

# Introduction to Plasma Tectonics & Electric Geology: Solar Wind Coupling to Planetary Circuits Lightning Tells The *Stellar Transformer* Story

Bruce Leybourne - Research Director  
Institute for Advanced Studies on Climate Change (IASCC)  
Aurora, CO, USA

Giovanni Gregori, PhD. - Professor  
Institute for Marine Engineering (INM) - National Council of Research (CNR)  
Rome, Italy

## ABSTRACT

*Plasma Tectonics, Electric Geology, and Stellar Transformer* concepts evolve from *Earth Endogenous Energy* theory by Gregori [1], Where self-organizing anode tufts, (biological analogy to “sea-urchin spikes”) project from the Earth’s core, considering plasma convection as tidally generated *Joule Heating* at the tips of the “spikes”. Like a soldering iron creating heat, magmas, and earthquakes. Expanding these circuits - by connecting the vertical “spike” Z-component, to a radial X-component (*Oceanic Fractures*) and axial Y-component (North-South *Mid-Ocean Ridges & Island Arcs*) reveal the *Stellar Transformer* concept. Where radial induction is driven by incoming polar space weather, while solar magnetism variation drives axial induction. Thus, simple step down energy induction occurs between Sun and Earth, much like the transformer process that steps down your household energy from the power company. *Diurnal Solar Induction* along the *East Pacific Rise (EPR)* and *Southeast Indian Ridge (SEIR)* drive *Lightning Hotspots* telling the *Stellar Transformer* story.

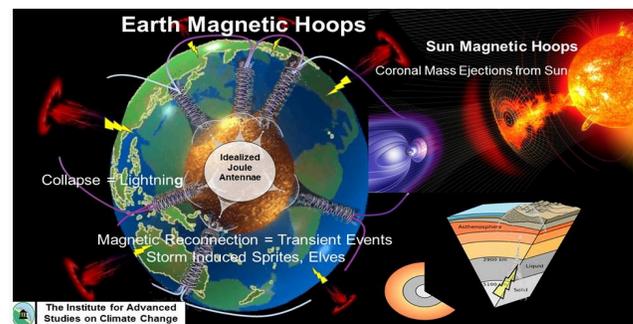
**Keywords:** *Plasma Tectonics, Electric Geology, Stellar Transformer, Earth’s Endogenous Energy, Joule Heating, Oceanic Fractures, Mid-Ocean Ridge & Island Arcs, Diurnal Solar Induction, East Pacific Rise (EPR), Southeast Indian Ridge (SEIR), Lightning Hotspots*

## 1. INTRODUCTION: ELEMENTS OF A STELLAR TRANSFORMER

Electro-Magnetic (E.M.) or magnetic induction is the production of an electromotive force, or voltage, across an electrical conductor in a changing Magnetic field. The Stellar Transformer Concept [2, 3] (Fig. 1)<sup>1</sup> contends that simple step

<sup>1</sup> The process commonly denoted as “reconnection” refers to a supposed “breaking” of magnetic field lines that merge anew with a different pattern. However, owing to the Maxwell laws, a magnetic field line certainly must *never* “break”. In fact, the real physical process results from the corpuscular nature of the solar wind. When an empty space occurs between any two subsequent corpuscles (i.e. when a micro-“plasma cavity” occurs), the composition changes of the physical system (i.e. a different number of charged particles), hence also the general pattern of the magnetic field lines. That is, the magnetic field observed is accordingly reorganized. The “reconnection” assumption helps to maintain the formalism of a continuous medium Magnetic-Hydrodynamic Dynamo (MHD). The corpuscle/continuous dilemma is analogous to, and reminds about, the quantum discovery by Max Planck when he explained the black body spectrum.

down energy induction occurs between Sun and Earth, much like the transformer process that steps down your household energy from higher voltage transmission lines sourced from the power company. The Sun would represent a large coil from the power company, while the Earth represents the smaller coil to your home. The larger coil element generally excites current into the smaller coil element by induction of “step down energy”, although a lesser feedback always occurs due to the action/reaction principle. Layers within the Earth hold and release charge acting as condensers, or capacitance layers - or, more exactly, the Earth operates like a battery where energy is either stored or released through time-change of state-of-matter.



**Fig. 1. Earth as a Stellar Transformer** idealized *Plasma Core Planetary Electronics* based on Sea Urchin Spike Model [1, 2, 3] as anodes tufts (Safire Project 2017 <http://safireproject.com/>) See: *Electric Universe* 2015 Presentation <https://www.iascc.org/free-stuff>.

Thus the larger *Stellar Transformer* hypothesis concludes that induction can be approximately illustrated as being determined by the Earth’s *Magnetic Moment*<sup>2</sup> representing the magnetic

<sup>2</sup> The *Magnetic Moment* is defined as a quantity that represents the *Magnetic* strength and orientation of a magnet or other object that produces a *Magnetic* field. The *Magnetic Dipole Moment* of an object is defined in terms of the torque the object experiences in a given *Magnetic* field. The strength and direction of this torque depends not only on the magnitude of the *Magnetic Moment* but also on its orientation relative to the direction of the *Magnetic* field and is therefore *considered a vector*. The direction of the *Magnetic Moment* points from the North to South Pole within the magnet in this case the Earth. The magnetic field of a *Magnetic Dipole* is proportional to its *Magnetic Dipole Moment*. The dipole component of an object’s magnetic field is cylindrically symmetric about the direction of its *Magnetic Dipole Moment*, and decreases as the inverse cube of the distance from the object. The strength of a *Magnetic Dipole* is called the *Magnetic Dipole*

strength and orientation that produces magnetic field current alignments between layers in the Earth and polarity and field strength. The whole phenomenon has to be primarily considered in relationship to the Sun & Moon, and to a lesser extent other planets, while a leading control is due to the solar wind and *Interplanetary Magnetic Field (IMF)* where the whole Solar System is embedded. The vector induction components concerning the torque generating power for the Earth's magnetic moment are outlined below (i.e. the Earth's *Tidal Driven (TD)* dynamo).

## 2. ELEMENTAL COMPONENTS (Z) (Y) (X)

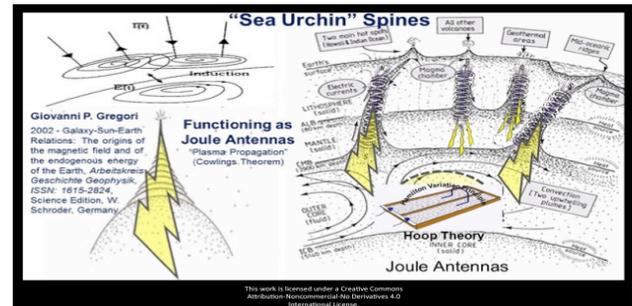
A simple description of phenomena can be intuitively and approximately explained in terms of three spatial components of the E.M. induction process.

**Earth's Vertical (Z)** induction effects are associated primarily with magnetic moment linked to Sun-Moon tidal variations affecting volcanic and magmatic electric Joule energy production of sea-urchin spikes (or anode plasma tufts). The spikes are to be considered connectors between the oppositely (+/-) charged double layers of the, radial or toroidal (**E**), and, axial or poloidal (**E**), electric fields. The Gregori model [1] relies on the relative motion of internal parts of the Earth, caused by a different action by the tidal interaction, originated mainly by the Moon, and partly also by the Sun. Such a relative motion amounts to power an efficient strong dynamo, called tide-driven (*TD*) dynamo. Electric currents are therefore generated everywhere inside the whole Earth's interior. But, currents always tend to expand as much as possible in space (as it is well-known in college physics, and it is formally expressed as "*Hamilton variation principle*"). This mechanism pushes currents to concentrate inside the Earth's body up to the outmost electrically less conductive layers, where currents decay by Joule heat. In particular, every former lesser bump at the Core-Mantle Boundary (*CMB*) thus develops into sharp spikes protruding upward through the mantle towards Earth surface. The process reminds about a soldering iron pushed into ice. The final result simulates a planetary sea-urchin pattern (Fig. 1 & 2). The Sea-Urchin *Plasma Core* concept has now been confirmed with "Star in a Jar" developments like the Safire Project, <http://safireproject.com/>, which shows the development of plasma anode tufts in organized energy patterns as the sea-urchin model predicts. Repulsive forces in the anode tufts control their energy geometry (see also section 4). While the induction energy mechanism is the key to internal forcing [1, 2, 3, 4].

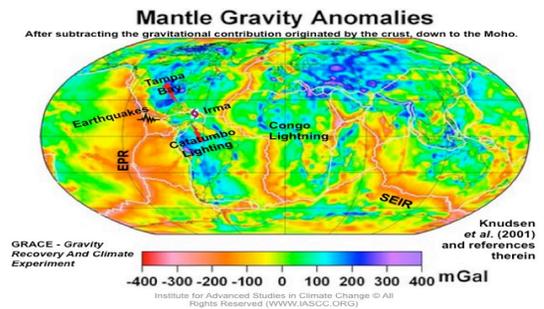
**Earth's Axial (Y)** dipole induction effects of the poloidal (**E**) electric field primarily induce into polar connected North-South circuits of the *Mid-Ocean Ridges (MORs)*, western Pacific rim, and inner core (*IC*). They are associated with magnetic moment of the total field strength and polarity variability of mostly the Sun, Moon and planetary orientation. But, a large dependence is

⇒ *Moment considered a measure of a dipole's ability to turn itself into alignment within a given external magnetic field.* In a uniform magnetic field, the magnitude of the dipole moment is proportional to the maximum amount of torque on the dipole, which occurs when the dipole is at right angles to the magnetic field. The *Magnetic Dipole Moment*, often simply called the *Magnetic Moment*, may be **defined then as the maximum amount of torque** caused by magnetic force on a dipole that arises per unit value of surrounding magnetic field in vacuum (Wikipedia & Britannica).

related to the Earth's deep conducting layers, directly connected with the fluid outer core (*OC*) and with the *IC*. The whole geometry, however, is largely deviating from any simple spherical symmetry. The concept is better represented in terms of an exact tetrahedron pattern, as briefly outlined in section 4. Indeed, a direct E.M. coupling occurs between solar wind and the Earth's system, through Earth's *IC/OC*, mantle, lithosphere, oceans, atmosphere and upper space [4]. The whole natural system is a unique entity, and it is nonsensical and *misleading* to separate the interaction between any simple couple of components, while neglecting all others. For instance, the trends of mantle circuits can be mapped with satellite mantle *Gravity* imaging of the thermal signatures given off through Joule heat of the *MOR* circuits (Fig. 3). Indeed, the encircling *MOR* pattern around Antarctic seems to be the Earth's surface signature of the aforementioned base of a tetrahedron within the core. The deformation has to be taken into account that is caused by the sliding of the lithosphere on the asthenosphere. In addition, the whole model is supported by a huge amount of observations that cannot be here listed. The resulting energy balance is impressive. In fact, the power supplied by the *TD* dynamo is found to be sufficient to justify *all* endogenous phenomena of the Earth, the largest percent being manifested like the ubiquitous release of geothermal flux, although non-uniformly in space and time.



**Fig. 2.** Earth "Internal" Sea Urchin Spike/Antenna Adding to conventional Earth Model the concept of electrical potential Joule spikes emanating from a plasma core. [1].

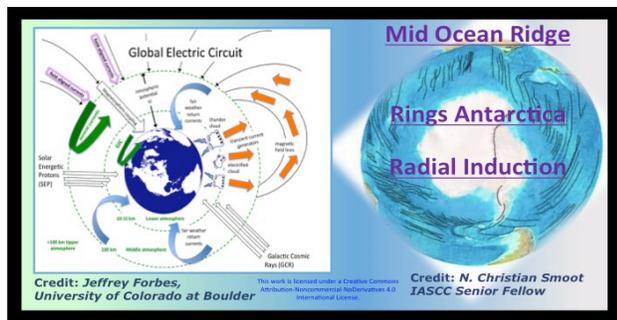


**Fig. 3.** Mantle Gravity Anomalies from GRACE satellite mission data [5] indicate East Pacific Rise (EPR) polar and continental circuit connections to Catatumbo, Tampa Bay *Lightning* anomalies, and Southeast Indian Rise (SEIR) connections to the African Rift/Congo global lightning anomalies.

**Earth's Radial (X)** induction effects of the toroidal (**E**) electric field, are associated primarily with variations of the magnetic moment of solar winds *IMF* strength and polarity variability. It is primarily concerned with the Earth's *OC* and the East-West oriented "orthogonal" fracture systems that are "COILS" [6]

of the Earth component of a *Stellar Transformer*. *IMF* polarity determines which orthogonal system switches on and the direction of energy-flow through the planet, indicating that the Earth is set in an *Alternating Current (AC)* space environment.<sup>3</sup> The South Pole has most energy transfer from a ring effect along the ridge encircling Antarctica (Fig. 4). In space, above the Earth's poles, the aurora plasma rings induce ground currents within the *MORs*, especially the *MOR* encircling the South Pole (*Radial Induction*), transformer "COILS" [6] (Fig. 4). That is, the geographical pattern of the *MORs* is a key feature to determine the related observed phenomena to be investigated (see section 4).

The induction characteristics are determined by current alignments between layers in the Earth and polarity relationships between of the Earth, Sun and other planets. The alignment and polarity determine the attraction or repulsive forces in *Plasma Core* physics and determine charging and discharging forces on our planet (Fig. 1, 2, 3, 4 & 5). Fig. 1 conceives an idealized *Plasma Core Model of Earth as a Stellar Transformer*, See: <https://www.iascc.org/free-stuff/>.

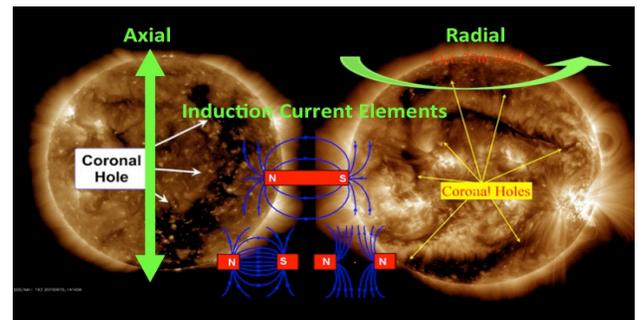


**Fig. 4. Global Electric Circuit** Conventional Model includes Ground Inductions Currents (*GIC*) magnetically coupled to Aurora Ring Currents torqued by Field Aligned Induction currents from magnetosphere coupling to solar forcing. (Forbes, J. – Univ. of Colorado – Boulder). Step down aurora energy to the *MORs* encircling Antarctica would generate powerful radial ground induction currents on *Stellar Transformer COILS*. [6].

For simplicity, every vector component is thus depicted as a separate primary effect. But, in reality these are not separable circuits. Rather, they should be considered altogether as coupled with the Sun's total variability and output, and ideally with position and magnetic fields of the Moon and other planets. To simplify the understanding of the relationships, solar coronal holes, that are aligned with the Sun's North-South polar axis, can be approximately considered axial induction elements, while those aligned with the equator can be considered radial induction elements. Many coronal hole configurations represent

<sup>3</sup> In this respect, the more frequently occurring *IMF* pattern displays an alternation of 4 sectors +/- co-rotating at the same spin rate of the Sun, i.e. with ~27 day period. Hence, the inducing signal into Earth and planets has an indicative period close to ~27/2 day. But, when the solar activity is particularly low, the 4-sector structure shifts into a 2-sector pattern. Thus, the inducing field has a typical period close to ~27days. A longer period implies a deeper skin-depth of penetration of the induction signal. More penetrating induction current determines a more efficient *TD* dynamo. The production and release of endogenous energy is thus enhanced, and geodynamics, volcanism and climate are supplied by greater power. Thus, a quiet Sun is associated to a more perturbed climate, consistently with well-known observational features. Owing to the same process, with a quiet Sun also the outer gaseous planets are observed to display anomalous large atmospheric storms.

some combination of the axial and radial elements. This is important, because the elements on Earth are directly energized by alignment relationships between these Sun and Earth elements controlled by magnetic moment orbital physics. These dark coronal holes on the Sun represent the induction current elements of the *Solar Stellar Transformer* (Fig. 5). Solar phenomena depend on elements within the arm of our spiral galaxy and thereby the Solar System including Earth, via E.M. frequency response, within an Electric Universe framework [7]. In particular, objective observational evidence supports a control of the solar wind emission caused by the encounters of the Solar System with clouds of interstellar matter during the motion of the Sun through the Milky Way (hence, the title "*Galaxy-Sun-Earth Relations*" [1]). Whenever the heliosphere,<sup>4</sup> i.e. the solar wind, is compressed inside the Earth orbit, a geomagnetic field reversal (*FR*) can occur (50% probability), implying a huge generation of extra Earth's endogenous Joule heat, with implications on geodynamics, volcanism, and climate. *Alignment and polarity determine the attraction or repulsive forces in plasma physics and determine charging and discharging forces on our planet. But, the most dramatic effects are manifested in geodynamics, volcanism, and atmospheric dynamics, due to the enormous injection by gas and fluid exhalation into lithosphere, oceans, and atmosphere.*

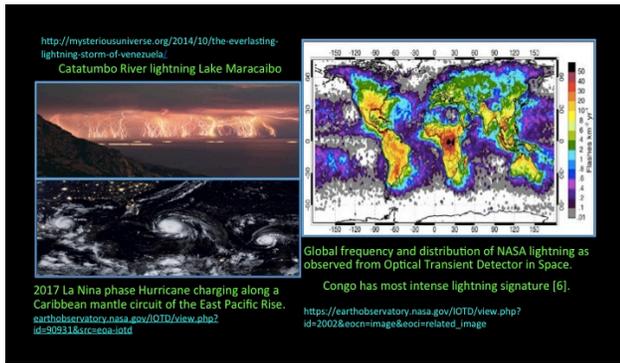


**Fig. 5. Solar Stellar Transformer Coronal Hole Induction Current Elements** express induction elements in axial vs. radial orientations determining axial vs. radial effects on Earth systems. Polarity determines attractive/repulsive force determining charging/discharging relationships [2, 3]. (Image Credit - Solar Heliospheric Observatory - SOHO)

### 3. RIDGE INDUCTION EFFECTS LIGHTNING TELLS THE STORY

National Aeronautics and Space Administration (NASA) launched Optical Transient Detector (OTD) in 1995 - 2000, a prototype of the Lightning Imaging Sensor (LIS) instrument launched in 1997 - 2015 [8]. These were specifically designed to detect *Lightning* from space during both day and night with storm-scale resolution. Lightning tells the Stellar Transformer story.

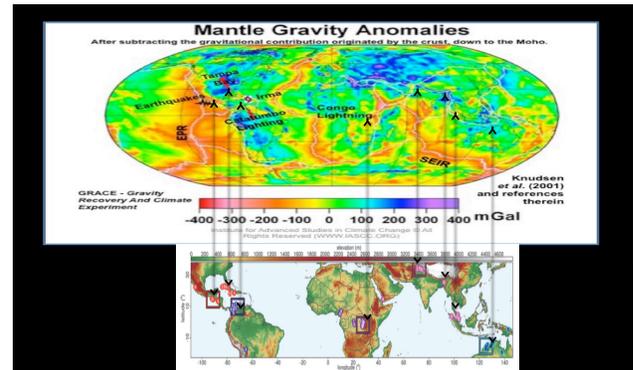
<sup>4</sup> *Heliosphere* -Much like the magnetosphere is a magnetic shield that protects the Earth from direct interaction with the solar wind, the heliosphere is a magnetic shield that protects the Solar System from direct interaction with the interstellar environment. The distance of the heliosphere from the Sun depends on the intensity of the flux of ionized interstellar matter encountered by the Sun during the trip around the center of the Milky Way with a period of ~25,920 years. The fractal dimension of the solar encounters with interstellar clouds is the same as for the time series of several Earth' phenomena, such as e.g. of the volcanism of the Hawaii hot spot that generated the Hawaii-Emperor Seamount Chain in central-north Pacific.



**Fig. 6. CATATUMBO LIGHTNING** (upper left image), and Intense African Congo *Lightning* from *NASA* (upper right image). Hurricanes Irma, Katia, & Jose (lower left image) charging the Earth along a Caribbean mantle circuit. The African Congo *Lightning* flash global frequency and distribution of *Lightning* as observed from space by the Optical Transient Detector (upper right image) shows Congo with most intense *Lightning* signature [8].

“For years, African Congo was known as the lightning Capital of the World, but in 2016 with new lightning analysis *Catatumbo* became the new lightning Capital of the World (Fig. 6). What made the global lightning distribution shift from Africa to South America? Review of 16 years of lightning climatology, by Albrecht et al. (2016) [9], revealed, “*Where are the Lightning hotspots on Earth?*” (Fig. 7) For years Tampa Bay, Florida was unofficially known as the “Lightning Capital of the United States,” but in 2016 the new lightning analysis shifted the hotspot location 30 miles southeast of Fort Myers Florida. Why the corresponding shifts in Florida from Tampa Bay to Ft. Meyers, with the global shift from Congo to *Catatumbo*? Closer inspection reveals a noon/midnight induction effect when magnetic moments of North-South aligned *MOR* structures (circuits) align with the solar axis. Especially along the *East Pacific Rise (EPR)* and the northern component of the *Southeast Indian Ridge (SEIR)*, situated 180° longitude antipodal. The largest peaks of lightning activity in *Catatumbo* at *Lake Maracaibo*, on the coast of Venezuela, activate when the *EPR* aligns at midnight. The largest peaks of lightning activity in *Mitumba Mountains* of Congo activate when the *SEIR* aligns at midnight, with lesser lightning peaks at noon alignments. *Lake Maracaibo* locally known as the “Lighthouse of *Catatumbo*” has most lightning from “nocturnal” thunderstorms “at night”. Daytime lightning occurs near the coast and is driven by a sea-breeze circulation observed only over a small area of the lake during the late afternoon when the *EPR* is aligned for maximum induction at noon. This strong daily, *diurnal*, cycle of lightning frequency reveals little lightning during the day and a nocturnal maximum from 0000 to 0500 *LST* (Local Standard Time) abruptly peaking at 0300 *LST*. This is the same time that the *EPR* is directly aligned with midnight! Lightning hotspots over the *Mitumba Mountains* exhibit higher mean *diurnal* cycle flash rates during the afternoon from 1500 to 1700 *LST* than in the central Congo at 1500 *LST*, with some activity during the night. The 1500 afternoon local time 3 hour offset from noon suggests induction from Northward component of the *SEIR* in the Indian Ocean along the Rodriguez Triple Junction just 3 time zones to the East of the African continental rift! This North-South trend of the *SEIR* also directly aligns with the Pakistan lightning area at the head of the Indus River. Data show Lake Victoria as well as other lakes along the East African Rift Valley, exhibit deep

nocturnal convective activity from a direct induction effect from African Rift alignment at midnight. Thus we see a *diurnal* ridge induction effect drawing lightning into the South American and African rift lakes systems especially at midnight with a smaller effect at noon. Thus *Solar Induction* effects govern a large portion of daily lightning and convection” [10].



**Fig. 7. LIGHTNING HOTSPOTS** (lower insert [9]), Relationships to *Mantle Gravity Circuits* (upper insert [5]). Although coastal relationships to *Lightning* exist in many instances, most if not all *Lightning* hotspots appear related to mantle circuit termination points associated with rift, rivers and lake systems within continents as well as nearby planetary scale vortex structures adjacent to circuits. *Mantle Gravity Circuits* signature portrays 4 global North-South polar connected electrical circuits.

#### 4. THE MID-OCEAN RIDGE (MOR) PATTERN

As already stressed, the MOR pattern is crucial in determining the either axial- or radial-component of E.M. induction effects caused by IMF. Only a very brief anticipation is here given of a paper in preparation. The rationale relies on the interaction inside deep Earth between nearby sea-urchin spikes. It is found that a stable configuration can be attained only through exact Platonic solid geometry patterns. The Inner Core (IC) seems governed by the tetrahedron (fire) pattern, where every edge is an alignment of sea-urchin spikes. Indeed, this is the unique available explanation for the observed MOR distribution. The observed tetrahedron has a vertex at the Earth North Pole and huge amounts of sea-urchin spikes occur along the edges of the tetrahedron stirring energy in the Outer Core (OC) creating meandering OC stream flows processes, discussed by Quinn [11]. The three edges of the tetrahedron face, i.e. the boundaries of the tetrahedron-base opposed to the North Pole vertex, is represented by the Circum-Antarctic Ridge. The three vertexes along the base seem to have surface expressions located at ~120° relative longitudes along Circum-Antarctic Ridge (~50°S Lat.) and seem to be associated with Scotia Arc (~50° W Long.), the Kerguelen Hot Spot (~70°E Long.), and indistinct features along South Pacific Fracture Zones (~170°W Long.). The southern hemisphere also appears to rotate faster than the northern, driven by OC jerks, discussed by Quinn associated with “geomagnetic jerks” [11]. Moving into the next Earth double layer through the Core-Mantle Boundary (CMB), the next Platonic solid duality of the cube (earth) and octahedron (air) seems to be encountered within the mantle charged double layers. The octahedron four equatorial tips seem to be represented by the 4 major domes near the equator spaced ~90° apart, represented by Lake Victoria in the African Rift, Banda Sea north of Australia, seafloor features near the Line Islands in

the mid-Pacific, and the volcanic arc of the Caribbean dome, while the sea urchin spikes (anode tufts) along the edges of the cube geometry, seem to be represented somewhat by the major North-South axial mantle circuits connecting the poles as discussed in the Stellar Transformer hypothesis (Fig. 3), such as the East Pacific Rise, Mid-Atlantic Ridge, Northern component of the Southeast Indian Ridge and Western Pacific Rim. Possibly the Pacific circuit was blown, revisiting the possibility that the area east of the Marianas Islands may be the origin of the Moon. In addition there seems to be an overprinting of the new circuits over much more ancient north-south “Super Anticline” circuits of Archean origin, discussed by Choi [12, 13]. Related to the Great Lakes/New Madrid-Caribbean [12], and Lake Baikal-Banda Sea connections [13], that twists eastward with the accelerated motion of the southern hemisphere related to the South Atlantic magnetic anomaly in the west, a well-known feature of the geomagnetic field, typically recognized by the violent impact on the radiation belts. In the east from the Banda Sea, the tectonic trends veer toward New Zealand, possibly associated with the wildfire outbreak areas in New South Wales, Australia, although this is much speculative.

For completeness sake consider that according to the *Stellar Transformer* [2, 3] model envisaged, endogenous heat and sea-urchin spikes generate continental-size upheavals, i.e. “super swells”. The lithosphere slides on the slopes of these super swells. The sliding occurs on the asthenosphere, a thin layer lubricated by Joule heating from a tiny percent of electric currents leaking off the CMB, located just on top of the serpentosphere.<sup>5</sup> Huge sliding slabs of lithosphere collide inside megasynclines, originating orogeny i.e. “Warm-Mud Tectonics” (WMT) [1], better known as “continental drift”. However, in general, a sliding of the lithosphere on top of the asthenosphere largely modifies evidence of exact Platonic solid patterns. From the viewpoint of the *Stellar Transformer*, the interacting electric conducting pattern should be identified with deep Platonic solid patterns that are identified with the precise deep alignment of sea-urchin spikes. The depth of the cube edges ought to be of the order of magnitude of ~100 km underneath MORs [14, 15], while the larger depths of the tetrahedron related to IC and OC is not well known, especially when considering regions with an overthrust of a continental shield. Possibly these are caused by a shorting of “blown” circuits from an extremely large event in some of these Platonic solid double layers.

## 5. ELECTRIC GEOLOGY - ELECTRIC EARTHQUAKES

Note, however, that the whole set of the aforementioned phenomena is driven by E.M. phenomena, and it is meaningless to separate different kind of effects. Hence, altogether the phenomenon can be described as “*Electric Geology*”, while different facts of natural reality can be eventually interpreted according to either one scheme, or another. Nature is more

<sup>5</sup> The serpentosphere is originated by serpentization of dry rocks that results from the interaction of water penetrating from Earth’s surface through the lithosphere. Serpentization is an explosive process that determines severe local fracturing. Hence, the speed of seismic waves is reduced (this is the Moho), and a larger electrical conductivity. Hence, owing to Hamilton’s, electric currents flow on top of the asthenosphere, where they release Joule heat. The final result is a tiny lubricated layer where the lithosphere can easily slide, being responsible for continental drift, geodynamics etc.

intricate than our “simple” scheme would like. Geological evidence gives some relevant indication of huge and anomalous air-earth electric discharges, as briefly reviewed by [16]. In particular, with reference to the evidence of rotating layers, the properties of the Birkeland currents are to be considered (coaxial, polygonal, alternate direction), from both the theoretical [17] and observational viewpoint [18], also confirmed by the Madagascar’s lavakas<sup>6</sup> that are the likely ground electric-geology signature related to the typhoon-track terminal in the Indian Ocean. The ground electrode ought to be analogous to the sea-urchin spike pattern that, underneath the African craton, ought to be associated to diamond bearing kimberlites (paper in preparation).

One appeal of *Electric Geology* concepts [16] implies that they easily explain some problems in geodynamics such as: 1.) The power needed to thrust up mountains ranges is difficult to justify with simple mantle convection/upwelling as a driver, but an electrically shorted North-South global mantle circuit (Fig. 3) during an extreme electric discharge should have the necessary power for uplifting North-South mountain chains for example the Andes and Rockies. Note that the TD dynamo provides the power for the electric discharge; 2.) The relatively young age of the seafloor, stated as ~200 million years by plate theorists, relative to the ancient age of continents up to 4.5 billion years is explained by recently created lithosphere from seafloor carve outs and subsequent electrical circuit “superswells”, likely related to some spreading. Electrical carve outs of global ocean seafloors from a series of arc blast plasma events explains melting of the seafloor and reset of the magnetic ages from reaching Curie temperatures which resets the magnetic age from induction effects during recrystallization. That is, some case histories of oceanic volcanism can be considered as the best-known signature of “*Electric Geology*”. 3.) Maybe, it could also make sense that the asteroid belt perhaps contains remnants of Earth’s blown out crust and mantle if the Earth-Sun system is considered as a *Stellar Transformer* with a few blown circuits stressed by very intense events. Color variations contrasted by orange and blue on *Mantle Gravity* map (Fig. 3) delineates the trend of the “Double Layer” or “Cathode (orange)/Anode (blue) short circuit relationships and delineates a South Pole to North Pole mantle circuits (Fig. 3). 4.) Extrapolating this idea to the larger interplanetary lightning scale envisioned, leads to the possible conclusion that if ocean basins were carved out by this process sending the seafloor into orbit as asteroids, then very likely the **magnetic signatures of MORs are the product of a lateral co-rotating Birkeland current, not the product of seafloor spreading as proposed in the plate tectonic paradigm. In other word the magnetic stripes on the seafloor are a lateral cut away view of the double layering effect!** [16]

Concerning seismicity, as already stressed, one must consider a unique whole physical system from deep Earth through outer space. In particular, strong evidence supports the existence of intense air-earth current flowing mainly in region of largely fractured crust [19]. This means that we must expect the intense air-earth electric currents permanently exist all over the Earth, mainly flowing in preferential areas. The origin is related to huge soil exhalation of gas and fluids that, however, can be detected only when integrated over regional scale-size. This also clearly explains the large amount of seismic precursor, co-seismic events and aftershocks that are observed in atmospheric

<sup>6</sup> We are indebted to Franco Bonavia for reminding about lavakas.

teleconnection phenomena, up to the ionosphere and above. A large amount of literature is already available. It is therefore possible to envisage large regions that are prone to experience a seismic shock during a time lag of subsequent few to several months. This is “*level 1*” in earthquake prediction [20]. But, the best location of the expected epicenter is given by a comparatively lower altitude effect, i.e. by an anomaly in the jet stream. Indeed, seismic locations are identified using jet stream’s anomaly interruption formerly identified by Wu [21]. An interruption of the velocity flow-lines occurs just above the epicenter approximately 3 months prior to earthquake events. The duration of this phenomenon is approximately 6 – 12 hours. The average distance between epicenters and jet stream’s precursors is about 100 km or less. According to the hypothesis of Lithosphere-Atmosphere-Ionosphere Coupling (*LAIC*) [22], when the jet stream’s pass over the active epicentre region, the faults release radioactive material (ionized gases) to the atmosphere, causing a series of physical and chemical reactions, resulting in temperature and pressure changes in the atmosphere, jet stream, and electric field effects in the ionosphere. Indeed, it should be stressed that the phenomenon is *not only* related to radioactive fluids, but to all kinds of endogenous and ionized fluids that are responsible for electric currents inside a huge electric system supplied by E.M. induction effects between solar wind and Earth’s system, down to the deep Earth’s interior, including the huge role of the *TD* dynamo powered by the Moon/Sun tide and modulated by the solar wind.

## 6. MONITORING TECHNOLOGY

### Radio Directional Finding (RDF)

The Radio Detection Finding (*RDF*) system of the Radio Emissions Project [23] is a geomagnetic detection system that provides global coverage for *Earthquake* detection of the entire terrestrial surface. This monitors low frequency radio signals from *Earthquakes*, because they are electrical. The operative principle is similar to *Lightning* detection networks that locate *Lightning* strike by the radio emissions, albeit at suitable higher frequencies (a huge literature is available). By triangulation (at least three monitoring stations) it is possible to determine the epicenter area and estimate the magnitude of the *Earthquake* about 20 hours before the main shock [24, 25]. It is thus possible to identify the precise axial position and direction of origin, with respect to the monitoring station. Low frequency Electromagnetic Emission (*EME*) detection has made extensive leaps in antenna design, compared to passive loop antennas. A new mobile high inductance antenna using a unique ratio of turns per layer, produces an integrated pre-amplifier, attenuating unwanted signal interference. Swiveling this loop antenna on a 360° base, attains a new Radio Direction Finding (*RDF*) technique deemed Point & Detect (*PND*) for low frequency *EMEs* to determine their identity and origins [26]. Confirming *Earthquakes* are driven from solar E.M. induction and understanding the relationships to various solar activity, will herald in new challenges in *Earthquake* forecasting techniques based on *Space Weather*.<sup>7</sup>

<sup>7</sup> A crucial issue should be clarified concerning *Space Weather*, generally referring to comparably high frequency perturbation in the solar wind originating cause-and-effect from interplanetary space through atmosphere to ground. This is the “*external*” way. At lower frequencies, E.M. induction occurs in deep Earth, via sea-urchin spikes operating like very efficient antennae ensuring effective E.M. coupling between solar wind and deep Earth. These very low frequency E.M.

### Acoustic Emission Monitoring

Seismic precursors signals are released by crustal solid structures and detected by means of signals of acoustic emissions (*AE*). This diagnostic tool is effective for monitoring the evolution of material performance inside geologic structures (seismic, volcanic, geothermal, etc.). The natural structures act like huge natural antennas with terminals at rocky outcrops. The monitoring instrument is composed of two parts, i.e. the sensor on the outcrop and the underground rocky block that is a huge natural probe embedded in the natural system. A key physical aspect deals with the *frequency* dependence of the *AE*. Mechanically vibrating structures (*AE*) are comparatively high frequency (*HF*). When crustal flaws increases (i.e. earthquakes), either due to the enlargement of one previous flaw, or to the coalescence of several previous smaller flaws (or both), some microspores of increasing size shall be formed, and the *AE* shall correspondingly become of progressively lower frequency (*LF*) [23, 24, 25]. A planetary network of double-frequency *AE* recording stations permits to monitor planetary scale propagation of crustal stress, much like the meteorological station network permits to monitor atmospheric phenomena for meteorological forecast. The stress propagation occurs inside the serpentosphere (below the asthenosphere). A planetary *AE* network represent “*level 2*” of seismic forecast, while *AE* monitoring of specific active faults represents “*level 3*” aimed to issue a forecast with 1-2-day advance in the regions that are crossed by a specific active fault. “*Level 4*” relies on the instant position of the Moon, and permits to forecast the time instant of a possible shock only within two very short time lags (several minutes each) during every day and in every given area. See [26] for details.

## 7. CONCLUSIONS

Present Earth’s sciences and solar-terrestrial relations are generally handled upon separating different drivers and phenomena, with great concern about thermodynamics, state-of-matter, geochemistry, radiation balance, gravitation etc. while E.M. interactions are treated like an almost ancillary facet of natural reality. In addition, different disciplines are considered the realm of separate classes of specialists, with the conventional *ad hoc* assumption of suitable Faraday shields that separate different topics of concern. This separation is devastating for the capability to understand natural reality. Rather, the natural system is a unique entity, ranging from the Sun through the Earth’s center, and E.M. phenomena are the major driver, glue that relates all other drivers. The solar modulation occurs overwhelmingly through corpuscular radiation, rather than by the best-known E.M. radiation. Large-scale E.M. induction processes at some extremely low frequency control the efficiency of the *TD* dynamo that is active inside the Earth and inside every planetary object that has component parts that can move relative to one another. A local space-gradient of gravitation supplies a dynamo, i.e. the *TD* dynamo that originates a tremendous amount of endogenous Joule heat. The timing of the exhalation of such a great energy input (gravitational → E.M. → thermal) determines huge thermal gradients. On the one hand, thermal phenomena are responsible for mechanical deformation and sliding, hence

perturbations are responsible for direct efficient modulation of the *TD* dynamo, and generation of endogenous heat. This is the “*internal*” way. *Space Weather* is therefore a twofold phenomenon, where, according to clear observational evidence, the internal way is certainly much more important than the better-known and conventional external way effect.

geodynamics, volcanism, fluid exhalation and climate. On the other hand, every convection process inside an ionized medium always determines the transformation of mechanical energy into E.M. energy [1], through the so-called “Cowling dynamo” (thermal → E.M.). The basic primary process is therefore the E.M. interaction between solar wind and the deep conducting structures of the Earth. A rationale, relying on Maxwell laws, implies the formation of a deep-Earth tetrahedron pattern. The signature at Earth’s surface is represented by the MOR pattern compared to a more deformed octahedral/cube double layer, and is perturbed due to the sliding of the lithosphere on top of the asthenosphere. A key issue is concerned with the global atmospheric electric circuit that involves the deep Earth’ layers and the TD dynamo, through the solar wind. The present standard concern is focused on lightning discharges. In contrast, steady and non-catastrophic phenomena constitute an enormous reservoir of energy that can be exploited. The “electric universe” concept [7] is a key, new, wide perspective that requires and deserves an unprecedented effort.

## 8. REFERENCES

- [1] Gregori, G.P., *Galaxy-Sun-Earth Relations: The origins of the magnetic field and of the endogenous energy of the Earth*, Arbeitskreis Geschichte Geophysik, Band 3, Heft 3, 471 pp.; ISSN: 1615-2824, Science Edition, W. Schroder, Germany, 2002.
- [2] Leybourne, B.A., **Stellar Transformer Concepts: Solar Induction Driver of Natural Disasters - Forecasting with Geophysical Intelligence**, *J. Systemics, Cybernetics Informatics*, Orlando, FL, 16(4), 26-37, ISSN: 1690-4524, 2018.
- [3] Leybourne, B.A., *et al.*, **Evolution of Earth as a Stellar Transformer**, *NCGT J.*, 5(1), 144-155, 2017; [www.iascc.org/the-science](http://www.iascc.org/the-science).
- [4] Gregori, G.P., **Climate and the atmospheric electrical circuit: the electromagnetic coupling between solar wind and Earth**. *NCGT J.*, 2(1), 99-112, 2014. Anticipation of an 8-volume set in preparation.
- [5] Knudsen, P., *et al.*, **Ocean tide effects on GRACE gravimetry**. In: Sideris, M.G., (ed.), **Gravity, geoid, and geodynamics 2000**, *IAG Symp.* 123, 398 pp., Springer-Verlag, New York, 2001.
- [6] Smoot, N.C. and B.A. Leybourne, **Orthogonal Megatrend Intersections: “Coils” of a Stellar Transformer**, *Conf. Proc., J. Systemics, Cybernetics, Informatics*, Orlando, FL, March 2020 (Pending Publ.).
- [7] Thornhill, W. and D. Talbott, *The Electric Universe*, Mikamar Publishing, 132p, 2007.
- [8] Christian, H.J. *et al.*, **Global frequency and distribution of lightning as observed from space by the Optical Transient Detector**, *J. Geophys. Res.*, 108(D1), 4005, doi:10.1029/2002JD002347, 2003.
- [9] Albrecht, R.I., *et al.*, **Where are the lightning hotspots on Earth?** *Bull. Am. Met. Soc.*; doi:10.1175/BAMS-D-14-00193.1, 2016. See News Article @: [www.northcollierfire.com/wp-content/uploads/2016/05/Latest-News-Lightning-Capital-of-US.pdf](http://www.northcollierfire.com/wp-content/uploads/2016/05/Latest-News-Lightning-Capital-of-US.pdf)
- [10] Leybourne, B.A., **Solar Induction of Mid-Ocean Ridge Circuits: Lightning Tells the Story**, *ILDC/ILMC 2020 - Connecting Lightning Research and Applications*, Broomfield, CO, 2020. Abstract Accepted - Pending Publication
- [11] Quinn, J.M., **Global Warming – Geophysical Counterpoints to the Enhanced Greenhouse Theory**, Dorrance Publishing, Pittsburgh, PA. 118p. 2010. ISBN: 978-1-4349-0581-9.
- [12] Choi, D.R. and Kubota, Y., 2015. North-South American Super Anticline. *NCGT Journal*, v. 3, no. 3, p. 367-377.
- [13] Choi, D.R., 2013a. An Archean geanticline stretching from the South Pacific to Siberia. *NCGT Journal*, v. 1, no. 3, p. 45-55.
- [14] Forsyth, D.W., *et al.*, **Imaging the deep seismic structure beneath a mid-ocean ridge: the MELT experiment**, *Science*, 280, 1215-1237, 1998.
- [15] Goss Levi, B., 1998. **New measurements constrain models of mantle upwelling along midocean ridge**, *Phys. Today*, 51(7), 17-19.
- [16] White, L., **History of electric geology**, 2020, *Conf. Proc., J. Systemics, Cybernetics Informatics*, Orlando, FL, (Pending Publ.).
- [17] Scott, D.E., **Birkeland currents: a force-free field-aligned model**. *Progress Phys.*, 11 (2), 167-179, 2015.
- [18] Burns, W., **Polygonal crater formation by electrical discharges**, *NCGT J.*, 3(2), 158-186, 2015.
- [19] Quinn, J.M., **Global remote sensing of Earth’s magnetized lithosphere**, 253 pp., Solar-Terrestrial Environmental Research Institute (STERI), Lakewood, CO. 2014, 2017.
- [20] Gregori, G.P., B. Leybourne, and L.A.G. Hissink, **Natural “catastrophes”: “forecast” and management deontological obligation and common sense**, *NCGT J.*, 6(3), 327- 346. 2018.
- [21] Wu, Hong-Chun, and I.N. Tikhonov, **Jet stream anomalies as possible short-term precursors of earthquakes with M>6.0**. *Res. Geophys.*, 4, (1), 12-18; DOI: 10.4081/rg.2014.4939, 2014.
- [22] Pulinets, S.A., and D. Ouzounov, **Lithosphere–Atmosphere–Ionosphere Coupling (LAIC) model – An unified concept for earthquake precursors validation**, *J. Asian Earth Sci.*, 41 (4/5), 371-382; DOI: 10.1016/j.jseaes.2010.03.005, 2011.
- [23] Straser, V., G. Cataldi, and D. Cataldi, **Radio-anomalies: a tool for earthquake and tsunami forecasts**. EGU Gen. Ass. 2015, Natural Hazard Section (NH5.1), Sea & Ocean Hazard - Tsunami, *Geophys. Res. Abs.*, 17, Vienna, Austria. Harvard-Smiths. Center for Astrophys., High Energy Astrophys. Div., SAO/NASA Astrophys. Data Syst., 2015.
- [24] Straser, V., G. Cataldi, G., and D. Cataldi, **SELF and VLF electromagnetic signal variations that preceded the Central Italy earthquake on August 24, 2016**. *NCGT J.*, 4(3), 473-477, 2016.
- [25] Straser, V., G. Cataldi, G., and D. Cataldi, **Seismic signals detected in Italy before the Nikol'skoye (off Kamchatka) earthquake in July 2017**. *NCGT J.*, 5(3), 391-396, 2017.
- [26] Jones II, K.B., **Loop Antenna Precursor Detection of Low Frequency Electromagnetic Emissions (EMEs)**, *Conf. Proc., J. Systemics, Cybernetics Informatics*, Orlando, FL, 2020 (Pending Publ.).
- [27] Gregori, G.P., and G. Paparo, **Acoustic emission (AE). A diagnostic tool for environmental sciences and for non-destructive tests (with a potential application to gravitational antennas)**. In Schröder, W., (ed.). *Meteorological and geophysical fluid dynamics, Arbeitskreis Geschichte der Geophysik und Kosmische Physik*, Science, Bremen, p. 166-204, 2004.
- [28] Gregori, G.P., *et al.*, **Storms of crustal stress and AE earthquake precursors**, *Nat. Hazards Earth Syst. Sci.*, 10, 319–337, 2010.
- [29] Paparo, G., *et al.*, **Crustal stress crises and seismic activity in the Italian peninsula investigated by fractal analysis of acoustic emission (AE), soil exhalation and seismic data**. In Cello, G., and B.D. Malamud, (eds), *Fractal analysis for natural hazards*, *Geol. Soc. Lond., Spec. Publ.*, 261, 47-61. 2006.
- [30] Gregori, G. P., **Earthquakes occur very close to either 06:00 or 18:00 lunar local time**, *NCGT J.*, 3 (1), 21-28, 2015.