcium, magnesium, silicon, and uranium.

While studying enstatite chondrite meteorites in the 1970s, I realized that, if silicon were present in Earth's core, it would combine with nickel as nickel silicide, which would form a mass at the center almost identical to the mass of the inner core. Then in 1979, I published a contradiction [36] to the 39 year old inner core idea (Figure 3).

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### The nickel silicide inner core of the Earth

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From observations of nature the suggestion is made that the inner core of the Earth consists not of nickel-iron metal but of nickel silicide.

Contemporary understanding of the physical state and chemical composition of the interior of the Earth is derived primarily from interpretations of seismological measurements and from inferences drawn from observations of meteorites. Seismological investigations by Oldham (1906), Gutenberg (1914) and others helped to establish the idea that a fluid core extends to approximately one half the radius of the Earth. The existence of a small, apparently solid inner core at the centre of the Earth was recognized by Lehmann (1936) from interpretations of

**Figure 3: From [36].**

Figure 4 is the image of a highly complimentary letter I received from Inge Lehmann.

p.t.Sebakkevej 11  
2840 Holte, Denmark  
August 17, 1979

Dr. J.M.Herndon  
Department of Chemistry  
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La Jolla, California 92093

Dear Dr. Herndon,

Thank you for sending me your very interesting paper:  
Earth's nickel silicide inner core.

I admire the precision of your reasoning based on  
available information, and I congratulate you on the highly  
important result you have obtained.

It has been a special pleasure to be informed in advance  
of publication. I shall be interested to note the reactions of  
other geophysicists.

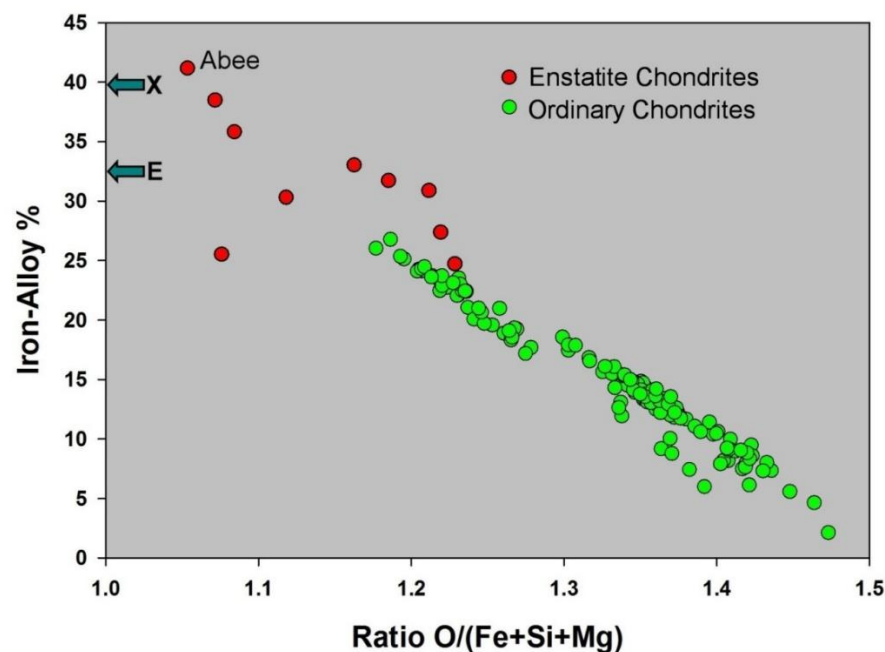
With kind regards

Yours sincerely  
*Inge Lehmann*  
Inge Lehmann

**Figure 4: Letter from Inge Lehmann to the author.**

While awaiting publication of my nickel silicide inner core paper [36], I imagined that there would be debate and discussion, and worried that geoscientists with well-funded laboratories would pick up the ball and run with it, leaving me in their dust. Instead there was silence. It was as if the paper had never been published. That work and following consequences have been ignored ever since then. Moreover, my NASA grant, which had funded the work, was not renewed, without good reason. I was “excommunicated,” and without that grant my university position evaporated.

Science, properly executed, is a logical progression of understanding. One new discovery, if correct, potentially leads to a series of successive discoveries. An incorrect “discovery” leads nowhere, trapping those blind adherents in an intellectual cul-de-sac: That is what happened to the geoscience community as a result of ignoring my 1979 fundamental, paradigm shifting, nickel silicide inner core scientific article [36]. Even in 1979, I realized that, if I were correct about the nickel silicide inner core, then most of the current scientific understanding about Earth’s origin, composition, and behavior is wrong. But was I correct? One question to ask is which of the chondrite meteorites have a sufficiently great weight percent of iron alloy to match the weight percent of Earth’s iron alloy core. The data, shown in Figure 5, leave no doubt that only the *enstatite chondrites*, not *ordinary chondrites*, are sufficiently rich in iron alloy to match Earth. Consequently, the rationale upon which Birch [31] based his inner core interpretation is baseless.



**Figure 5: Comparison of the mass percent of iron alloy in various chondrite meteorites to that of the Earth as a whole (E) and the endo-Earth (X) (lower mantle plus core [37]).**

The composition of Earth’s inner core is not an isolated, disconnected entity, but is inextricably related to Earth’s origin and composition. Thus, the ratios of mass for the internal shells of the Earth (inner core, total core, lower mantle) should match those of the Abee enstatite chondrite meteorite, and they do, as shown in Table 1 from [38].

**Table 1. Comparison of fundamental Earth mass ratios with corresponding ratios for the Abee enstatite chondrite**

| Fundamental Earth Ratio                           | Earth Ratio Value | Abee e.c. Ratio Value                                                     |
|---------------------------------------------------|-------------------|---------------------------------------------------------------------------|
| Lower Mantle Mass to Total Core Mass              | 1.49              | 1.43                                                                      |
| Inner Core Mass to Total Core Mass                | 0.052             | theoretical<br>0.052 if Ni <sub>3</sub> Si<br>0.057 if Ni <sub>2</sub> Si |
| Inner Core Mass to Lower Mantle + Total Core Mass | 0.021             | 0.021                                                                     |
| D'' CaS + MgS Mass to Total Core Mass             | 0.09              | .011                                                                      |
| ULVZ of D'' CaS Mass to Total Core Mass           | 0.012             | 0.012                                                                     |

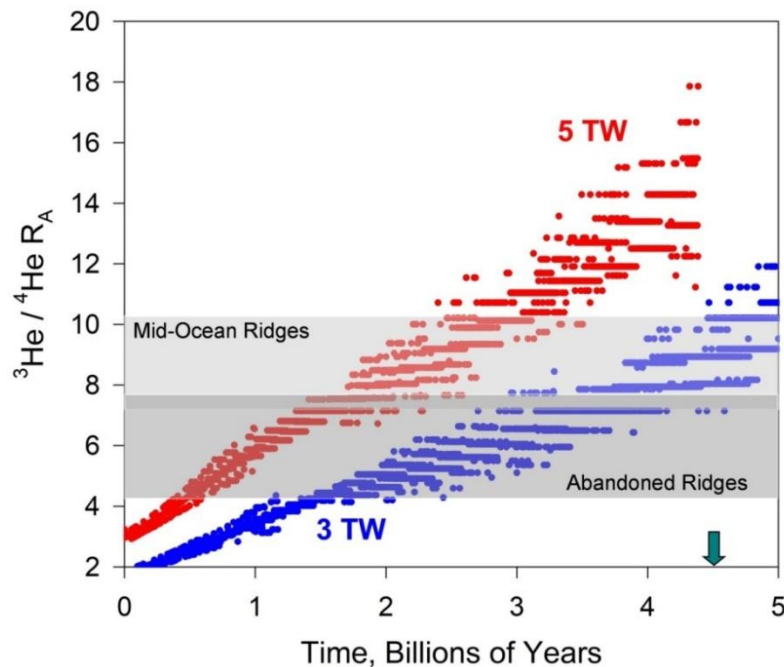
In an article published in *Naturwissenschaften* in 1982 [39], I pointed out the importance of determining whether uranium resides in the alloy component of enstatite chondrites. Serendipitously, in 1982 Murrell and Burnett [40] discovered that virtually all of the uranium in the Abee enstatite chondrite resides in its alloy portion. Because Earth's core is virtually identical to the alloy portion of the Abee enstatite chondrite, shown in Table 1, one may therefore infer that a very large proportion of Earth's uranium exists in its core, not in its rocky mantle as often assumed by the geoscience community [41].

The next step in my logical progression of understanding was realizing that uranium in Earth's core would settle at the very center of the Earth. In 1993 and in subsequent publications, I applied Fermi's nuclear reactor theory [42] to demonstrate the feasibility of an accumulation of uranium at Earth's center functioning as a nuclear fission breeder reactor, called the *georeactor*, as the energy source and production mechanism for the geomagnetic field [43-57].

### Georeactor Evidence #1

In 1969, Clarke et al. [58] discovered that <sup>3</sup>He and <sup>4</sup>He are venting from the Earth's interior. At the time there was no known deep-Earth mechanism that could account for the experimentally measured <sup>3</sup>He, so its *ad hoc* origin was assumed to be a primordial <sup>3</sup>He component, trapped at the time of Earth's formation, which was subsequently diluted with the appropriate amount of <sup>4</sup>He from radioactive decay. The <sup>3</sup>He/<sup>4</sup>He ratio of helium occluded in basalt at mid-ocean ridges is  $8.6 \pm 1$  times greater than the same ratio in air, expressed as 8.6 RA. When a uranium nucleus undergoes nuclear fission, it usually splits into two roughly equal, large fragments. Once in every 10,000 fission events, however, the nucleus splits into three pieces, two large and one very small. Tritium, <sup>3</sup>H, is a prominent very small fragment of

ternary fission. Tritium is radioactive with a half-life of 12.32 years and decays to  $^3\text{He}$ ;  $^4\text{He}$  is likewise georeactor produced and also derives from the alpha particles of natural decay. Figure 6 presents helium fission product results from georeactor numerical simulations conducted at Oak Ridge National Laboratory, expressed as  $^3\text{He}/^4\text{He}$  relative to the same ratio measured in air [47]. That georeactor-produced  $^3\text{He}/^4\text{He}$  ratios have the same range of values observed in oceanic lava is strong evidence that the georeactor exists and is the source of the observed deep-Earth helium [59].



**Figure 6: Fission product ratio  $^3\text{He}/^4\text{He}$ , relative to that of air,  $R_A$ , from nuclear georeactor numerical calculations at 5 terawatts, TW, (upper) and 3 TW (lower) power levels [47]. The band for measured values from mid-oceanic ridge basalts is indicated by the solid lines. The age of the Earth is marked by the arrow. Note the distribution of calculated values at 4.5 billion years, the approximate age of the Earth. The increasing values are the consequence of uranium fuel burn-up. Icelandic deep-Earth basalts present values ranging as high as 37 times the atmospheric value [60].**

Numerical simulations of georeactor operation, conducted at Oak Ridge National Laboratory, provide compelling evidence for georeactor existence: Georeactor helium fission products matched quite precisely the  $^3\text{He}/^4\text{He}$  ratios, relative to air, observed in oceanic basalt as shown in Figure 6. Note in that figure the progressive rise in  $^3\text{He}/^4\text{He}$  ratios over time as uranium fuel is consumed by nuclear fission and radioactive decay. The high  $^3\text{He}/^4\text{He}$  ratios observed in samples from 'hotspots' or 'mantle plumes' are consistent with the sharp increases observed from georeactor simulations as the uranium fuel becomes depleted and  $^4\text{He}$  diminishes.

Thermal structures, sometimes called mantle plumes, beneath the Hawaiian Islands and Iceland, two high  $^3\text{He}/^4\text{He}$  hot-spots, as imaged by seismic tomography [61, 62], extend to the interface of the core and lower mantle, further reinforcing their georeactor-heat origin. The

high  $^3\text{He}/^4\text{He}$  ratios measured in 'hotspot' lavas appear to be the signature of 'recent' georeactor-produced heat and helium, where 'recent' may extend several hundred million years into the past. Mjelde and Faleide [63] discovered a periodicity and synchronicity through the Cenozoic in lava outpourings from Iceland and the Hawaiian Islands, 'hotspots' on opposite sides of the globe, that Mjelde et al. [64] suggest may arise from variable georeactor heat-production.

## Georeactor Evidence #2

As early as the 1960s, there was discussion of antineutrinos being produced during the decay of radioactive elements within the Earth. In 1998, Raghavan et al. [65] were instrumental in demonstrating the feasibility of their detection. In 2002, following publication of the August issue of Discover Magazine in which my discovery of the georeactor was the feature-cover story; I received a request for additional material by a summer intern at Lucent Technologies who was to present a lunch-time seminar on the subject. Following that seminar, an attendee Raghavan [66], authored a paper, entitled "Detecting a Nuclear Fission Reactor at the Center of the Earth" wherein he showed that antineutrinos resulting from nuclear fission products would have a different energy spectrum than those resulting from the natural radioactive decay of uranium and thorium. Raghavan's 2002 paper stimulated intense interest worldwide, especially with groups in Italy, Japan and Russia. Russian scientists [67] expressed well the importance: *"Herndon's idea about georeactor located at the center of the Earth, if validated, will open a new era in planetary physics"*.

The georeactor is too small to be presently resolved from seismic data. Oceanic basalt helium data, however, provide strong evidence for the georeactor's existence [47, 59] and antineutrino measurements have not refuted its existence [68, 69]. The two currently operational deep-Earth antineutrino detectors, at Kamioka, Japan [70] and at Grand Sasso, Italy [71], to date have not only failed to refute georeactor nuclear fission, but at a 95% confidence level, have measured georeactor energy production of 3.7 and 2.4 terawatts, respectively. Notably, the energy production levels used in the Oak Ridge National Laboratory georeactor calculations, indicated in Figure 6, ranged from 3 to 5 terawatts [47]. These antineutrino measurements provide the second independent, compelling evidence of the existence of Earth's nuclear fission georeactor.

## Earth's Jupiter-like Formation

In 1944, Eucken [72] showed that the first primordial condensate from a cooling gas of solar composition at high-pressures would be molten iron at high-temperatures, followed at lower temperatures by silicate minerals, and at still lower temperatures, by ices and gases. In other words, condensing from within a giant gaseous protoplanet, the formation of Earth began with liquid iron metal raining out to form its core, followed by the condensation of minerals to form its mantle, and further condensation of ices and gases yielding a planet similar in mass to Jupiter [49, 73-75].

Primordial condensation at high-pressures, high-temperatures progressed on the basis of relative volatility with the first condensate being molten iron and elements dissolved therein. The primordial gas at high-pressures, high-temperatures led to an oxygen-starved fluid iron alloy core, including portions of Earth's oxygen-loving elements such as uranium, silicon,

calcium, and magnesium. Uranium precipitated and settled at the center of Earth where it eventually began functioning as a nuclear fission reactor [43-45, 47, 52-54, 57, 76], producing the geomagnetic field [50-52, 54, 56, 76, 77]. Silicon precipitated as nickel silicide and formed Earth's inner core [36]. Calcium and magnesium precipitated as sulfides and floated to the top of the core, forming the seismically "rough" matter observed there [43, 78] (Table 1).

As Earth's fluid core formed, other oxyphile or oxygen-loving elements exsolved from the fluid condensate as the solid silicate, enstatite ( $\text{MgSiO}_3$ ) which formed Earth's lower mantle. Rocky-matter condensation followed along with in-falling debris forming Earth's upper mantle and crust. Primordial condensation continued with the most volatile substances condensing as ices and gases to form a fully condensed gas giant proto-Earth having a mass almost identical to Jupiter [75].

Subsequently, violent T-Tauri phase solar winds, accompanying thermonuclear ignition of the sun, stripped the ices and gases away leaving, at the beginning of the Hadean eon, a rocky planet, fully covered by continental rock, compressed to about two-thirds of present-day Earth-diameter, and containing within itself the great stored energy of protoplanetary compression [25, 49, 79, 80].

### Whole-Earth Decompression Dynamics

As described by *Whole-Earth Decompression Dynamics*, Earth's subsequent decompression accounts for virtually all of Earth's surface geology and geodynamics [25, 26, 38, 49, 81, 82]. As whole-Earth decompression progresses and as Earth's volume increases, its surface area increases by the formation of decompression cracks [25]. Primary decompression cracks with underlying heat sources extrude basalt-rock, which flows by gravitational creep until it falls into and infills secondary decompression cracks that lack heat sources. This accounts for the separation of the continents and for the topography of Earth's ocean basins. As whole-Earth decompression progresses and as Earth's volume increases, its surface curvature must change. The manner by which surface curvature adjusts to changes in volume explains, in logical, causally-related ways, the formation of mountain chains characterized by folding as well as fjords and submarine canyons [83, 84], Figure 7.



**Figure 7: Left: Example of mountain folding; Center: The necessity for surface curvature change during whole-Earth decompression. The un-decompressed Earth is represented by the orange, while the larger, decompressed Earth, is represented by the melon. Note the curvatures do not match; Right: Two causally-related curvature-change mechanisms that naturally result in**

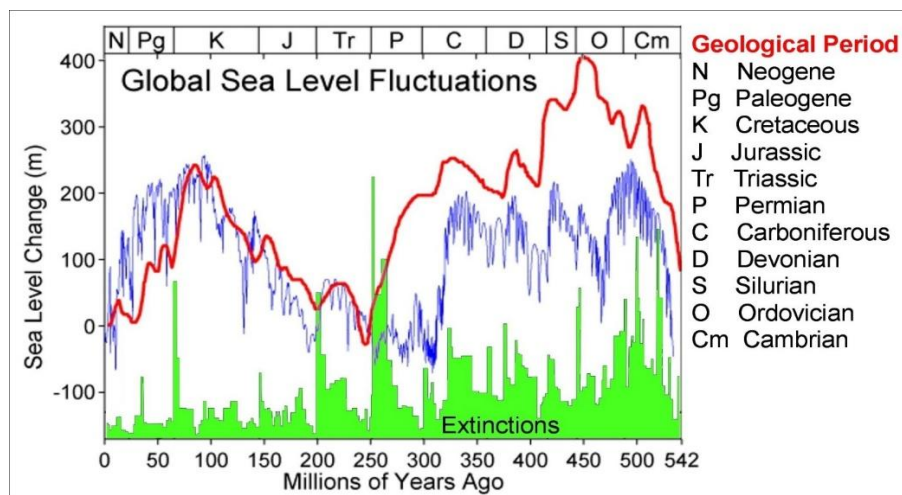
**surface curvature change, namely, major curvature adjustment by folded-over tucks, minor curvature adjustment by continental-perimeter tears.**

*Whole-Earth Decompression Dynamics* explains, more completely and more correctly, observations usually attributed to plate tectonics without requiring physically-impossible mantle convection [38] or fictitious super-continent cycles [85]. In addition, *Whole-Earth Decompression Dynamics* explains geological observations that are inexplicable by plate tectonics, including the geothermal gradient [81], oceanic troughs, the origin of petroleum and natural gas deposits [86], and more.

### GEODYNAMIC BEHAVIOR RELATED TO SPECIES EXTINCTION

The geodynamics and geology of Earth are intrinsically related through my indivisible geoscience paradigm, *Whole-Earth Decompression Dynamics*. Ultimately, myriads of seemingly complex and theoretically unresolved observations can be resolved and understood in logical, causally related ways. For example, the apparent correlation of geomagnetic field reversals with species extinction [87, 88], with major episodes of volcanism [89, 90], and with drastic sea-level changes [91], is understandable as geomagnetic field collapse, in principle, can lead to a spike in georeactor output energy, and thus possibly trigger a decompression spike manifest, for example, by volcanism, earthquakes, continent splitting, ocean basin formation, species extinction, and more [53, 54, 76].

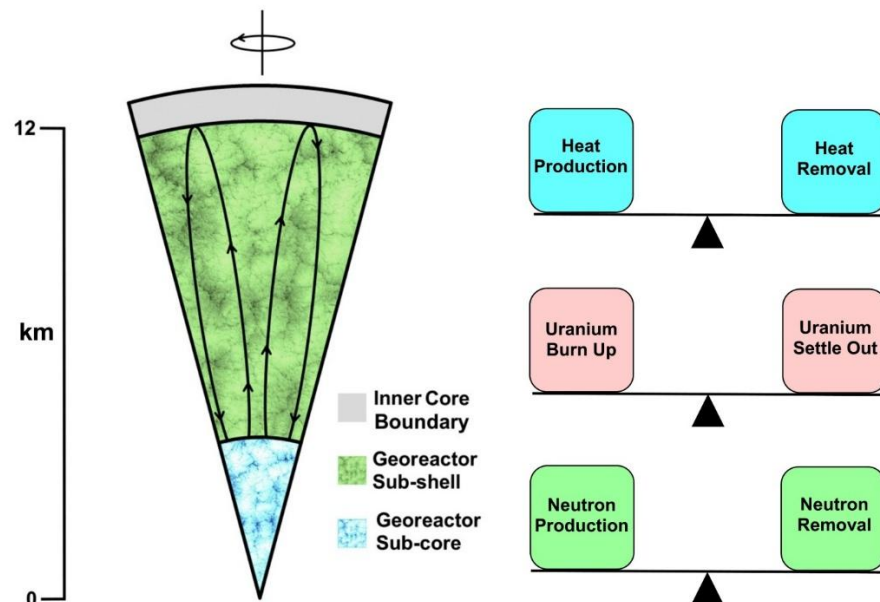
The progressive splitting of continental crust and concomitant opening of ocean basins necessarily causes lowering of sea levels, which over time is compensated by new ocean water additions. Continent fragmentation not only leads to the release of primordial water occluded in mantle minerals, but also exposes sea water to non-oxidized minerals, such as pyrite and arsenopyrite, that can acidify and toxify sea water, and potentially lead to massive species extinctions [92] (Figure 8).



**Figure 8: 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 [15, 21, 93-98].**

When the T-Tauri solar winds stripped away Earth's massive layer of primordial ices and gases, the compressed Earth was approximately two-thirds of present Earth diameter with a continental-rock shell fully covering its surface and contained within a great energy source, the protoplanetary energy of compression. For decompression to take place the lost heat of compression must be supplied, either from the surroundings, which might impede decompression, or from a separate energy source, in this instance, Earth's georeactor.

The left portion of Figure 9 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 Figure 9 represents the balances that must be maintained for stable georeactor operation.



**Figure 9: 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.**

### Geomagnetic Field Generation

Heat produced by nuclear fission chain reactions in the uranium sub-core results in 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, Earth's fluid core, which removes the georeactor produced heat and maintains the adverse temperature gradient (sub-shell top cooler than bottom) necessary for stable convection [99]. 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.

In the micro-gravity environment at the center of Earth, georeactor heat production that is too energetic would be expected to cause actinide sub-core disassembly, mixing actinide elements with neutron-absorbers and nuclear waste in the sub-shell, quenching the nuclear fission chain reaction. But as actinide elements begin to settle out of the mix, the chain reaction restarts, ultimately establishing a balance, a dynamic equilibrium between heat production and actinide settling-out, a self-regulation control mechanism [51].

### **Geomagnetic Reversals and Excursions**

Reversals or excursions of the geomagnetic field are produced when stable convection is interrupted in the region where convection-driven dynamo action occurs, in the sub-shell of the georeactor which is the repository for uranium, impurities, and nuclear waste. Upon re-establishing stable convection, the convection-driven dynamo action resumes with the geomagnetic field either in the same or in the reversed direction. The mass of the georeactor is quite low, less than one ten-millionth of the fluid core mass. Consequently, reversals can occur much more quickly, and with greater ease, than previously thought. Trauma to the Earth, such as a massive asteroid impact or the violent splitting apart of continental land masses, might de-stabilize georeactor dynamo-convection, causing a magnetic reversal or excursion. It is also possible that a geomagnetic reversal or excursion might be caused by a particularly violent event on the sun.

Earth is constantly bombarded by the solar wind, a fully ionized and electrically conducting plasma, heated to about 1 million degrees Celsius that streams outward from the sun and assaults the Earth at a speed of about 1.6 million kilometers per hour. The geomagnetic field deflects the brunt of the solar wind safely past the Earth, but some charged particles are trapped in donut-shaped belts around the Earth, called the Van Allen Belts. The charged particles within the Van Allen Belts form a powerful ring current that produces a magnetic field which opposes the geomagnetic field near the equator. If the solar wind is constant, then the ring current is constant and no electric currents are transferred through the magnetic field into the georeactor by Faraday's induction. High-intensity changing outbursts of solar wind, on the other hand, will induce electric currents into the georeactor, causing ohmic heating in the sub-shell, which in extreme cases might disrupt convection-driven dynamo action and lead to magnetic reversals or excursions.

### **Triggering Whole-Earth Decompression Episodes**

The stored energy of protoplanetary compression is the primary energy source for Earth's decompression. However, for decompression to progress without cooling and impeding

decompression, the lost heat of compression must be supplied by georeactor nuclear fission. In addition to doing work against gravity, the stored energy of protoplanetary compression heats the base of the crust by a process known as *mantle decompression thermal tsunami* [81]. Decompression beginning within Earth's mantle propagates outward like a wave through silicates of decreasing density until it reaches the rigid crust where compression and compression-heating takes place. That compression-heating is the heat source for the geothermal gradient as well as for other surface phenomena including shallow-source volcanoes.

The mechanism for triggering whole-Earth decompression episodes is as a multi-stage amplifier that involves disruption of sub-shell convection either by trauma or by a change in solar flux impinging on Earth's magnetic field. Disruption of sub-shell convection results in extra uranium settling-out, which causes a burst of nuclear fission energy, which replaces some of the lost heat of protoplanetary compression, which causes a burst in whole-Earth decompression, which results in a burst of heat emplaced at the base of the crust and/or Earth's surface experiencing decompression-driven movement, the extent of which is a function of the degree of sub-shell convection disruption.

The mechanism for triggering whole-Earth decompression episodes of major-scale provides a logical, causally-related explanation of species extinction involving splitting the continental crust and concomitant opening of new ocean basins, which for a time lowers sea-level, potentially toxifying oceans, as well as resulting in major volcanic eruptions, earthquakes and environment devastation. The principles involved may also apply to less-severe changes in the solar wind flux, which potentially provide an explanation for observed increases in earthquakes [100-102] and volcanic eruptions [103-105] that are associated with increased solar activity [106].

## CONCLUSIONS

Since 1979, fundamental contradictions are systematically ignored and the scientific community continues to assume without legitimate basis that previous, underlying ideas are correct even though refuted and shown to be no longer viable. Consequently, for decades, members of the geoscience community have attempted unsuccessfully to reconcile major species extinctions with geophysical phenomena based upon false assumptions, including for example, physically-impossible mantle convection [38], fictitious supercontinent or Wilson cycles [85], questionable paleolatitude determinations [107], unspecified energy sources, and physically-impossible geomagnetic field production in Earth's fluid core [55]. I have described briefly the false assumptions that have impeded understanding, and then demonstrated how logical, causal relationships related to species extinction follow from my new geoscience paradigm called *Whole-Earth Decompression Dynamics* [25, 26].

The mechanism for triggering whole-Earth decompression episodes, related to geomagnetic changes, is as a multi-stage amplifier that involves disruption of georeactor sub-shell convection either by trauma or by a change in solar flux impinging on Earth's magnetic field. Disruption of sub-shell convection results in extra uranium settling-out, which causes a burst of nuclear fission energy, which replaces some of the lost heat of protoplanetary compression, which causes a burst in whole-Earth decompression, which results in a burst of heat

emplacement at the base of the crust and/or Earth's surface experiencing decompression-driven movement, the extent of which is a function of the degree of sub-shell convection disruption.

The geomagnetic mechanism for triggering whole-Earth decompression episodes of major-scale provides a logical, causally-related explanation of species extinction connected to magnetic reversals and excursions that involves splitting the continental crust, opening new ocean basins, lowering sea-levels, toxifying oceans, as well as major volcanic eruptions, earthquakes and environment devastation.

The principles involved may apply to less-severe changes in the solar wind flux, which potentially provide an explanation for observed increases in earthquakes [100-102] and volcanic eruptions [103-105] that are associated with increased solar activity [106]. This explanation therefore may provide a legitimate basis for the development of earthquake and volcanic eruption prediction methodologies.

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