LUNAR, SOLAR (DAILY), & SOLAR (ANNUAL) KINETIC ENERGY TRANSFER DRIVES TIDAL BULGE, PACIFIC PLATE & CONTINENTAL LAND MASS MOVEMENT, AND THE EL NINO SOUTHERN OSCILLATION

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AUTHOR INTRODUCTION: Retired and Independent researcher. Entire career in the private sector. No employment in academia nor government service. BChE Chemical Engineering Univ. of Detroit-Mercy 1973, MBA Univ. of Delaware 1980, Prof. Engr (non-practicing). Member American Geophysical Union and Geochemical Society. Forty (40) years experience in industrial commodity chemical processes. Thirty two (32) years with E.I. DuPont de Nemours in Process Engineering, Design, and Project Engineering leadership. This paper is entirely my own based upon my engineering education, experience, literature search, and logical deduction. I have received no funding for this work.

DEDICATIONS - To the most special people in my life, Judy Cronin, love of my life, now departed, and our sons Steven and Robert.

ABSTRACT – Tidal Pumping is the very well-known Astrophysical phenomenon wherein the gravity of a major celestial body exerts a “pumping” or drag force on a smaller orbiting celestial body as it swings through an eccentric orbit. This force drives tectonics and volcanism. Jupiter’s volcanic moons are paved in basaltic rock, like the ocean floor of the Earth. Jovian moon Io is the most volcanic celestial body in the solar system. Saturn’s tidally pumped moons have cryovolcanoes. Planetary rings were formed by moons ripped apart by tidal pumping forces.

As the Earth passes from the Aphelion (July 4, the most distant point in Earth’s orbit) to the Perihelion (Earth’s closest approach to the Sun, approx. Jan. 4), both its rotation and orbital motion speed up. As Earth passes through its Winter Solstice (Dec. 21) and its Perihelion, there is a deceleration, with kinetic energy transfer onto the solid Earth and causing a tidal bulge calculated at 10 to 12 cm. There are limited means for direct observation during this once-per-year transient event. By comparison, the Moon causes a tidal bulge on the solid Earth with a vertical lift of 40 to 55 cm. The gravity of the Sun also exerts a tidal deformation on the solid Earth from day-to-night. The side of the Earth rotating to face the Sun is uplifted 15 to 21 cm.

Due to tidal lock with the Earth, the moon has been recontoured into an egg shape, with the broad end facing Earth.

This paper extends prior papers that the tidal effects of the Moon, Sun, and Earth’s passage through the Perihelion are principal triggers of tectonic activity and the El Nino Southern Oscillation (ENSO) - by exerting tidal bulge (vertical uplift) on highly stressed seismic regions in the near-equatorial South Pacific and releasing seismic heat into the waters of the Equatorial South Pacific. Furthermore, these combined tidal forces have dragged and pushed continental land masses into the Northern Hemisphere.

Pertinent references on tidal deformation related to seismic activity are listed. Particular emphasis on references 67 to 75.

DISCUSSION

(1) TIDAL PUMPING - Tidal Pumping is the very well-known Astrophysical phenomenon wherein the gravity of a major celestial body exerts a “pumping” or drag force on a smaller orbiting celestial body as it swings through an eccentric orbit to drive tectonics, volcanism, and uplift on land masses. Prime examples include the volcanic moons of the gas giants as they swing through their eccentric orbits. The Jovian moon Io is the most volcanic celestial body in the Solar System. Enceladus undergoes cryo-volcanism as it is tidally pumped by Saturn. The rings of the gas giants were formed as moons were ripped apart by Tidal Pumping forces.

The Sun tidally pumps Venus, producing circular corona volcanoes, a CO2-rich atmosphere and all-enshrouding clouds of sulfuric acid. Sulfuric acid’s heat capacity is approx. 1/3 that of water, thus sulfuric acid a far less powerful coolant than water. The Water Cycle is the dominant cooling system for the Earth.

The Earth’s rotation deforms Earth into a globe, an oblate spheroid, bulging at the Equator by 21 kilometers vs. a spherical shape. The Equator is a line of maximum crustal stress concentrations and fractured strata.

Earth gains rotational speed and orbital speed as it moves from Aphelion (most distant point in the orbit, approx. July 4) to the Perihelion (Earth’s closest approach to the Sun, approx. Jan. 4). As the Earth passes through the Perihelion, there is a abrupt deceleration and kinetic energy transfer on the order of 10^{20} Joules once per year, causing a tidal bulge (vertical uplift) on Earth calculated as 10 to 12 centimeters. An appropriate analogy would be an automobile descending a slope and gaining speed. As the vehicle reaches the very bottom of the slope and rides across the platform of a DMV brake tester, there is a kinetic energy transfer or load transfer at the very bottom, before the vehicle begins the up-slope. There are limited means for direct observation during this once-per-year transient event. By comparison, the Moon’s tides exert a kinetic energy transfer of 10^{20} Joules/year. Earth’s watery lunar tides range from less than 2 meters (microtidal) to more than 4 meters (macrotidal), up to 11.7 meters in the Bay of Fundy. The solid Earth’s lunar tidal bulge is 40 cm in the mid-latitudes and 55 cm at the Equator. The Equator represents a belt of greatest seismic stress concentration. The Sun’s night-to-day tidal effect also deforms the solid Earth, exerting a daily energy transfer of 10^{17} Joules/day. The side of the Earth facing the Sun is uplifted 15 to 21 cm. The Sun’s effects on watery tides are observed in the Full Moon and New Moon (Sun and Moon in alignment) versus Spring Tides and Neap Tides (Sun and Moon at right angles). The solid Earth undergoes plastic or elastic deformations. (Calculations by AI).

Although Venus does not have a direct tidal effect on Earth, the combined gravities of Venus and Jupiter can elongate the eccentricity of Earth’s orbit on a 405,000 year cycle, thereby providing a closer approach at Earth’s Perihelion (27). Mars can also elongate Earth’s orbital eccentricity and move Earth closer to the Sun at the Perihelion (66).

As a final note, the last full solar eclipse observed across North America occurred on April 8, 2024. As the Sun and Moon were moving into full alignment, combining their tidal effects, a rare Richter 4.8 earthquake struck Tewksbury, NJ on April 5, 2024.

(2) TECTONIC PLATE MOVEMENTS –

The hypothesis proposed here describes the movement of the Pacific plate from Southeast to Northwest due to the combined tidal pumping effects described above. The Pacific plate is the largest tectonic plate in the world. The Winter Solstice (approx. Dec. 21) positions the Southern Hemisphere facing the Sun most directly. The Earth's closest approach to the Sun, the Perihelion (approx. Jan. 4) incurs a brief transient of an annual tidal force, in addition to lunar tides and daily solar tides. The SE to NW movement of the Pacific plate opens the East Pacific Ridge (divergence). The Nazca plate is pushed eastward to subduct beneath the South American plate at the Peru/Chile Trench. The Peru/Chile Trench moves East-Southeast to East-Northeast at 6.5 to 7.5 cm per year.

In the western Pacific, the Pacific plate subducts beneath the Australian plate at the Tonga Trench (convergence). The Tonga Trench is the fastest moving trench system in the world and only slightly less than the Mariana Trench in depth. The northern end of the Tonga moves West-Northwest at 24 cm per year. The Australian plate is pushed Norh-Northeast at 6.5 to 7 cm per year. Likewise, the Indian plate moves northly at 5 cm/year and subducts beneath the Eurasian plate to thrust up the Himalayas. The Mid-Atlantic Ridge spreads west and east driving the Eurasian plate eastward.

The combined action of the spreading Mid-Atlantic Ridge and the north-going Indian plate cause the Eurasian plate to rotate in a very slight clockwise rotation.

In the middle of the Pacific plate is the Hawaiian island chain, stretching from Oahu in the Southeast, only 3 million years old, to Kauai in the northwest, at 3.8 million years old. Midway atoll is 28 million years old. The Hawaiian islands move Northwesterly at 7 to 10 cm/year, passing over the fixed Hawaiian mantle plume volcano.

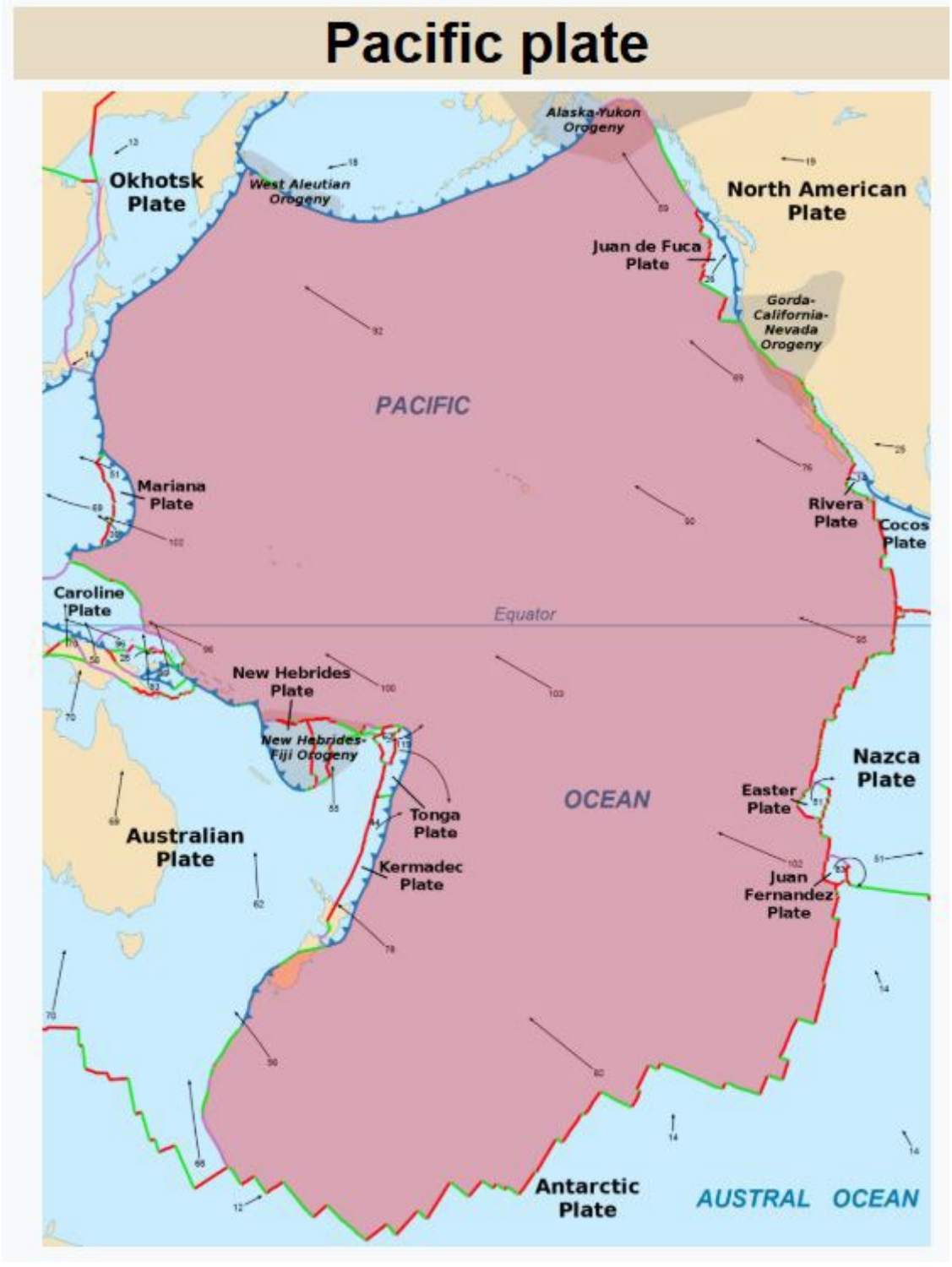
The north-going Pacific plate forms strike-slip transform faults like the San Andreas fault to also shoulder the North American plate northward. The North American plate extends above the Eurasian plate and then rotates in a slight Southeasterly or counterclockwise rotation. The Eurasian plate and North American plate mesh as a pair of gears.

Through all of these movements the major continental land masses are dragged and pushed into the Northern Hemisphere.

Combined with the counter-clockwise rotation of the planet, the Pacific plate is dragged from SE to NW and major continental land masses are pushed or dragged into the North Hemisphere. The Indian plate subducts beneath the Eurasian plate to form the Himalayas. Tidal Pumping explains how new crust is formed as the Earth is pulled apart in the SE Pacific.

There are deep flaws in the concepts of Mantle Convection, crustal recycling, "slab pulling", subduction extending several kilometers deep, and Continental Drift. Nothing drifted. God put the continents right where He wanted them, then placed Polaris and the Southern Cross into the night sky to allow man to find his way in the dark.

PACIFIC PLATE



GALAPAGOS TRIPLE JUNCTION (3-WAY DIVERGENT)

The Galápagos microplate is forming at the triple junction of the Nazca (shown in pink), Cocos, and Pacific plates

TONGA TRENCH (CONVERGENT), PACIFIC PLATE SUBDUCTS BENEATH AUSTRALIAN PLATE.
THE SOMOA HOT SPOT LIES AT THE NORTH RIM OF THE TONGA TRENCH

(3) EL NINO SOUTHERN OSCILLATION –

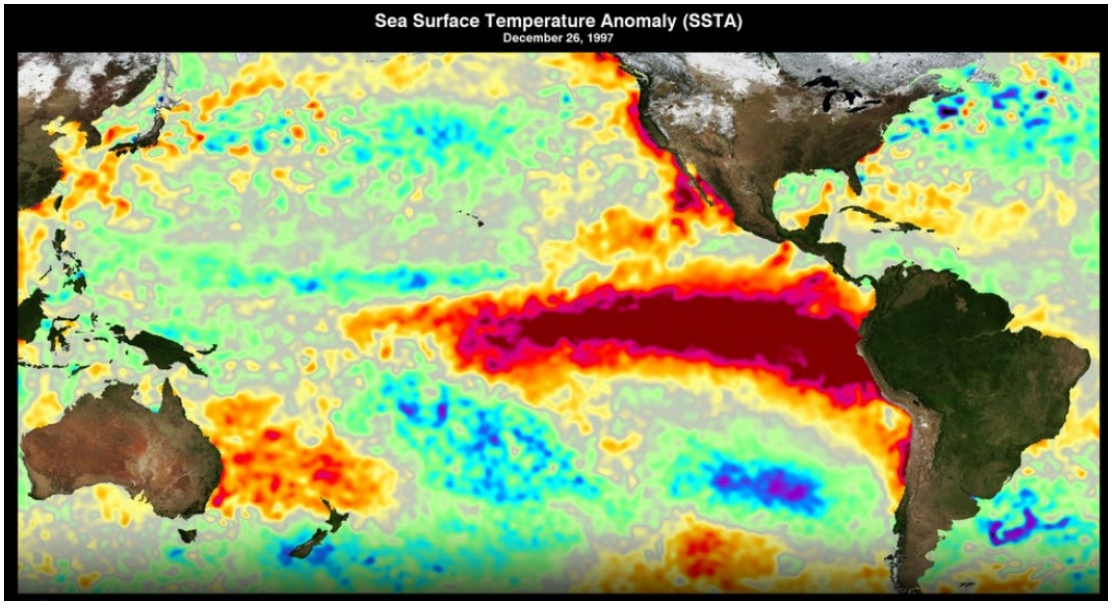
(3.1) El Nino –

The Galapagos Triple Junction is a 3-way divergent point where the East Pacific Rise, Cocos plate and Nazca plate are pulling apart. The Galapagos lie at 0.3° S. Latitude and 90 ° W. Longitude. This area is noted as the warmest waters of the El Nino phenomena, observed most prominently in the month of January. Spreading of the Peru/Chile Trench injects seismic heat and warms the waters along the Peruvian coast, also noted at the El Nino. As the crustal uplift initiates divergence of the Cocos/Nazca ridge, the warming spreads to the west, along the Equator. The South Pacific gyre carries the warm waters westward. An upward convection cell forms a low pressure center in the eastern Pacific, drawing moist air from the Amazon, over the Andes.

The warmest waters observed off the South American coast are centered on the Galapagos, beginning in January. The Peru/Chile Trench along Peru also warms noticeably. This warming has been noted as the start of the El Nino. Deep water anchovies disperse, to return in two prime seasons - May through June and again in November through December. A low pressure cell forms and the rainy season begins. January and February have the most intense rainfall, tapering through March and April. The Pacific low pressure initiates rain stretching back across the Andes (Sacred Valley, Cuzco, Peru) to the Amazon Basin. The Rio Solimoes has a khaki or tan color from silt washed down from the Andes.

Although solar irradiance is more or less uniformly distributed with low clouds providing albedo, seismic heat release is scattered across 40 or 50 global "hot spots". In rough order, the five (5) most pronounced hot spots rank as: 1) Hawaii 2) Iceland 3) **Galapagos** [0.3° S. Lat.] 4) Afar, Ethiopia [12° N. Lat.], 5) **Samoa**, north rim of **Tonga Trench** [14° S. Lat].

SEA SURFACE TEMPERATURES – EL NINO



(3.1) La Nina –

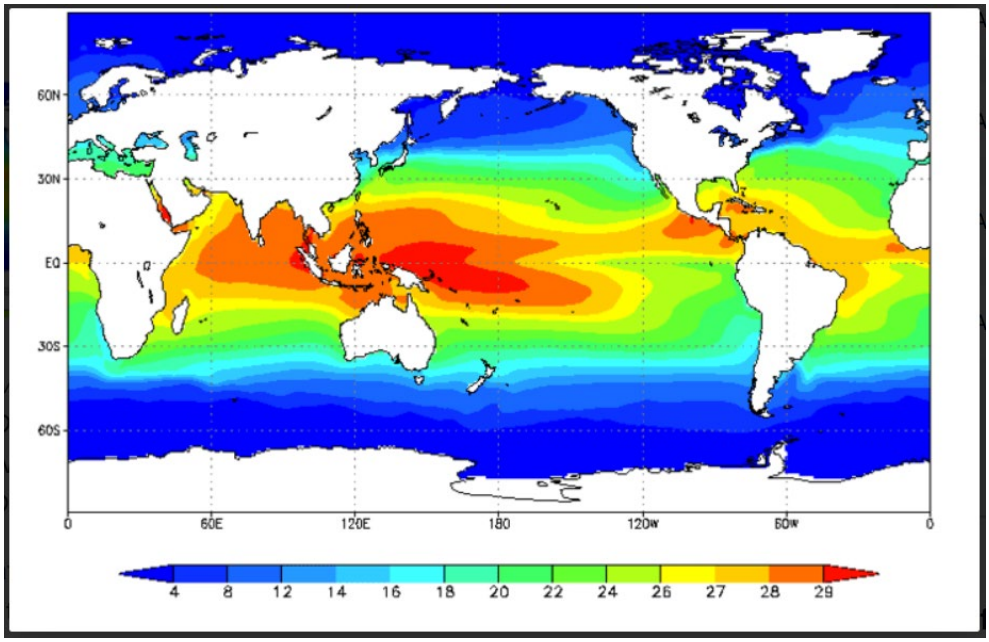
In the West, the Pacific plate subducts beneath the Australian plate at the Tonga Trench at 15 ° S. Lat. and 174 ° W Long.. A hot water plume effect stretches westward from Samoa and the Tonga Trench so the warmest surface temperatures of the La Nina are observed in Samoa, the Marianas Islands, waters east of Papua New Guinea, and the Solomon Islands, spanning 0 ° – 5 ° N. Lat. and 150 ° – 170 ° E. Long.

The most noteworthy recent observation of these conditions was the years of 2020 and 2021, with an extended La Nina. The elevated wind shear conditions from the sub-tropical jet stream (Pacific jet stream) during an El Nino suppress formation of Atlantic hurricanes. The opposite effect is observed during a La Nina. Thus, the entire alphabet of letters were used in names of Atlantic tropical storms for the years 2020 and 2021.

The La Nina is generally considered a “cooling phase” for the planet with increased monsoons in Southeast Asia but drought conditions for California. This was disrupted by the most powerful submarine volcano ever observed, with the eruption of the Tonga-Hunga volcano on January 15, 2022. This eruption spewed an estimated 145 million tons of water vapor into the stratosphere and raised the global humidity an estimated 5 to 10 %. In 2022, rains fell across North Africa, suppressing the dust that typically blows from North Africa to seed tropical storm formation in the Atlantic. Named Atlantic tropical storms fell to the typical average of fourteen (14). As a result of the steam injection by Tonga-Hunga, 2023 was deemed the “Hottest Year on Record.” Precipitation returned in 2024 with hurricane Helene and continued into 2025 with highly energetic cosmic ray energy input by the emergence of Solar Maximum # 25, resulting in polar ionospheric heating, polar vortex disruption and violent Rossby Waves, flash floods in the U.S. midlands during June/July, a high pressure “heat dome” during August/September, then a high pressure wave settled along the U.S. East Coast which blocked hurricane landfalls. Hurricanes Erin, Humberto, Imelda, and Melissa were turned out into the Atlantic. A record-setting “bomb cyclone” struck Nova Scotia, November 4 thru 5, 2025.

Some atmospheric scientists estimate that as much as 25 million tons of water vapor from Tonga-Hunga will still linger in our atmosphere into 2030.

SEA SURFACE TEMPERATURES – LA NINA



(4) STRENGTH OF MATERIALS –

The ocean floor is comprised of basaltic rock [(Mg, Fe) SiO2]. In a dense, unfractured condition, basalts have a tensile strength ranging from 1500 to 3600 psi. In a fractured condition, as is the case of stressed or seismically active regions, the tensile strength drops to less than 725 psi. The surface and volcanic regions of Jupiter's tidally pumped moons are also comprised of basalts. Enceladus and the tidally-pumped moons of Saturn have cryovolcanoes. The tensile strength of ice ranges from 150 to 1000 psi, in the same range as fractured basaltic rock.

(5) FAINT YOUNG SUN PARADOX

Well known in Evolution is the paradox that the earliest photosynthetic life, Cyanobacteria, emerged 3.5 billion years ago when the Sun was only 70% as luminous as today. Only allowing for solar radiation, the Earth should have been a frozen ball of ice, with no liquid water on the surface. The current radiogenic heat of the Earth is estimated at 21 to 23 TW. Extrapolating back in time, Earth's radiogenic heat stood at 50 to 55 TW. The Earth has 40 to 50 "hot spots" such as Hawaii, the Galapagos, and Samoa. Even with a mostly ice-covered planet, scattered "hot spots" certainly provided regions of liquid water, suitable to support the earliest photosynthetic life.

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