Advances in Social Sciences Research Journal – Vol. 8, No. 2
Publication Date: February 25, 2021
DOI:10.14738/assrj.82.9743.
Herndon, J. M. (2021). Whole-Earth Decompression Dynamics: New Earth Formation Geoscience Paradigm Fundamental Basis of Geology and Geophysics. Advances in Social Sciences Research Journal, 8(2) 340-365.

Whole-Earth Decompression Dynamics: New Earth Formation Geoscience Paradigm Fundamental Basis of Geology and Geophysics

J. Marvin Herndon, Ph.D.
Transdyne Corporation
San Diego, California USA

ABSTRACT

Policymakers and educators depend upon the advice of scientists to warn of natural and anthropogenic dangers to the environment and to Earth's biota. Decades of mal-administered government-funding have led to the corruption of science, however, and to the formation of unofficial cartels that promulgate a seriously flawed, consensus view of Earth's origins, structure, and geodynamic behavior. Proponents of this "consensus" view, in contradiction to long-standing scientific principles, suppress or ignore concepts that better explain Earth's fundamental behavior. Here I present, as published in the peer-reviewed scientific literature over a period of four decades, a fundamentally new, indivisible paradigm that posits Earth's early formation as a Jupiter-like gas giant, which makes it possible to derive virtually all the geological and geodynamic behavior of our planet, including two previously unanticipated, powerful endogenous energy sources; the origin of mountain ranges characterized by folding; the origin and typography of ocean floors and continents; the origin of fjords and the primary initiation of submarine canyons; the origin of Earth's magnetic field; the causes of geomagnetic disruptions; the source of the geothermal gradient; the origin of Earth's petroleum and natural gas deposits; and more. The logical, causally related advances documented here stand as a reference by which to compare and evaluate the phenomenological model-nonsense that has been published for decades by government-funded scientists.

Key Words: Plate tectonics; Geodynamics; Mountain formation; Petroleum; Continent cycles; Paleolatitude; Convection; Pangaea.

INTRODUCTION

Government leaders and educators depend upon scientists to describe truthfully and to the best of their knowledge the way Earth's processes work, and to warn of natural and anthropogenic dangers to the environment and to Earth's biota. One hundred years ago, when there was essentially no government support for science, scientists themselves maintained scientific integrity. But after World War II, the glut of government support for science, coupled with flawed funding-administration procedures, progressively led to the corruption of science [1, 2].

About a decade before I earned the Ph.D. degree in nuclear chemistry in 1974, changes had begun to take place in the physical sciences. Instead of making discoveries, logically and causally connected to the properties of matter and radiation, scientists began making phenomenological models that purport to describe empirical relationships of phenomena to each other [3]. Such models are typically based upon *ad hoc* assumptions, employ computer-based computations and parameters pre-selected to yield an *a priori* desired result. Although a model may appear to emulate some aspect of nature, there is no certainty that nature behaves in the manner modeled. As noted by Box [4], all models are wrong, but a few are useful, for example, models that might predict the path of hurricanes.

When a new idea or observation arises in science, scientists should attempt to refute it. If unable to refute it, scientists, should cite it in subsequent publications on the subject. That is how science progresses, and to be reliable, must progress.

Over the past 45 years, I have made fundamental scientific discoveries that have yielded several paradigm shifts in geoscience. But these advances have been systematically ignored, and at times suppressed, by government-funded scientists functioning in the manner of cartel members. Here I describe a fundamentally new indivisible paradigm that explains Earth's origin and behavior in logical, causally related ways grounded in the fundamental properties of matter and radiation. The advances documented here stand as a reference by which to compare and evaluate the model-nonsense that has been published for decades by government-funded scientists.

PHENOMENOLOGICAL MODEL NONSENSE

In 1897, Chamberlain [5] set forth a new hypothesis for planetary formation. In 1900, Moulton [6] modified that hypothesis, which became the Chamberlin-Moulton *planetesimal theory of planetary formation* [7] that explained planetary formation by the accumulation of small bodies.

Beginning in 1963, the *planetesimal theory* became the basis of phenomenological models [8-11] which in aggregate became known by adherents as the *standard model of solar system formation* [12-14]. At the time it was incorrectly believed that the Earth resembled an *ordinary chondrite* meteorite. The model assumed the minerals of an ordinary chondrite condensed from primordial matter, a hot gas of the composition of the sun at very low-pressure (one ten-thousandth the pressure of the air we breathe) [11, 15]. Then the condensate progressively gathered into larger rocks, boulders, planetesimals, and finally planets [9, 10]. But the gathered condensate was a homogeneous mixture of iron metal and silicate-rock and all planets have iron metal cores. So, without corroborating evidence, to account for planetary cores, the standard model assumed whole-planet melting with a magma ocean that allowed the more dense molten iron metal to drain down to the planet-center [16, 17].

Phenomenological model-makers typically do not adhere to long-standing scientific principles. For example, in a paper published in the *Proceedings of the Royal Society of London* [18], I utilized thermodynamic considerations to show that, under the assumed low-pressure, hot gas composition of the photosphere of the sun, the condensate would be fully oxidized (unlike the minerals found in ordinary chondrites) and would contain no metal for planetary cores. My work was ignored by the model-makers.

Typically, models are composed of layer upon layer of *ad hoc* assumptions, the consequences of which can often lead to absurdities committed in the name of "science." Consider the planets of our Solar System shown in Figure 1.

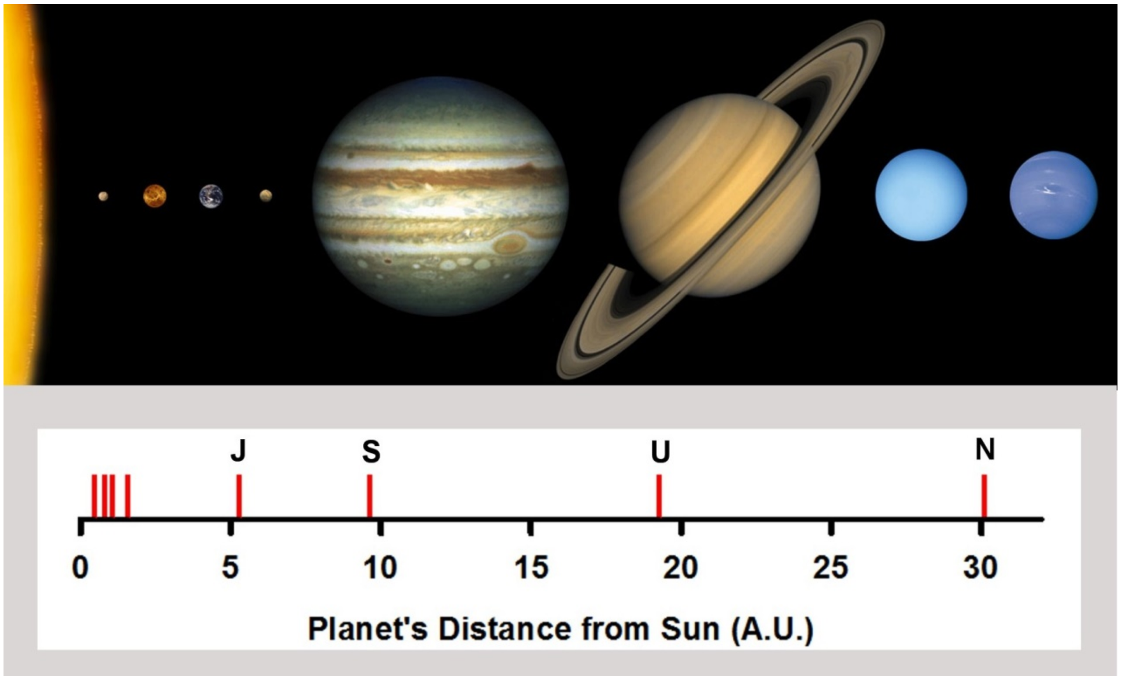

Figure 1. Upper images showing the relative sizes of the planets in our Solar System. Their relative distances are shown in the lower graph.

The inner four planets are *rocky* while the outer four, the *gas-giants*, contain copious amounts of ices and gases. Lacking corroborating evidence, how were these differences explained by the standard model of solar system formation? It was simply assumed that during primordial condensation there was a temperature gradient across the Solar System with a *frost line* between Mars and Jupiter. Beyond the frost line temperatures were sufficiently low to permit condensation of ices and gases, but inside the frost line, temperatures were too high for ices and gases to condense, so that only rocky material could condense.

In the late 1990s, astronomers discovered exoplanets orbiting other stars. Some of these exoplanets were gas giants located as close or closer to their stars as Earth is to the sun. How then could they have formed? To explain this anomaly, astrophysicists invented the concept of *planet migration* wherein gas-giant exoplanets were assumed to have formed in the outer regions of their star systems, and then migrated to where they are currently observed [19].

In 2006, I submitted a brief Letter to *Astrophysical Journal Letters* entitled "Evidence Contrary to the Existing Exo-Planet Migration Concept." The evidence I presented was historical, interdisciplinary, and model-independent. That Letter was rejected out of hand [20]. Suppressing publication of evidence that conflicted with a new unchallenged theory thus allowed planet migration theory to become part of official astro-nonsense – not science [21, 22].

The discovery of close-to-star, gas-giant exoplanets should have been an invitation to make new findings and should have caused astrophysicists to ask the question "what is wrong with this picture." Had they asked basic questions that probed their problematic assumption, they might have realized the flaws in their models, and made scientific progress [23].

NATURE OF EARTH'S FORMATION

Meteorites that crash to Earth from space can be categorized into groups on the basis of their chemical compositions. Members of one group, called *chondrites*, are special in that their different non-volatile chemical elements have not been appreciably separated from one another since their origin in a great nuclear furnace. They therefore provide useful knowledge about processes in the Solar System at the time planets formed [24-26]. There is a complication, however.

There are three sub-groups of *chondrite* meteorites that differ greatly in their mineral components, because their parent matter formed under quite different conditions, which controlled the amount of oxygen available during formation:

- *Ordinary Chondrites*
- *Carbonaceous Chondrites*
- *Enstatite Chondrites*

Taking thermodynamic considerations into account, I determined that the abundant ordinary chondrites could not have formed in the hydrogen-rich environment thought to have prevailed during their primordial condensation [18, 27, 28], but they must have different origins [29].

The rare, primitive, oxygen-rich *carbonaceous chondrites* are devoid of metal [30, 31] and could not have formed planets with iron metal cores.

The matter from which the rare, primitive, oxygen-starved *enstatite chondrites* formed was an enigma until 1976 when Suess and I [32] demonstrated that primordial condensation at high-temperatures and high-pressures (10-1000 times the pressure of the air we breathe) would lead to the level of oxygen-starvation found in an enstatite chondrite, provided its parent matter was isolated from the gases at lower temperatures.

GIANT GASEOUS PROTOPLANETARY PLANET FORMATION

In 1755, Kant [33] set forth a hypothesis on the origin of the sun and planets that was modified by Laplace [34] four decades later. Laplace's nebula hypothesis was the forerunner of the modern protoplanetary theory of planet formation in which planets are thought to form within giant gaseous protoplanets. The protoplanetary theory attracted scientific attention in the 1940s and 1950s [35-37], but was abandoned and ignored by phenomenological model-makers in the early 1960s who favored the planetesimal theory.

In 1944, Eucken [35] published a scientific article entitled "Physikalisch-chemische Betrachtungen ueber die frueheste Entwicklungsgeschichte der Erde" [Physico-Chemical Considerations about the Earliest Development History of the Earth]. From thermodynamic considerations, Eucken investigated condensation from a gas of the composition of the outer part of the sun, mostly hydrogen and helium, but containing small amounts of nearly all of the chemical elements, which is thought to resemble the primordial matter from which the planets formed. Eucken 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 gases and ices. 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.

Thirty-two years later, while investigating condensation of enstatite chondrite parent material, Suess and I [32] *independently* confirmed Eucken's calculations. The next step was to demonstrate that the core and lower mantle of Earth are essentially identical, respectively, to the alloy and silicate portions of an enstatite chondrite. Using ratios of mass, I related parts of the Abee enstatite chondrite with parts of the Earth [38-41]. These mass-ratio relationships are shown in Table 1. For details, see [41].

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 0.052 if Ni_3Si 0.057 if Ni_2Si
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

Connecting parts of Earth to enstatite chondrite parent matter, and connecting the oxygen-starved parent matter of enstatite chondrites to primordial condensation at high-temperatures and high-pressures, therefore connects Earth's formation to high-temperature and high-pressure condensation from within a giant gaseous protoplanet that began with liquid iron metal raining out forming the core, followed by condensation of Earth's mantle minerals.

In 2011, NASA's MESSENGER orbiting spacecraft produced important images of features unique to planet Mercury that were inexplicable to NASA scientists. Many of the images revealed *"... an unusual landform on Mercury, characterized by irregular shaped, shallow, rimless depressions, commonly in clusters and in association with high-reflectance material .... and suggests it indicates activity*" [42] (Figure 2).

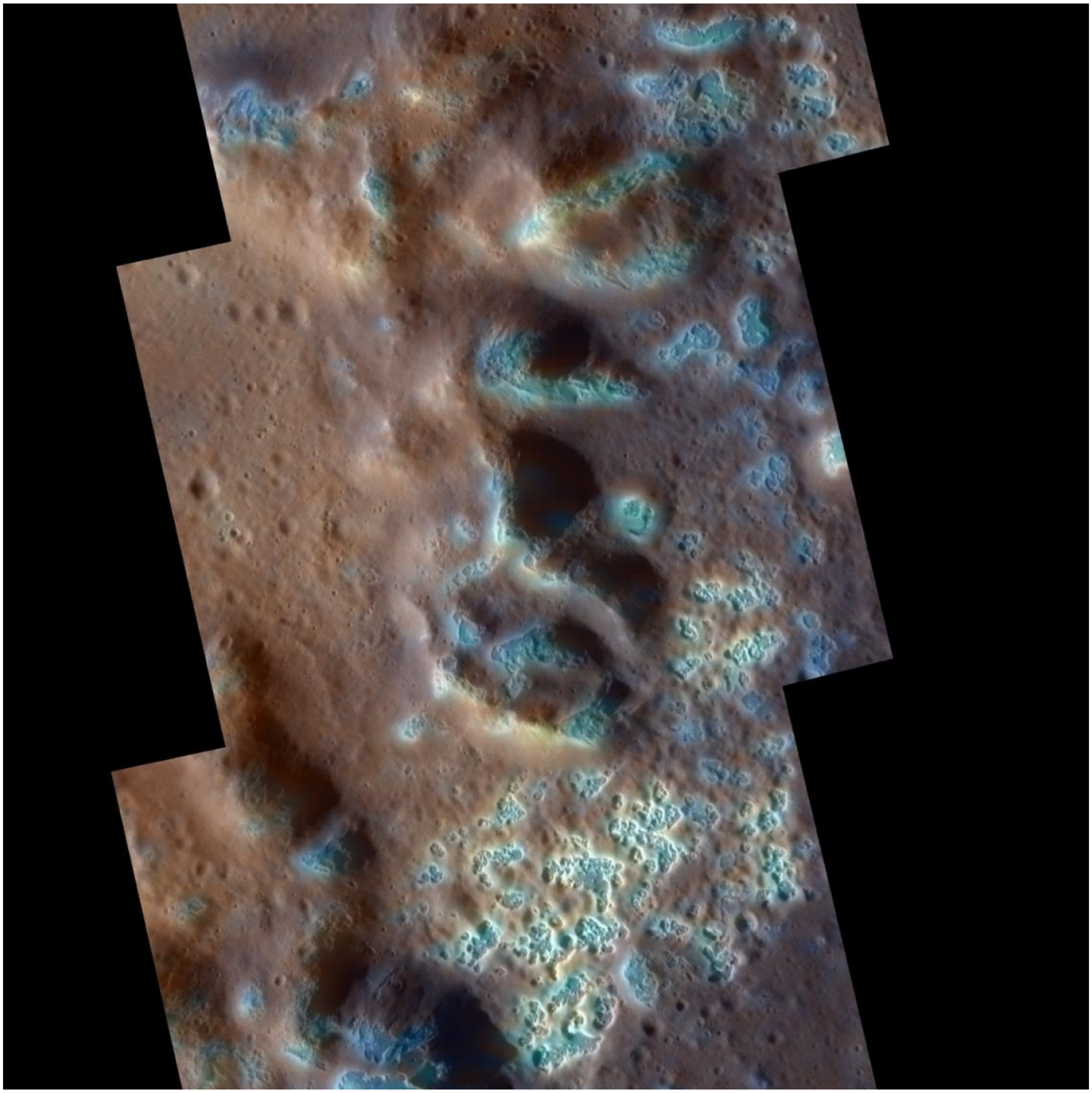

Figure 2. NASA MESSENGER image showing pits surrounded by shiny material. These bright shallow depressions appear to have been formed by disgorged volatile matter from within the planet.

In 2012, I published a scientific explanation for the anomalies observed on Mercury's surface[43]. During formation, Mercury's iron core, in condensing and raining-out as a liquid at high pressures and high temperatures from within what was a giant gaseous protoplanet, dissolved a considerable amount of hydrogen, as hydrogen is quite soluble in liquid iron. As Mercury's core solidified, the hydrogen was dispelled and erupted from the surface like hydrogen geysers, forming the surrounding shiny iron metal by turning relatively low reflecting iron sulfide into highly reflecting iron metal.

Figure 3 shows the relationship between condensation and dissolved hydrogen. For the indicated hydrogen gas pressures (left vertical axis) and temperatures, the red curve shows the boundary between liquid iron and gaseous iron in an atmosphere like the outer part of the sun. For each temperature/pressure point along the red curve, the amount of hydrogen dissolved in the molten iron, indicated by the blue curve, can be read from the right vertical axis. For reference, the green lines tie together these corresponding points. The hydrogen volume units, at STP (standard temperature and pressure), are equal to the volume of planet Mercury.

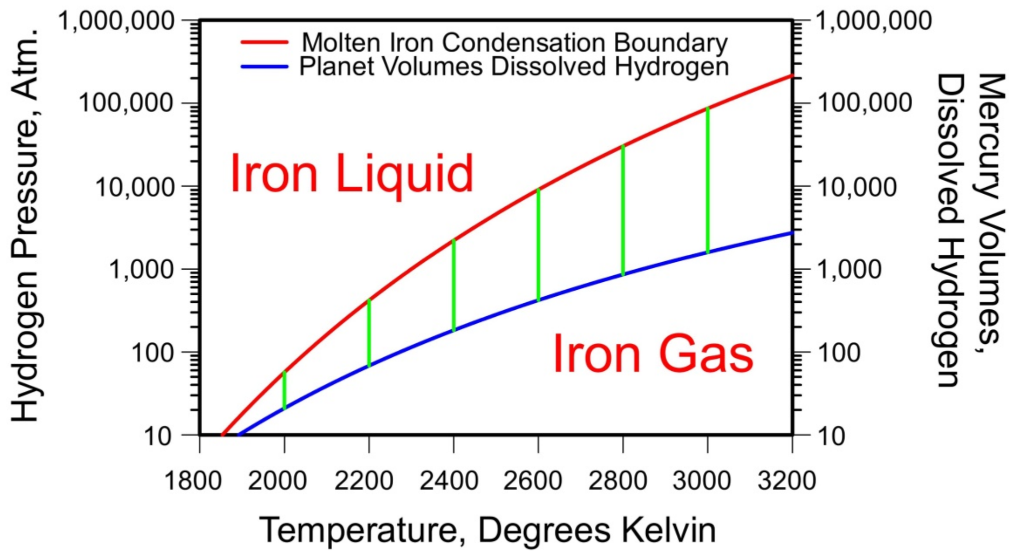

Figure 3. By condensing from a giant gaseous protoplanet at pressures above 10 atm., Mercury's core initially was liquid and contained copious amounts of dissolved hydrogen. For details see [43].

REMOVAL OF INNER PLANET ICES AND GASES

If planets formed from giant gaseous protoplanets, as compelling evidence indicates, how were the gases lost from the inner planets (but not the outer planets)?

There is a brief period of violent activity, called the T-Tauri phase, that occurs during the early stages of star formation and is characterized by grand eruptions and super-intense 'solar wind'. A Hubble Space Telescope image of an erupting binary T-Tauri star is shown in Figure 4. The white crescent marks the leading edge of the plume from an observation made five-years earlier.

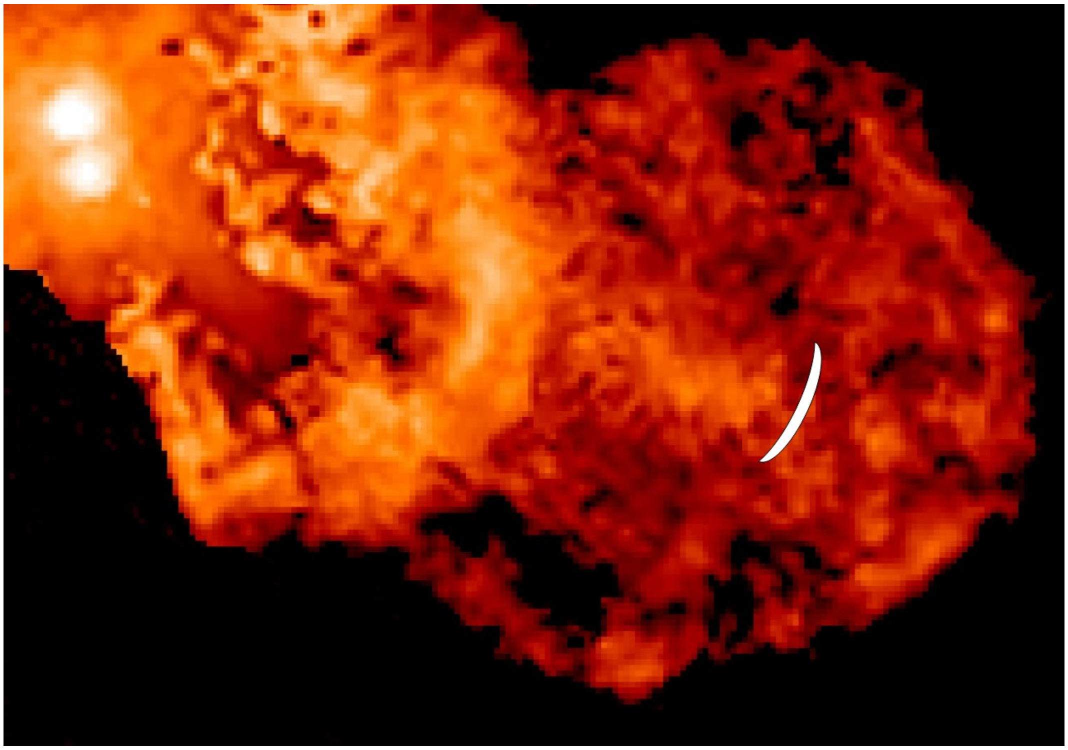

Figure 4. Hubble Space Telescope image of a T-Tauri outburst from the binary XZ-Tauri in 2000. The white crescent shows the leading edge of the plume in 1995.

A T-Tauri outburst from our sun, I posit, stripped gas from all the inner planets, and even stripped part of Mercury's incompletely condensed protoplanetary material, and deposited it between Mars and Jupiter where it contributed to the formation of the asteroid belt [28, 29].

GEOPHYSICAL COGNITIVE DISSONANCE

The apparent "fit" of transoceanic continental coastlines (South America with West Africa; North America with West Europe), the matching of *Mesosaurus* fossils in Brazil and those in Ghana, and the matching of sediments, including coal field strata deposited in the Carboniferous, in both Europe and North America, led Wegener [44] in 1912 to conclude that these continents were joined about 330 million years ago in the super-continent, Pangaea, which broke apart and drifted through the surrounding ocean as continents and islands, reaching their present locations in recent times. Fifty years later, upon discovery of ocean-floor magnetic striations, geoscientists recast *continental drift* into *plate tectonics theory*, based upon the idea that continental "plates" move about Earth' surface riding atop putative mantle convection cells [45] – a physical impossibility because the density increase, caused by compression due to the weight above, is too great to be overcome by thermal expansion [41, 46].

In 1933, between the beginnings of *continental drift* and *plate tectonics theory*, Hilgenberg [47] had a different idea. He imagined that at some time in the past, Earth was smaller, its surface completely covered with continental matter, that then expanded, resulting in continent separation. *Earth expansion theory* had its adherents [48], but there were problems. Vast amounts of energy are required for planetary expansion [49, 50]; further, most of Earth's ocean floors are no older than 200 million years. In 1982, Scheidegger [21] stated: "*If expansion on the postulated* *scale occurred at all, a completely unknown energy source must be found*". In 1993 and 2005, I discovered two unknown energy sources, georeactor nuclear fission energy [51-59] and the stored energy of protoplanetary compression [29, 60, 61], set forth *Whole-Earth Decompression Dynamics* [41, 60, 62], and resolved geophysical cognitive dissonance by the still dominant theories of plate tectonics and continental drift.

WHOLE-EARTH DECOMPRESSION DYNAMICS: THE DYNAMIC BASIS OF GEOLOGY

The primary energy source for geodynamics and supplemental nuclear fission energy are both direct consequences of our planet's protoplanetary formation as a Jupiter-like gas giant.

Primordial condensation at high pressures and high temperatures resulted in oxygen-starved elemental matter within the Earth, including uranium concentrating at Earth's center and functioning as a nuclear fission reactor [51-59, 63, 64].

Earth's complete primordial condensation and aggregation resulted in the formation of a gas giant planet whose rocky interior was surrounded by 300 Earth-masses of ices and gases, a planet similar to Jupiter. All that remains is the rocky planetary interior with its fluid core that originally was compressed, by the weight of these ices and gases, to about two-thirds Earth's present diameter.

When the sun entered its T-Tauri stage, presumably during ignition of its thermonuclear fusion reactions, the gases and ices were stripped from the Earth, leaving behind a compressed rocky planet with a contiguous crust devoid of ocean basins [23, 60, 61, 65] (Figure5).

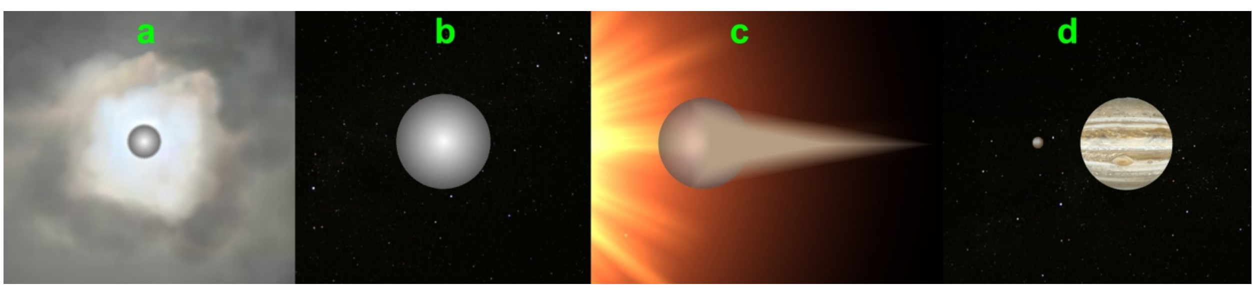

Figure 5. *Whole-Earth Decompression Dynamics* formation of Earth. From left to right, same scale: a) Earth condensing at the center of its giant gaseous protoplanet; b) Earth, a fully condensed gas-giant planet; c) Earth's primordial gases being stripped away by the sun's T-Tauri solar eruptions; d) Earth at the onset of the Hadean eon, compressed to two-thirds of its present diameter showing Jupiter for size comparison.

During protoplanetary compression by about 300 Earth-masses of ices and gases, the heat of compression was lost. Following removal of the great weight of ices and gases by the young sun's T-Tauri eruptions, Earth, at the onset of the Hadean eon, was compressed to about two-thirds of its present diameter, completely surrounded by a rigid (continental) crust without ocean basins, and containing a vast energy source, the protoplanetary energy of compression.

What was Earth like at this point? Its core had already formed; in fact, the core was the first part of Earth to form. The crust and perhaps into the upper mantle was initially quite cold having formed just before the Sun ignited and began stripping away 300 Earth-masses of primordial gases by the super-intense solar wind, which may have cooled the crust even more. There must have been intense bombardment by meteorites and comets in the final stages of Earth formation, which emplaced iron and iron-loving elements, like nickel, in the upper mantle and in the crust.

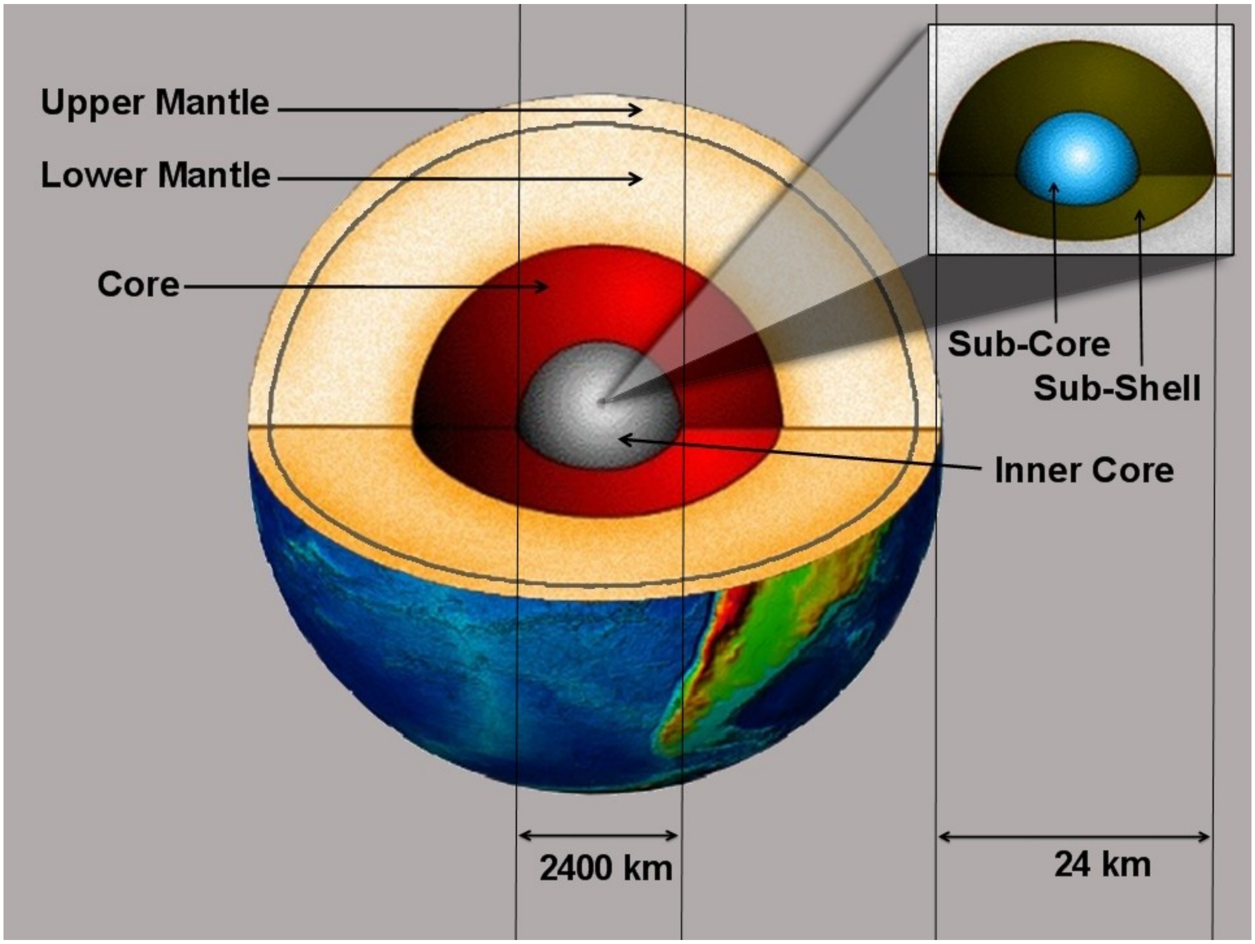

Figure 6. Schematic representation of the major parts of Earth. Inset shows the nuclear fission georeactor, source of the geomagnetic field [64].

After the primordial gases and ices had been stripped from Earth's rocky surface, and the violent T-Tauri phase had ended, water brought to Earth's surface by comets began to collect; perhaps the water was brought by the small comets described by Frank [66, 67], which he asserts continue to bring water to Earth today. Volcanic eruptions may have contributed water as well. In the absence of deep ocean basins, inland seas eventually covered much of Earth's surface. Oceanic features, such as pillow basalts from underwater volcanic eruptions and banded ironstone deposits (Figure 7), consequently are found within continents [68].

Figure 7. Banded ironstone from North America, formed 2.1 billion years ago, presumably during a transition period from less available oxygen to more available oxygen. Photo courtesy of André Karwath.

Meanwhile, deep within the Earth, pressures were building. Occasionally there would be a "blow out". Pressure would force a column of matter from a depth of about 150 km to puncture a narrow hole a few meters in diameter through all of the overlying rock and explode at the surface in a funnel shape as wide as 200 meters [69]. The eruptions of these diamond-bearing kimberlite pipes, however, were just sporadic events. Major catastrophic geological violence would occur again and again, as whole-Earth decompression split the continental crust, created new ocean basins, produced mountain ranges characterized by folding, and caused widespread species extinction.

Earth's behavior, described by *Whole-Earth Decompression Dynamics* [41, 60-62, 70], is the basis for virtually all surface geology and geodynamics.

Even though it possessed the two powerful energy sources needed for decompression, the stored energy of protoplanetary compression and nuclear fission energy, whole-Earth decompression was impeded by several factors. For decompression to progress, heat must be added to replace the lost heat of compression. Unless heat is added, decompression would cause cooling and impede decompression. The relative rate of decompression is also a function of *rheology*, the manner by which matter responds to deformation. Furthermore, much greater pressure is required to initiate cracks than to subsequently extend those cracks in the rigid crust.

Nuclear fission energy and the decay energy of radioactive nuclides within the Earth provide sufficient heat to replace the lost heat of protoplanetary compression. As decompression proceeds, Earth's surface responds in two fundamental ways, by increasing surface area and by altering surface curvature.

As described by *Whole-Earth Decompression Dynamics* [60], during whole-Earth decompression, as Earth's volume increases, its surface area increases by the formation of decompression cracks. *Primary decompression cracks* with underlying heat sources extrude hot basalt-rock, which flows by gravitational creep until it falls into and infills *secondary decompression cracks* that lack heat sources.

The chains of volcanos that form the mid-ocean ridge system, encircling Earth's surface like stitching on a baseball (Figure 8), represent a major system of primary decompression cracks. Basalt extruded from these volcanos forms new seafloor, and flows by gravitational creep across the ocean basins until it falls into and infills secondary decompression cracks that are often located on continental margins. Prominent examples of secondary decompression cracks include the circum-Pacific trenches.

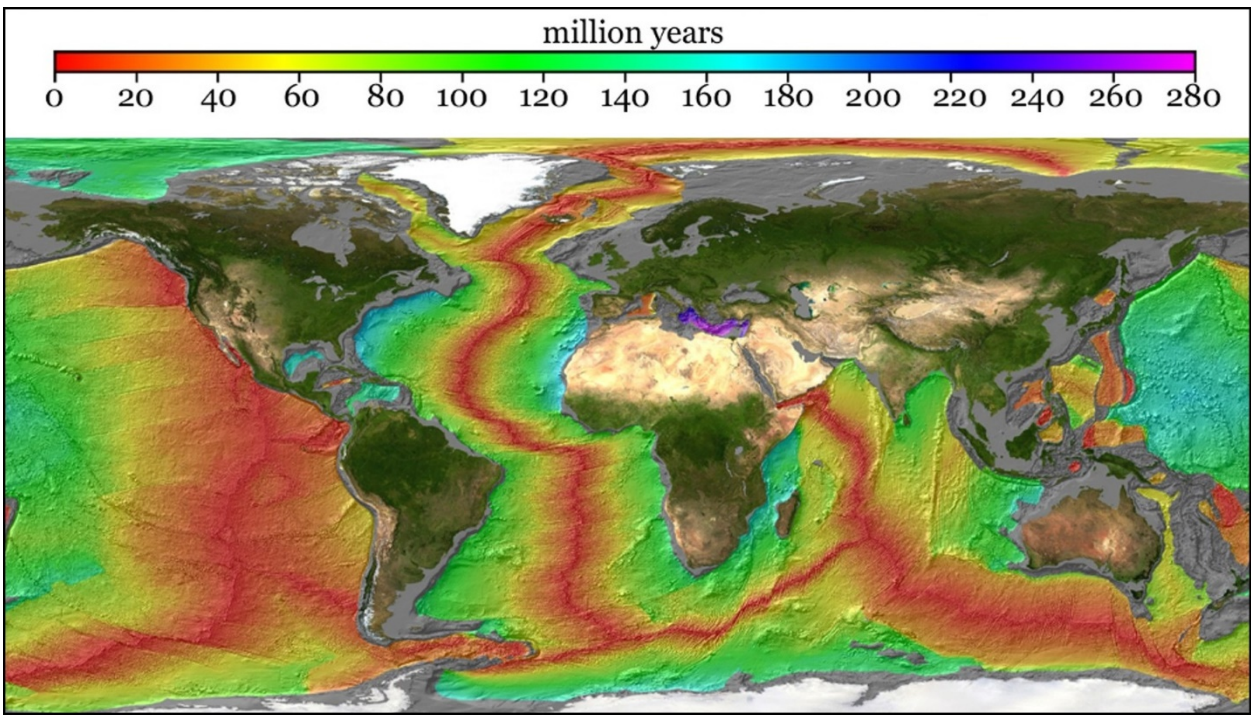

Figure 8. U. S. National Oceanic and Atmospheric Administration image showing the ages of ocean floor basalt extruded from volcanos of the mid-ocean ridge system.

Whole-Earth Decompression Dynamics [60] explains the myriad submarine geological features, usually attributed to plate tectonics theory, without requiring physically impossible mantle convection [41]. Plus, *Whole-Earth Decompression Dynamics* [60] explains oceanic troughs, inexplicable in plate tectonics, as partially-infilled secondary decompression cracks.

As described by *Whole-Earth Decompression Dynamics* [60], during whole-Earth decompression, as Earth's volume increases, its surface curvature must change. The manner by which surface curvature alteration takes place, illustrated in Figure 9, explains, in logical, causally related ways, major Earth geological features, including mountain chains characterized by folding [70], fjords, and submarine canyons [71].

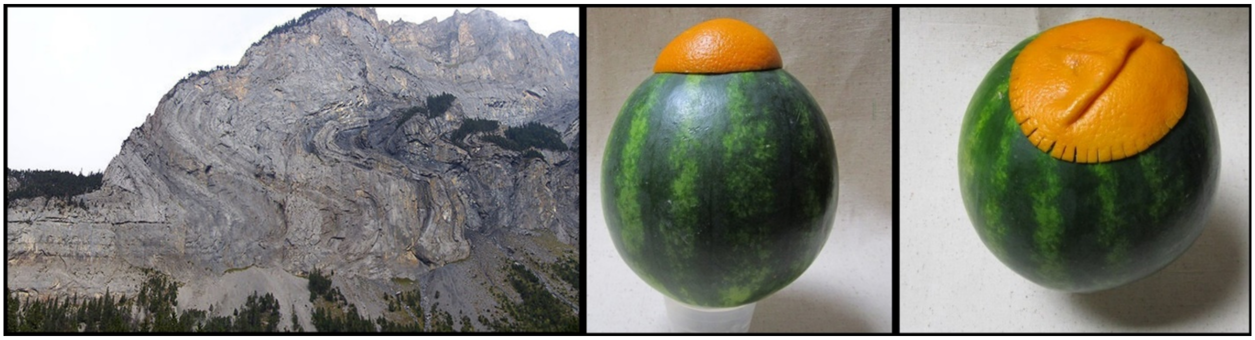

Figure 9. Left: Example of mountain folding; Center: The necessity for surface curvature change during whole-Earth decompression. The un-decompressed Earth is represented by the orange, while the larger, decompressed Earth, is represented by the melon. Note the curvatures do not match; Right: Two causally-related 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: ORIGIN OF MOUNTAIN RANGES CHARACTERIZED BY FOLDING

The origin of mountain chains characterized by folding (Figure 10), among Earth's most conspicuous geological features, have not previously been correctly explained, although attempts were made by Dana [72], La Conte [73], Suess [74], Kossmat [75], and others.

Figure 10. Mount Everest in the Himalayan fold-mountain chain.

The origin of mountain chains characterized by folding is a natural consequence of *Whole-Earth Decompression Dynamics* [70]. Increases in planetary volume result in excess surface matter within continental perimeters that formed when Earth's volume was smaller. As illustrated in

Figure 9, gravity causes the excess continental surface matter to buckle, fall over, and break, thus forming mountain ranges characterized by folding [70]. To a lesser extent, the excess continental surface matter causes decompression-stress-tears around continental edges resulting in the formation of fjords (long, deep, narrow channels; see Figure 11) as well as submarine canyons [71].

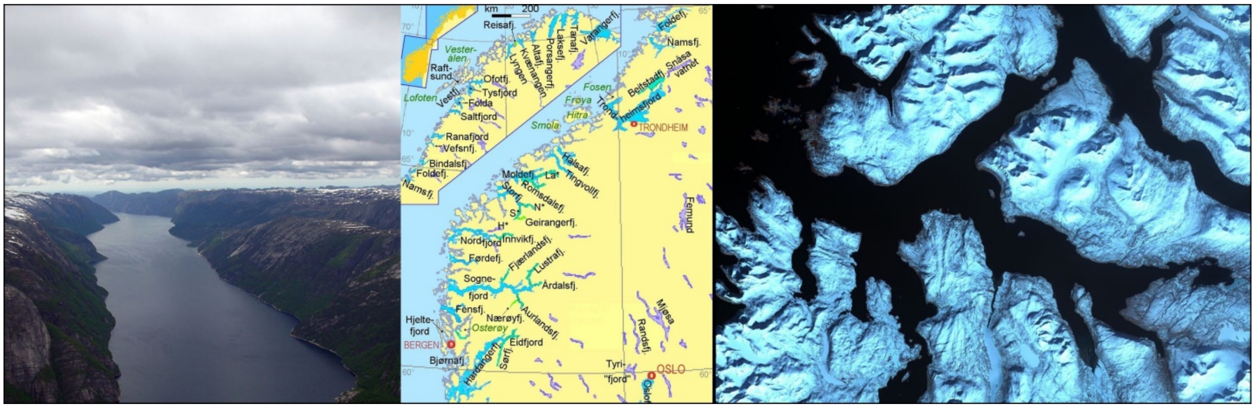

Figure 11. (left to right) Photo of Lysefjord, Norway, courtesy of Snorre; Norwegian map showing fjords; Satellite photo of fjords in northern Norway.

FICTITIOUS SUPER-CONTINENT CYCLES OF PLATE TECTONICS

When individual scientists attempt to describe natural phenomena, events, or processes within the binding framework of a problematic paradigm, the explanations they proffer are generally more complex, if not physically impossible, than subsequent, corresponding explanations made within a newer, more-correct paradigm. In plate tectonics theory, mountain formation is thought to be caused by continent collisions [76], since the plates are assumed to move around the globe riding atop so-called mantle convection cells that defy the laws of physics [41]. Within that belief, discoveries of mountain chains older than the assumed formation of Pangaea necessitated the invention of fictitious supercontinent cycles [46], as illustrated in Figure 12.

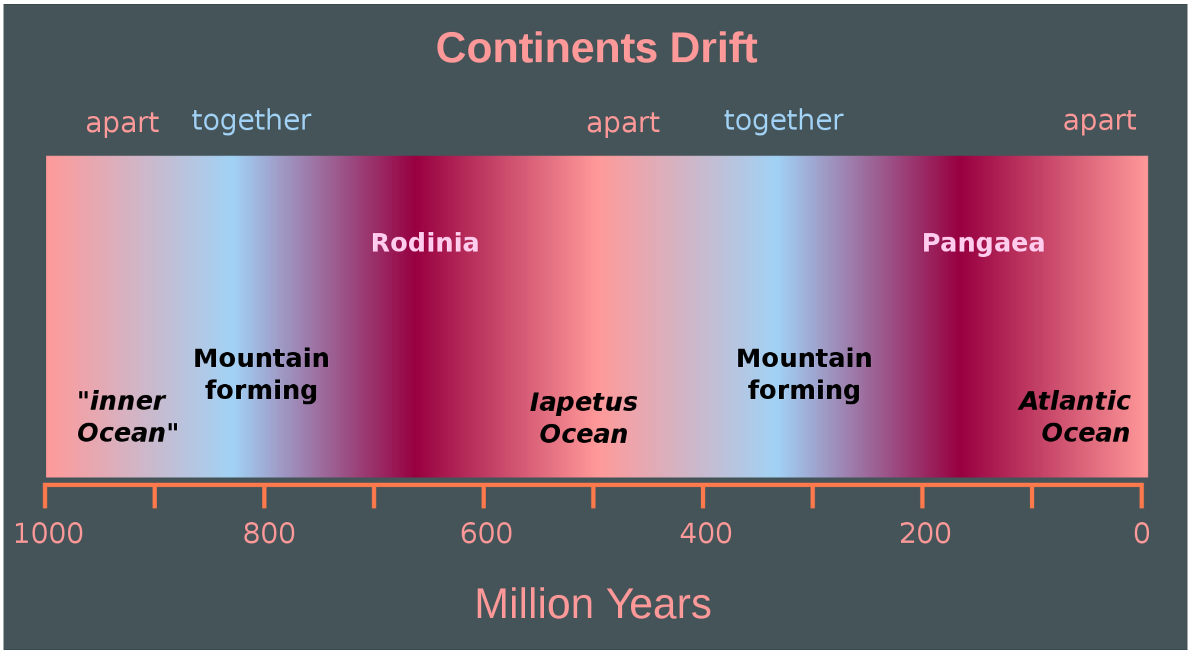

Figure 12. Illustration showing the fictional plate tectonics idea of supercontinent cycles. Courtesy of Hannes Grobe.

A similar problem in plate tectonics arises from rock-magnetism measurements. False rock-magnetism paleolatitude determinations led to the belief that rocks in one location (for example, Vancouver Island, Canada) were thought to have acquired their magnetism in a different location (Baja California, Mexico) [77]. The problem with paleolatitude magnetic measurements, as I discovered [78], is that they are based upon the false assumption that Earth's diameter has not changed over time.

WHOLE-EARTH DECOMPRESSION DYNAMICS: CONSEQUENTIAL HEAT TRANSPORT

The stored energy of protoplanetary compression, as described above, provides the energy for whole-Earth decompression, but requires some additional energy to replace the lost heat of protoplanetary compression. Otherwise, whole-Earth decompression would cool Earth's interior. There is, however, one consequence of whole-Earth decompression that emplaces heat at the base of the crust and produces the *geothermal gradient* within Earth's crust. I call that phenomenon *mantle decompression thermal tsunami* [62].

Earth's matter is layered gravitationally on the basis of density. Earth-decompression, beginning as deep as the bottom of the mantle, will propagate upward through progressively less-dense matter, like a tsunami, until it reaches the rigid crust where compression takes place, producing heat due to compression. Mantle decompression thermal tsunami heats the base of the crust and is the reason that the temperature in the crust increases with depth, constituting the geothermal gradient.

Earth's central nuclear-fission georeactor [51-59] powers and produces its geomagnetic field and aids whole-Earth decompression by providing heat to replace the lost heat of protoplanetary compression. Georeactor heat also channels from Earth's core to its surface [41]. Among its fission products, the georeactor produces helium-3 and helium-4 which serve as tracers that identify georeactor heat channeled to Earth's surface [41] (Figure 13). As the uranium fuel is consumed in Earth's Terracentric nuclear reactor, the *helium-3 to helium-4 ratio*, relative to air, as shown in Figure 13, increases over time. Helium ratio values of 10 or higher are indicative of recently-produced georeactor helium.

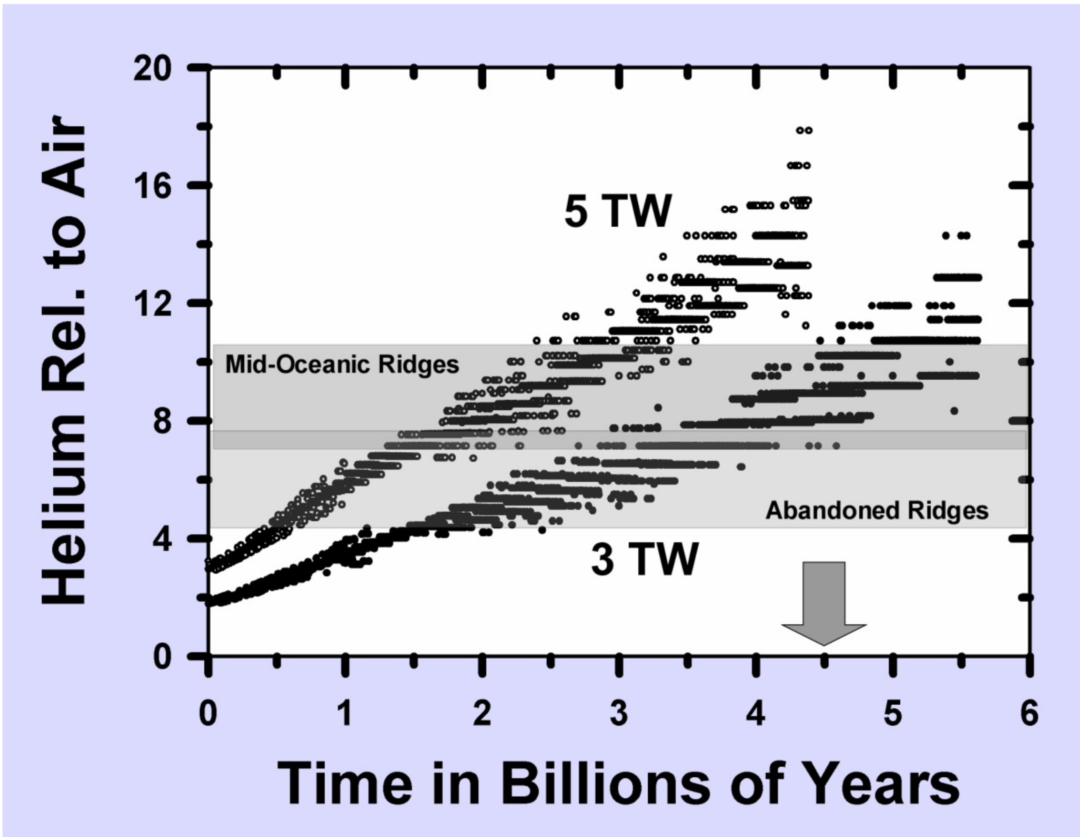

Figure 13. Oak Ridge National Laboratory georeactor simulation data calculated at energies of 3 and 5 terawatts compared to measured helium ratios, relative to air, in oceanic basalts. Data from [54].

Sometimes called mantle plumes, thermal structures or heat channels beneath Iceland and the Hawaiian islands have been seismically imaged as extending all the way to the top of Earth's fluid core [79, 80]. Basalt that erupted at these two locations contains traces of helium with the high-ratio signature of georeactor-produced helium [81]. The heat channels provide paths for the very light, unreactive, very mobile helium to reach Earth's surface [41]. The high-ratio helium is indicative of accompanying heat produced by georeactor nuclear fission chain reactions.

Major basalt floods, containing the high-ratio signature of georeactor-produced helium, occurred in the geologic past, for example, 250 million years ago in Siberia (Siberian Traps) [82] and 65 million years ago in India (Deccan Traps) [83].

Currently, basalt extruded by volcanos along the East African Rift System [84] and in Yellowstone (USA) [85, 86] contain the high-ratio signature of georeactor-produced helium. The Yellowstone measurements, which indicate that Yellowstone's heat source is the nuclear-fission georeactor, is of serious concern, because Yellowstone is believed to be a potential super-volcano [87-90]. Natural or anthropogenic disruption of the geomagnetic field might trigger eruption of that super-volcano [57-59].

WHOLE-EARTH DECOMPRESSION DYNAMICS: SPLITTING OF CONTINENTAL CRUST AND PETROLEUM ORIGINATION

The basis for virtually all surface geology, as described by *Whole-Earth Decompression Dynamics* [60], is that as Earth's volume increases during whole-Earth decompression, its surface area increases by the formation and infilling of decompression cracks, and its surface curvature changes mainly by the formation of mountains characterized by folding [70].

Splitting Earth's continental crust has been a progressive series of events over geologic time, for example, by the mid-ocean ridge system shown in Figure 8. That fundamental crust-splitting process is still taking place, for example, in the East African Rift System (Figure 14).

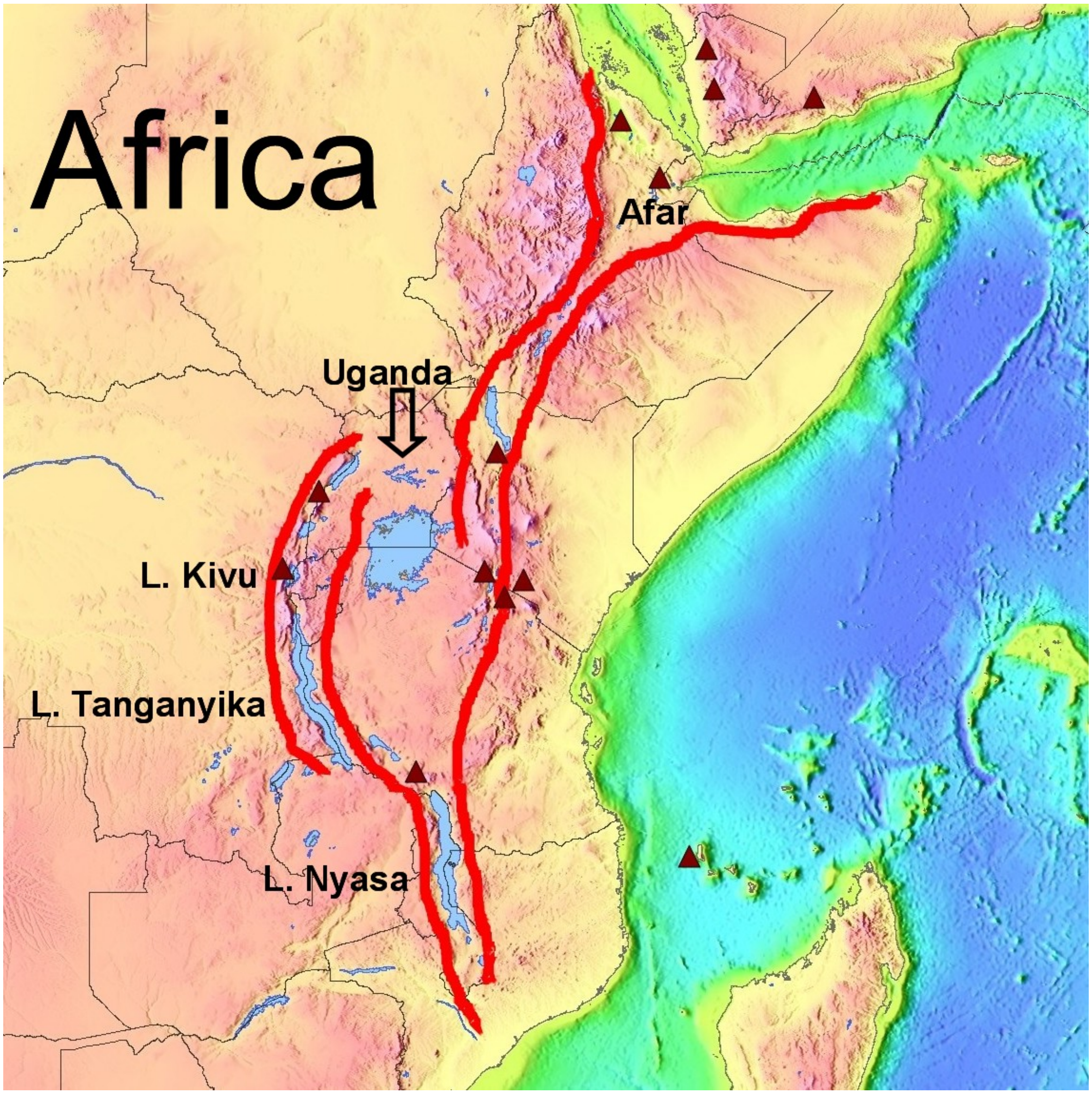

Figure 14. East African Rift System indicated in red. Triangles show areas of volcanic activity.

In 2016, in the *Journal of Petroleum Exploration and Production Technology*, I published an article entitled "New Concept on the Origin of Petroleum and Natural Gas Deposits" [91]. That article built upon and extended my two other articles [92, 93] that described the *Whole-Earth Decompression Dynamics* basis for the origination of petroleum and natural gas deposits.

In plate tectonics, the term "rift" refers to the idea that two plates are being pulled apart. In *Whole-Earth Decompression Dynamics*, the geological terms "rift" or "rift zone" pertain to Earth's crust being cracked as a consequence of Earth's volume increasing, which potentially allows mantle gases and organics to escape or be trapped in surface strata. Viewed in this context, it became evident that many, if not most, of the world's great petroleum and natural gas fields are associated with zones where major whole-Earth decompression splitting of the continental crust has taken place, including at the continental margins [91].

Petroleum and natural gas exploration and production are currently underway along the East African Rift System (Figure 14), the Rio Grande Rift System in the U.S.A. and in rift systems, basins, and along continental margins that were formerly whole-Earth decompression cracks or failed decompression cracks all over the planet. The West Siberian Basin, host to one of the world's greatest petroleum and natural gas deposits, is the site of a failed whole-Earth decompression crack referred to as the *Siberian Traps*, where massive basalt floods occurred 250 million years ago (Figure 15).

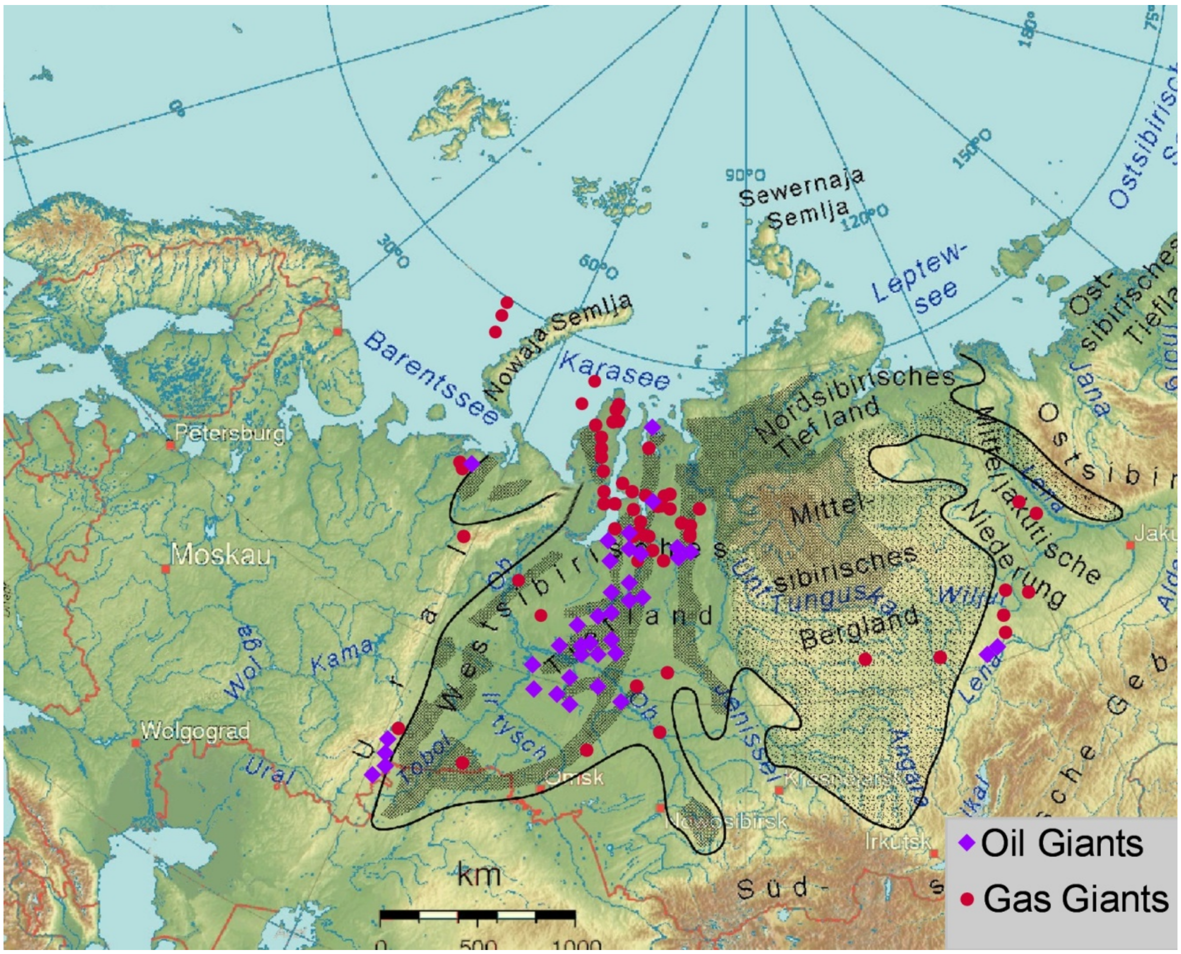

Figure 15. Map showing the extent of the *Siberian Traps*, with circles showing major gas fields and diamonds showing major oil fields. From [91].

WHOLE-EARTH DECOMPRESSION DYNAMICS: THE BROADER PICTURE AND PATH AHEAD

In attempting to understand the complex, highly incomplete geological record, much confusion has arisen from interpretations based upon an incorrect paradigm. For example, in the unchanging global-dimension of plate tectonics, the supercontinent Pangaea is thought to be surrounded by ocean. In that view, Pangaea-fragmentation shifted land and ocean volumes around without producing any major change in sea level. The only mechanism envisioned in that paradigm for a rapid, major lowering or raising of sea level was the onset or ending of an ice age, when a large volume of ocean water was sequestered or released as polar and glacial ice [94].

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 [95, 96], with major episodes of volcanism [97, 98], and with drastic sea-level changes [99], 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, species extinction, and more [57-59].

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 thus 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 [100] (Figure 16).

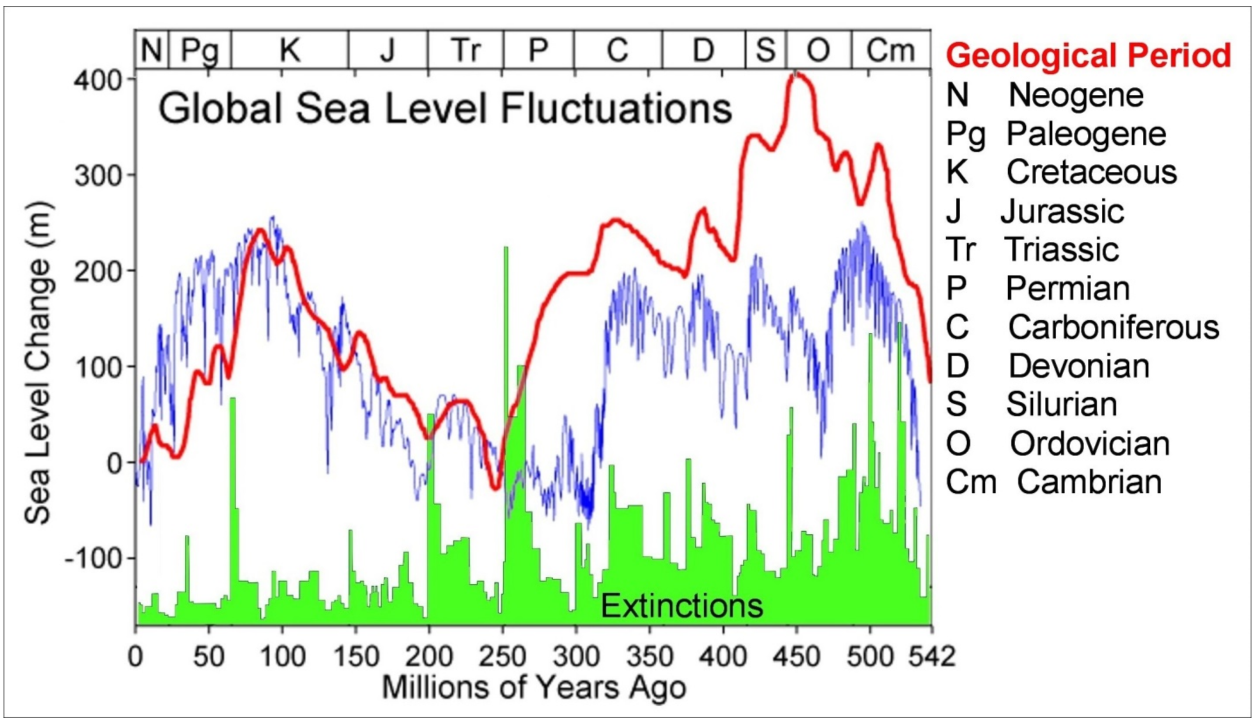

Figure 16 Spikes in seawater levels (red and blue) appear to correlate with spikes in species genus extinction intensity (green), and they correlate as well with boundaries of major divisions of geological time, abbreviated at top of graph. For details and data, see [101-108].

Evidence from the geological past is incomplete, but with *Whole-Earth Decompression Dynamics*, the confusion inherent to previous scientifically convoluted explanations for fundamental geological phenomena can be clarified and united with the hopeful result that geoscientists can begin afresh to attain an understanding of Earth's history that is securely anchored to the known properties of matter and radiation.

CONCLUSIONS

I have described a fundamentally new, indivisible paradigm that recognizes Earth's early formation as a Jupiter-like gas giant and makes it possible to derive virtually all of the geological observations and geodynamic behavior of our planet, including two previously unanticipated powerful energy sources whose absence otherwise raises insuperable dilemmas. Earth's interior condensed from primordial matter at high pressures and high temperatures, with Earth's fluid iron alloy core first raining-out at Earth's center.

Primordial condensation at high pressures and high temperatures progressed on the basis of relative volatility with the first condensate being molten iron. The primordial gas at high pressures and high temperatures led to an oxygen-starved condensate, containing in the fluid iron alloy core, 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, producing the geomagnetic field. Silicon precipitated as nickel silicide and formed Earth's inner core. Calcium and magnesium precipitated as sulfides and floated to the top of the core, forming the seismically "rough" matter observed there.

Following condensation of Earth's fluid core, the principal silicate, enstatite ($MgSiO_3$), condensed and formed Earth's lower mantle, followed by the remaining rocky-matter condensate, mixed with in-falling debris, forming the 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.
Subsequently, violent T-Tauri phase solar winds stripped the ices and gases away leaving, at the beginning of the Hadean eon, a rocky planet that had been compressed to about two-thirds of present-day Earth-diameter, and containing within itself the great stored energy of protoplanetary compression.

Earth's subsequent decompression, described by *Whole-Earth Decompression Dynamics*, in logical and causally related ways, accounts for virtually all of Earth's surface geology and geodynamics.
As whole-Earth decompression progresses and as Earth's volume increases, its surface area increases by the formation of decompression cracks. 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 Earths 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, fjords, and submarine canyons.

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

The observations and discoveries cited-herein have been published in the peer-reviewed scientific literature over a period of four decades. They have rarely been cited by government-funded scientists. The logical, causally-related advances documented here stand as a reference by which to compare and evaluate the phenomenological model-nonsense that has been published by government-funded scientists for decades at taxpayer expense.

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