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Continental Drift and Plate Tectonics vis-a-vis Earth's Expansion: Probing the Missing Links for Understanding the Total Earth System

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Abstract

Hypotheses like continental drift, plate tectonics or Earth's expansion should not be considered as viable in view of solid and rigid state of mantle which, in contrast, would resist such phenomena. Based on Hilgenberg's model of Earth's expansion (1933), the author elucidates that before expansion when the Earth was small and devoid of oceans, its mantle must have been sufficiently fluid owing to association of ocean-forming water. Further, matching thickness of fluid outer core and extent of radial expansion of the Earth strongly support that the outer core was opened up as a void geosphere owing to planetary expansion. At the deep interior of the planet, owing to occurrence of a void or pseudo-fluid geosphere separating basaltic mantle and solid iron core, an additional force of reverse gravity would develop acting in opposite direction of normal inwardly directed force of gravity. This postulation leads us to consider that in the deep interior of the planet an upwardly directed force of gravitational attraction would act in a predominant manner, thereby sustaining sufficiently low temperature and pressure condition and magnetic nature of the inner core which completely agrees with observed features of terrestrial magnetism.

Over the Earth's surface the crustal layer was fragmented due to expansion while through the expansion cracks widespread incidences of magma emission occurred forming rudimentary ocean basins. With further expansion, these basins were expanded and filled up with water that degassed from the mantle associated with the process of magma emission while owing to desiccation, the mantle itself eventually turned into a rigid body. Before expansion of the planet when the iron core and the mantle were juxtaposed to each other, due to external magnetic influence the magnetic iron core was deflected causing major change in polar and equatorial disposition of the planet. Subsequently in younger geological period when due to expansion a major void geosphere was opened up between the iron core and mantle, external magnetic influences caused the magnetic core to execute smooth revolutions giving rise to new magnetic phenomena like pole reversal and polar wandering, documented over the planet's younger strata. It may be noted that while due to expansion, the continental fragments would tend to move away from one another, owing to rotation of the planet along its axis of rotation some continental fragments came closer to each other or even collided to form mountain ranges.

Keywords: Geospheres; Plate tectonics; Silicate rocks; Celestial body

Introduction

More than four hundred years Ortelius [1] prepared the first authentic atlas of the world which showed occurrence of parallel shore-lines between Africa and South America across the Atlantic Ocean. This remarkable feature led the pioneer cartographer to consider existence of these continents in a conjoint manner in the past. With further improvement of the atlas occurrence of parallel shore lines between distantly placed continents became conspicuous and in due course many Earth scientists attempted to adjust the relevant continental fragments.

With progress in geology, a new branch termed global tectonics was developed for elucidation of Earth's structure. Further advancement in a consorted manner by geologists and geophysicists established presence of three thick geospheres in the interior of the planet, two of which are solid, namely the 2867 km thick basaltic mantle occurring below the granitic crust of 33 km and the deepest or inner-most part of the planet termed inner core of 1391 Km radial thickness and constituted of solid iron with some nickel [2-5]. These two solid geospheres are separated by a 2080 km thick fluid geosphere, termed Outer Core which too has been considered in the prevalent concept to be composed of iron although in fluid state. Based on the observation of increase of temperature with depth recorded in the crustal surface and mantle, the prevalent concept conjectures that values of temperature and pressure steadily increase up to the center of the core attaining to nearly 4000°C and 3.5 million atmospheres, respectively.

In course of time various concepts on Earth sciences were developed amongst which two most extensively discussed views are based on unaltered dimension of the of Earth throughout the past geological periods. These views are continental drift, vehemently debated since 1912 when the concept was put forward by Wegener [6-8], though not for the first time, and the concept of plate tectonics-which in reality is a modified version of the drift theory. The concept of plate tectonics [9], developed in the sixties, considers existence of several plates or continents that emerge at certain places and are destroyed elsewhere, thereby, in consequence keeping the dimension of the planet unaltered.

Besides these two concepts another idea that endorses altered dimension of the Earth is expansion of the Earth and, of late, many scientists are seriously considering it as a plausible model for elucidating global features. The view of expansion for defining the remarkable parallelism between the distantly placed continental coastlines was first

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hinted out by s Bacon [10] when he used the Latin word 'exporrecti', meaning expansion for the fit. Amongst many who attempted to adjust continental fragments without altering the dimension of the globe, the name of Alfred Wegener is well-known although much before him several scientists, such as the pioneer Pellegrini of France [11], shown in Figure 1, American geologists Taylor [12] and Baker [13], as well as, the South African Alexander du Toit [14] attempted continental fitting. On the other hand, those who advocated Earth's expansion, the names of Yarkovskii [15] of Russia, Mantovani [16,17] of Italy, Hilgenberg of Germany [18] and Carey [19-21] of Australia-who spent almost his entire life persuading studies on expansion, deserve special mention. Of late, many Earth scientists are intrigued with the concept of Earth expansion theory although – since a possible cause of the phenomenon has not been put forward – presently the concept has yet to be duly acknowledged or accepted.

Continental Drift, Plate Tectonics and Earth Expansion

Wegener's view of continental drift [6], despite some initial support was criticized by several Earth scientists, including the renowned British Geophysicist Harold Jeffrey's who differed mainly because of solid and rigid state of the mantle, as well as, inappropriate fitting of continents even where parallelism of distant shorelines appeared to be distinct. The author considers that both the views, namely, that of Wegener and also of Jeffrey's are partially correct indicating that there must be a missing link in the relevant model of tectonics that needs to be fathomed out. The author in fact argues that in case of rigid and solid state of the mantle, as firmly established by seismic studies, all these three major global features would not be possible since for manifestation of such mobilistic phenomena it is essential that the mantle must have to be sufficiently fluid.

Wegener's view of continental drift, shown in Figure 2, assumes that initially the continents were joined together forming a super-continent called Pangaea surrounded by a large ocean termed Panthalassa. The concept fails to deliver a satisfactory explanation for fragmentation of the huge super-continent. Both continental drift and plate tectonics cannot explain formation of oceans and emergence of water over the Earth's surface as well as how the long elongated features known as mid-oceanic ridges were formed occurring mid-way between in the oceans and the continental shores.

The concept of presence of convection current in the mantle was mooted by the distinguished Scottish geologist Homes [22,23], who nevertheless categorically warned that his ideas were "purely speculative". Holmes' suggestion that the continents are carried out by flow of the mantle caused by convecting current was accepted by a large number of supporters of continental drift or its modified version plate tectonics. Apparently the main reason for acceptance of the vague concept was – as the author considers – owing to failure to fathom out a plausible cause for the much cherished concept that views unchanged global dimension throughout the geological periods. The author points out again that as the mantle is a rigid and solid, firmly confirmed by seismic waves, occurrence of convecting current with in the mantle is absurd. Another major absurd fantasy on mantle convection is that the speed of the process is extremely slow. How such slow moving convection can drift continents to great distance and, also, cause development of geomagnetism in the core? Harold Jeffreys' point of inappropriate fitting of continents in case where parallelism of distant shorelines appear to be distinct is indeed an expected feature since the dimension of the Earth was kept unaltered. That perfect fitting of the continents is feasible in a globe of reduced dimension is a definite confirmation that originally the planet's dimension was much smaller. Based on the model of ocean-less condensed Earth obtained by snug-fit of landmasses in a globe reduced to two-third of its present radial length, shown in Figure 3 [18], the author [24,25] has conceived that since the primordial small Earth was devoid of oceans, the ocean-forming water, was originally associated with the mantle. Consequently the original mantle was sufficiently fluid because of incorporation of ocean-forming water under ultrahigh pressure – a view conceived based on studies of hydrothermal systems of silicate rocks at elevated temperature and pressure, confirming lowering of melting point of silicate rocks under ultrahigh pressure condition [26]. Hence, it can be reasonably conceived that the small Earth at the unexpanded stage could sustain widespread global expansion in response to

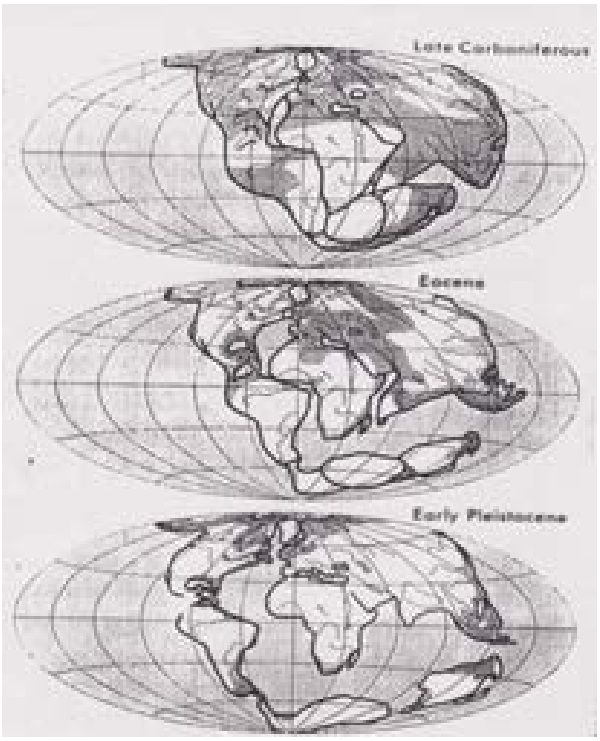

Figure 2: According to Wegener all continents had once been joined together forming a supercontinent which subsequently fragmented and drifted apart forming several continents.

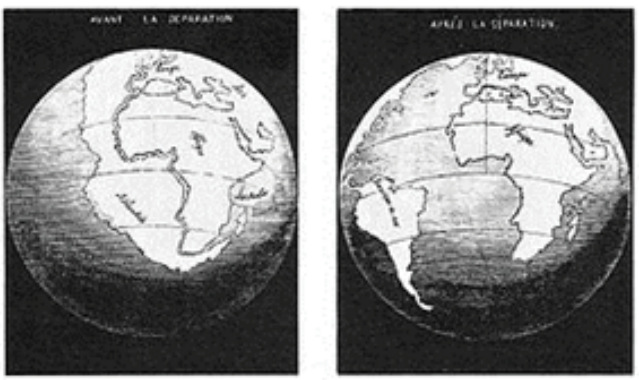

Figure 1: Antonio Snider-Pellegrini's illustration of the closed and opened Atlantic Ocean [11].

Figure 3: Otto Hilgenberg of Germany, put forward earth expansion theory independently in 1933 with models showing that if we could reduce the radius of the Earth to two-third of its present thickness all the continental blocks could be perfectly fitted in the small and ocean-less globe.

an external force of suitable magnitude.

A stable and static condition of the Earth with a vast quantum of ocean water already present, as conceived in plate tectonics and other concepts, on the other hand, leaves no scope for considering a sufficiently fluid or mobile condition of the mantle under which plate movements could be contemplated.

Causes of the Earth's Expansion

Based on the evidence of the gravitational pull over the Earth, induced by the Moon causing periodic tides, it can be conceived that the Earth's expansion too is significantly related to the Moon's gravitational pull, especially affecting the planet's semi-fluid mantle. In the primordial pre-expansion stage of the planet when its mantle was significantly fluid, the effect of such extra-terrestrial gravitational attraction was obviously much more pronounced than what it is today over the rigid terrestrial body.

To account for a fairly uniform pattern of expansion of the Earth with identical bulge around its axis of rotation and uniform pattern of disposition of the internal geospheres, a fairly slow rate of expansion, as well as existence of the Earth in a stable, condensed and consolidated state during the pre-expansion stage has been contemplated. It appears that the extra-terrestrial body which was initially situated at a far greater distance during the Precambrian and earlier periods, came nearer to the Earth in a smooth and gradual manner and was captured by the larger planet Earth and thus increasing the magnitude of the periodic gravitational pull over the terrestrial surface. In all probability it can be concluded that it was owing to the Moon's gravitational pull accomplished in a periodic manner the Earth was expanded, especially affecting the planet's semi-fluid mantle.

Impact of Magnetic and Gravitational Influences of the Extra-terrestrial Body on Earth

It was due to approach of the extra-terrestrial body - the Moon; the Earth's surface, as well as, internal features were conspicuously affected, cumulatively causing major reorientation of various global structures. Geological data [4] show that originally equator of the Earth was oriented at right angles to its present disposition. Nearly 500 million years ago this orientation started to change in a steady and gradual manner and, in a span of nearly 250 years, the equatorial disposition of the planet was deflected or tilted by nearly 90° from its original disposition. This change in the axis of rotation and equatorial disposition of the Earth can be explained by considering that the sources of the terrestrial magnetic field, which was firmly attached within the Earth's body up to the Permian, was tilted or deflected by the magnetic influence of a similar dipolar extra-terrestrial magnetic object. It appears that a planetary body with similar characteristics approached the Earth in a slow and steady manner, causing to shift the terrestrial magnetic poles which in turn changed the Earth's disposition in space. With the advent of this extra-terrestrial magnetic body or the Moon, the equator and the axis of rotation of the Earth were tilted which must have initiated during the Precambrian period and continued up to the Middle Permian, bringing about a rotation of the Earth's axis by 90° (Figure 4).

It can be conceived that as the magnetic celestial body approached nearer to the Earth, the mutual force of gravitational attraction between the two also enhanced. By the time the Earth experienced a tilt of 90° by the magnetic influence of the celestial body, the gravitational pull exerted by the same celestial body, in all probability the satellite Moon, caused a rupture along the original mantle-core conjunction of the planet Earth along which, in consequence, a void zone was subsequently developed. Towards the beginning of the Mesozoic era this void zone encircling the solid iron core was sufficiently enlarged so that the latter could execute free and secular rotation within it in response to external magnetic forces.

Discussion

Based on information obtained from various sources,

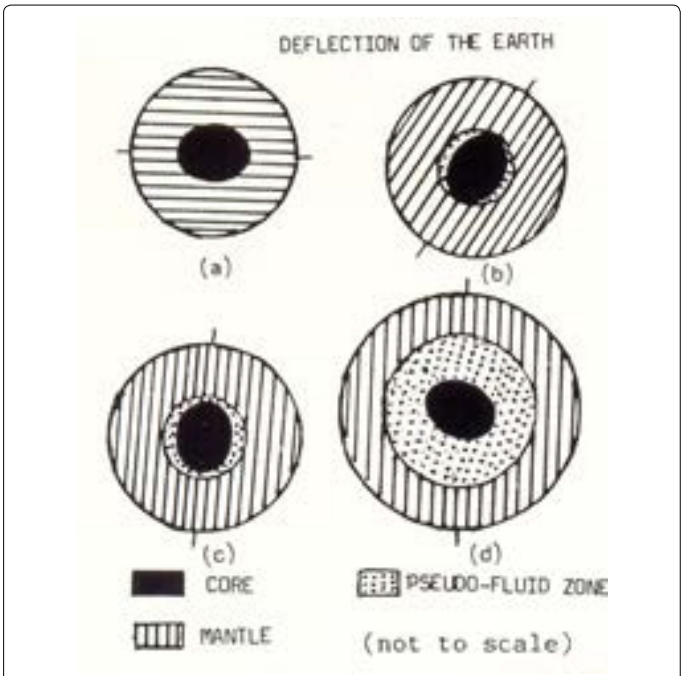

Figure 4: Before expansion of the planet, the solid iron core and semi-fluid mantle were juxtaposed to each other (Figure a). Due to expansion the original core-mantle conjunction was ruptured (Figure b) and along the ruptured surface a void zone or pseudo-fluid geosphere was developed (Figure c). Hence, due to occurrence of two solid geospheres separated by a virtually void zone, in the deep interior, the phenomenon of reverse gravity would prevail, generating low temperature and low pressure zones in the Earth's core and deeper parts. After development of the thick pseudo-fluid geosphere (Figure d), the iron-core remained within it in a suspended condition. Hence, at this stage in response to extra-terrestrial magnetic influences, polar wandering, pole reversal and westward drift could take place (not to scale).

followed by relevant updated discussion, it can be concluded that the primordial Earth was considerably small, ocean-less and covered with a sialic super-continent. Since the small Earth was devoid of oceans, it is reasonable to presume that the ocean-forming water was originally associated with its mantle, thereby turning the geosphere adequately fluid and especially suitable for expansion. Based on evidence of the Moon's gravitational pull over the fluid bodies on Earth, it can further be deduced that such external force or pull was responsible for expansion of the Earth, predominantly affecting the planet's primordial semi-fluid mantle.

The gravitational pull exerted by the extra-terrestrial body, obviously the Moon, over the semi-fluid mantle of the Earth which was rotating or spinning on an axis of rotation, added by the satellite's movement around the planet caused uniform distribution of the pertinent force on Earth. Consequently, the expansion of the Earth was manifested in a uniform manner without causing any uneven protrusion or irregular rising over the relevant portion of the planet. Due to such external pull the following remarkable alterations over the granitic crust, as well as, in the deep interior of the planet took place.

- The planet's dimension was enhanced concomitantly increasing the horizontal space between the adjacent fragmented sialic crusts. The newly developed space was continuously filled up with semi-fluid mantle to form floor of the rudimentary ocean bodies.
- The individual fragmented sialic blocks, completely encircled by oceans, formed continents. Formation of both oceans and continents can be linked with upliftment of the semi-fluid mantle, bring about development of additional horizontal space between the separated broken fragments of the super-continent. This appears to look as if the relevant broken continental fragments - which were once joined together - moved horizontally away from one another. Strictly speaking it was an apparent look caused due to increase of space owing to upliftment of the mantle.
- The expansion cracks along which several oceans grew, although horizontally remained fixed in their original position, due to expansion were uplifted or experienced vertical lift, thereby, giving an apparent impression of shifting of positions towards the middle part of the newly developed ocean bodies to form mid-oceanic ridges. In reality, these fissures continued to remain stationary or fixed in their original position but the oceans gradually grew up between the continents due to upward rise of the mantle over which continents and oceans and mid-oceanic ridges rest.
- There is yet another prominent force caused by rotation of the planet around its axis of rotation which is most effective around the Earth's equatorial plane but least so around the Polar Regions. The continents which remained stationary in regard to horizontal movement, though uplifted as discussed earlier, also experienced drift – which is horizontal positional shift – caused due to rotation of the planet. Several major features over the crust, including mountain belts, have been formed owing to this force.
- As discussed earlier, owing to expansion widespread disgorge of molten magma took place spreading on both sides of the expansion cracks to form floors of ocean basins. Extrusion of molten magma is invariably associated with expulsion of extensive quantum of volatiles containing large amount of water vapour. The water that continuously released from the mantle due to degassing in tandem filled up the ocean basins, at the same time turning the geosphere solid and rigid in a gradual manner due to depletion of water. It is known that the melting point of a silicate rock would be lowered owing to presence of adequate amount of water. The mantle - which is a silicate rock – would, therefore, acquire sufficient fluid or semi-fluid characteristics owing to presence of ocean-forming water and absence of it would turn the medium solid and rigid.
- The same silicate medium – the mantle – due to depletion of water caused by widespread degassing, would gradually turn into a solid and rigid body, representing its present state when further expansion of the planet would be virtually stopped.
- It has been explained that due to expansion caused by extra-terrestrial pull, the Earth's semi-fluid mantle was swelled up. This in turn caused fragmentation of the sialic super-continent to form continents surrounded by oceans over the crustal surface. In the interior of the planet upward rise of the semi-fluid mantle initiated splitting the core-mantle contact along which with further upliftment of the mantle a void zone was gradually developed. Due to influx of particles and fine materials and volatiles from the adjoining walls, mainly from the rocky mantle, the void zone would turn into a thick pseudo-fluid or low density zone, separating the mantle from the core (Figure 5).
- Under such set up of occurrence of two thick geospheres separated by a thick zone pseudo-fluid or low density zone, both the geospheres would exert gravitational pull on each other. Consequently the trend of gravitation in the mantle would follow normal downward direction, while in the core due to the pull exerted by the mantle, an upward trend of gravitational pull would result giving rise to the phenomenon of reverse gravity in the deep interior of the planet, including the core.
- Such trend of resultant force of gravity in reverse direction in the iron core would cause low temperature-pressure condition at the core – a state congenial for sustenance of magnetic properties of iron. Hence, it is conceivable that the Earth's inner core, constituted of iron with some nickel, from where magnetic lines of force emit, is indeed a huge dipolar magnet. The prevalent concept conjectures very high temperature-pressure condition at the core – a state under which magnetic properties of magnet would be destroyed.
- Before expansion, the Earth was small and at that stage its magnetic iron core and semi-fluid mantle were juxtaposed to each other. Hence at that pre-expansion stage of the planet owing to magnetic influence of an external planetary object, such as - like pole of Earth facing like pole of the external object -would bring about major changes in the Earth's disposition in space in a slow and steady manner which in turn would cause remarkable alteration in the Earth's climatic zones (Figure 4).
- The fluid geosphere, termed in the prevalent concept as outer core is composed of iron in fluid state. The present treatise views that this geosphere - the thickness of which matches with extent of expansion of the planet – has been opened up owing to expansion of the planet. Earlier observers have not noticed this significant clue neither any have put forward any reason why such an enigmatic fluid zone could emerge in the deep interior of the planet (Figure 5).

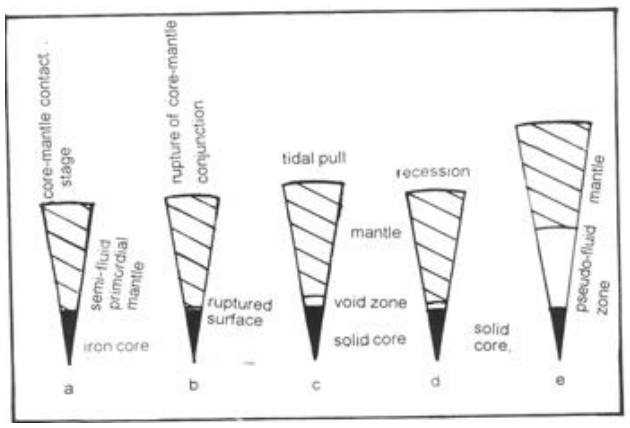

Figure 5: Stages of expansion of the planet and development of the void zone of Earth's Structure. The process must have been very slow and was probably caused by gravitational attraction.

- After sufficient expansion of the planet, when a thick pseudo-fluid geosphere was developed which completely encompassed the magnetic inner core, the latter could execute free and secular oscillation within the former in response to magnetic influence of an extra-terrestrial planetary object – presumed to be the Moon. Such oscillations of the magnetic core gave rise to the phenomena of polar wandering, pole reversals and west ward drift which have been taken place several times during younger geological periods as recorded in various iron bearing sedimentary rocks (Figure 4).

Conclusion

Earth expansion theory is one of the oldest concepts on Earth system sciences supported and developed over the years by a number of scientists belonging to a wide spectrum of disciplines, such as, geology, cartography, paleontology, astrophysics, physics, including Nobel Laureate physicist Dirac [27]. Detail updated information on certain crucial aspects of global features reveal that initially the planet Earth was considerably small and covered with a thin silicate crust. Below the crust three major geospheres occur which, in sequential order, are made of semi-fluid mantle of basic composition, followed downward by a virtually void zone –opened up owing to expansion of the Earth that encompassed the inner-most region of the planet composed of magnetic iron with some nickel from where magnetic lines magnetic force emerge. Before expansion of the Earth, when the pseudo-fluid zone was not opened up, its magnetic core iron and semi-fluid mantle were juxtaposed to each other. At that stage owing to influence of an external magnetic object – possibly the Moon which was approaching Earth – the planet was deflected in a steady manner thereby causing major alteration in its climatic feature that are precisely documented in the crustal rocks of the planet. Because of presence of a void-like zone between core and mantle, in addition to normal inwardly directed force of gravitation, a reversely directed gravitational force would occur in deep interior, including the core, in consequence of which the temperature – pressure condition of the core would be sufficiently low and congenial for maintenance of magnetic properties of the core. After opening up of the pseudo-fluid zone that encompassed the solid magnetic core, the latter could execute smooth rotation or revolution in response to external magnetic influence which have been accurately recorded on several sedimentary rocks containing iron. The mantle which was originally of semi-fluid turned into solid and rigid body owing to extensive degassing of volatiles containing water from it that filled up the ocean basins.

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