

The Electromagnetic Signatures Produced by Earthquakes

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Abstract—For centuries, there was no reliable way to know whether an earthquake was eminent, even though strange animal behavior and odd lights in the sky had been observed before earthquakes. It was noted that long range radio skip was interrupted before the 1960 Valdivia, Chile earthquake and the same interruption occurred before the 1964 Alaska earthquake. Scientists took notice, primarily outside of the seismology community, and began inquiring what mechanism could cause such an interruption. In the 1960s, it was already known that certain types of sunspot activity could cause the same type of radio skip alteration. It is now known there is a prodigious amount of electromagnetic activity proceeding and during an earthquake. It has been demonstrated in the laboratory that certain types of rock act like semiconductors when subjected to stress and produce an electric current that fluctuates. It is not known how many other earthquake related issues remain outside of our knowledge, especially the odd coincidence of human health problems just before and coincident to an earthquake.

I. Earthquakes

The actions that occur in an earthquake zone (EQZ) before an earthquake are very complicated, involving physical, electromagnetic (EM) and chemical processes. The EM processes are emphasized in this paper, but many of the other processes are covered in the references. This paper presents research that is contrary to what is being taught to the public in schools and by the mainstream media.

It is now known that various types of seismic EM signatures (SEMSIG) are produced in and above an earthquake zone before and during an earthquake. A dramatic increase in ground currents are produced before earthquakes, and the very low frequency fluctuation of these currents produce propagating EM waves that can be detected by ground and satellite instruments. The French DEMETER satellite measured earthquake precursor EM wave signatures from 2004 to 2010.[1-2] Satellites are providing extensive information on the Earth's EM characteristics that were not available to earlier scientists. For a couple decades, NASA and NOAA infrared (IR) satellites have observed thermal (TIR) signatures from EQZ before the actual earth movement and NASA radiation belt satellites have identified changes in electron flux.

Depending upon the magnitude of the pending earthquake, its SEMSIG can alter elements of the Earth's own EM signatures. The Earth's EM signatures are a result of the Earth's rotation and its magnetosphere interacting with the Sun's magnetosphere and various types of solar activity. Solar activity can alter the characteristics of the Earth's EM signature.

Telluric currents are one particular type of Earth EM signature and some of these currents are now man-made. To gain a perspective as to what scientists thought they knew about telluric currents and Earth conductivity can be reviewed in a National Academies Press publication "The Earth's Electrical Environment," chapter 16, "The Telluric Currents: The Natural Environment and Interactions with Man-made Systems".[3] All of the references cited in ref.(3) are before 1985; the term semiconductor was not used in the text. A summation of what was known about Earth electricity up to 2014 is contained in an article titled, "Earth electricity: a review of mechanisms which cause telluric currents in the lithosphere."[4] Thirty-two specific mechanisms are identified in ref.(4), and some of these mechanisms can be altered by SEMSIG. It is significant to note that telluric currents have fluctuations that are below 1 Hz. Telluric currents are not known to produce localized high electric potentials between the Earth's surface and the atmosphere.

All of the conclusions made about Earth conductivity have to be reconsidered because of the discovery, by Dr. Friedemann Freund, that certain types of rocks function like semiconductors when under stress.[5-8] The seismic electrical currents produced are unipolar, a positive polarity, and the currents vary at a very low frequency, primarily less than 1 Hz. The most current description of p-hole action and why the currents fluctuate are contained in a 2015 article titled, "Pre-earthquake magnetic pulses."[9]

Another discovery reported in 2010 is titled, "Certain doped-oxide ceramics resist Ohm's Law." [10] "Applying or removing a voltage caused a gradual change in the materials's electrical resistance. The new effect was seen consistently regardless of the temperature or whether the experiments were conducted in vacuum, air, or in an oxygen atmosphere. ... West's proposed mechanism for the non-Ohm behavior is also unconventional: the ionization of only one of the two extra electrons from oxygen atoms that are attached to dopant atoms. This process leaves behind a positively charged "hole" that can move fairly readily in what is called a hole current." The material was subjected to heat but not pressure or tension. Who would have thought that a material that is a very good electrical insulator would alter its resistance characteristics just by applying and removing a voltage? What we know about various materials will change as they are subjected to more test conditions.

II. Earthquake Phenomena

There are various phenomena associated with earthquakes that had not been properly identified. Some of these can be explained now that we know p-hole currents create a localized high positive electric potential between the Earth's surface and the atmosphere, and these currents produce propagating EM fields. The Earth already has an average 100 volts per meter potential at the surface due to normal atmospheric conditions, and this can jump to 10,000 volts with an overhead cumulonimbus cloud. Field mills are used to measure this potential.

A given Earth surface area will be in potential balance unless some influence creates an imbalance. The p-hole action described in ref. (8) can result in rapidly changing ground to air potential differences in surface areas of an EQZ, which can encompass hundreds of square kilometers, and these variations will have an associated pulsating current. When the currents and surface potentials are high enough, there will be a variety of effects, including visuals, that will cause human and animal responses. The p-hole action in the EQZ causes surface moisture to be converted to higher levels of hydrogen peroxide. There is evidence that some of the SEMSIG are affecting human health in a very serious manner before the earth movement actually occurs.

A. Animal Behavior

For centuries, unusual animal and invertebrate activity has been reported before an earthquake. The usual explanation for this is that the biological entities are detecting vibrations in the ground that instrument were not detecting or there was an inherited reaction response. No one considered that high ground to air electric potentials or varying currents in the ground or the magnetic fields produced by these currents or chemical changes could be the cause for the reactions.

One of the better animal behavior studies, before p-hole current activity was known, is titled, "Earthquake Prediction by Animals: Evolution and Sensory Perception." [11] The article actually suggested that there could be an electrical and magnetic link that is causing animal responses. The article provided some recommendations in its Discussion section, one being, "Finally, seismologists should not limit their recording and monitoring efforts solely to ground motions, which has historically been the case." A paper titled, "Nature of Pre-Earthquake Phenomena and their Effects on Living Organisms" brings together multiple earlier papers. [12]

What was not covered in any of the preceding earthquake and animals reports is that animals have vision in some part of the ultra-violet (UV) spectrum, and it has been observed that some animals react very adversely to UV corona discharges. [13-14] A corona discharge will be visible in the UV spectrum before it becomes strong enough to be seen within our visual range. Earthquake lights (EQL) are a visible corona discharge associated with large magnitude earthquakes. [15] We will not know if earthquakes of other sizes produce corona discharges in the UV spectrum until instruments are deployed to monitor for this phenomenon in an EQZ. EQL can occur well removed from the earthquake epicenter.

Solar-blind UV detectors are available that allow viewing and recording UV coronas that can not be seen in the daytime.

The spreading p-hole charges create EM phenomena as well as chemical changes in sub-surface and surface water.[16] The chemistry changes alone are responsible for a variety of animal and aquatic creature responses. It is known that electrical currents can cause worms to exit the ground, and worms do not like hydrogen peroxide.[17] The fact that earthworms avoid hydrogen peroxide now raises the question as to why they exit the ground before an earthquake and during thunderstorms when there are large moving ground potentials; these moving ground potentials will appear as a current to an earthworm. Do the worms exit the ground because of the electric currents or their avoidance of hydrogen peroxide?

When you have the current knowledge about SEMSIG and the associated ground, air and water chemistry changes, you can understand how earlier studies on determining why animals respond in various ways to earthquakes were hampered by *incomplete information*.

B. Human Behavior

Human mental health reactions to earthquakes, other than to the motion and destruction, has been raised as an issue by Chinese studies. The Chinese studied a set of individuals within 25 days of the 2008 Wenchuan 8.0 magnitude earthquake and again two years later.[18-19] The titles of the two reports are revealing. The first report is titled, "High-field MRI reveals an acute impact on brain function in survivors of the magnitude 8.0 earthquake in China." The second report is titled, "Altered functional connectivity in the brain default-mode network of earthquake survivors persists after 2 years despite recovery from anxiety symptoms." None of the studied subjects had suffered outward physical injuries during the earthquake. The cognitive issues are described using the terms *acute distress disorders* and *post-traumatic stress disorder* (PTSD)

A 2013 publication titled, "A study of correlation between seismicity and mental health:Crete, 2008–2010," revealed human reactions to relatively low magnitude earthquakes.[20] The study took particular notice of the effect EM fields (EMF) have on mental health and the central nervous system. A Russian researcher, Alexander Shitov, presented the results of a study that identified multiple earthquake related processes, other than outward physical injuries, that had negative impact on human health.[21]

Until EQZ are better instrumented, it will not be known if there are EM *hot-spots* within the zone that produce extremely intense EMF emissions. The most efficient transfer of EMF energy to a biological structure is when there is a close correlation between the size of the biological conducting structure and the wavelength of the EM emission.

It is known that an external magnetic stimulus can alter a persons cognitive functions.[22] Although the study identified the pulse rate and maximum Tesla level applied to the cranial area, it did not identify the rise-time of the pulse, nor did the instruction manual. The magnetic stimulator devices produce a positive unipolar pulse. The ref. (22) study never considered that the magnetic pulses could be creating Lorentz currents within the conducting structures of the brain, and that these currents could be disrupting ion movements within an axon structure. Sufficiently high currents can overheat the fluids in the axon structure.

At the time the physical movements of the earthquake are occurring, all of the potential differences created by p-hole action will be come to a climatic end, and this could create high-rise time EM pulses (EMP). It is probable that the EMP is a series of pulses along the fault line. Perhaps in the future, when the Chinese study subjects die, they could determine if there was *honeycomb* type axon damage like that identified in a John Hopkins School of Medicine pathologist's study.[23] The report stated the damage was unlike that of a concussion and the report never speculated as to what caused the *honeycomb* type damage. My personal theory as to what caused the axon damage is contained in a 2015

report.[24] Until EQZ are properly instrumented, it will not be known if the SEMSIG contains high intensity EMPs. Artificially produced EM emissions could mask emissions produced by an EQZ.

III. Cause of Earthquakes

The textbooks describe plate action and the various mechanism that produce plate movement. The Earth's EM environment, its magnetic field and interaction with the Sun's magnetic field, never come into an earthquake cause explanation. A study by Austrian geophysicists suggest a direct link between the processes that produce telluric currents and earthquakes.[25] When viewing diagrams of telluric currents on a world-wide view, it is remarkable that these currents are not described as being the result of Lorentz forces; the ref.(25) report is an exception. That report stated, "And if we consider just a part of the entire current ring, e.g. a section of 200 x 200 km on the Earth's surface (assumed size of any earthquake zone), we end up with an energy of a $M = 3,8$ earthquake for this area, which is the maximum possible torque in the seismic region (at point P) during the time of day, about at noon, when current I flows at right angles to H. However, the interference with tectonic activity depends on the specific orientation of the stress field in each earthquake zone."

IV. Associated Earthquake Phenomena

There is a tremendous amount of information available from satellites that has just begun to be examined relative to earthquakes. It is not difficult to find satellite research that identifies changes in measured characteristics high above the atmosphere that are correlatable to earthquake precursors.

Even Schumann resonances are altered. The consensus that lightning strikes are the only energy source for Schumann resonances can now be challenged because it is known that the Earth's SEMSIG produces EM waves that are below and encompass the Schumann frequencies. Perhaps Schumann resonances obtain energy from both lightning and earthquake activity. Earthquake precursor EM waves are present 24/7.

Since p-hole out-flow creates a large positive ground to atmosphere potential in an EQZ, any existing thunderstorm activity would tend to produce more lightning strikes. This concept was presented by Russian researchers in a study titled, "Explanation of Lithosphere-Atmosphere-Ionosphere Coupling System Anomalous Geophysical Phenomena on the Basis of the Model of Generation of Electromagnetic Emissions Detected Before Earthquake." [26] Although the enhanced lightning strikes appears to be a logical conclusion, it could be difficult to quantify the amount of increased lightning activity over *normal* activity.

Thermal infra-red (TIR) anomalies have been observed before earthquakes by various satellites for more than two decades. It has taken a number of years to develop the Robust Satellite Technique (RST) that positively associates the observed TIR anomalies to the EQZ.[27] There still are considerable unknowns about the pre-earthquake TIR anomalies. It appears that the TIR signature is not from ground heating as it appears and disappears rapidly, which would not happen if the TIR was from a thermal mass. However, one might expect some ground heating from the massive p-hole current flow, but research in this area is inconsistent because of the variability in the precision of ground temperature measurements, some shallow, some deep, and many cases have limited measurement locations. Oddly, some measurements show a decrease in temperature in deeper sub-surface measurements away from the epicenter, which raises the question, "Do p-hole electrical current processes replicate a Peltier effect?" [28]

There are a lot of unanswered questions about the appearance of TIR anomalies in bodies of water.[29] Figure 1 in ref. (2) displays a TIR anomaly 18 days and then 1 day before the actual earthquake. No TIR anomaly was seen at the epicenter, which was in deeper water. Cloud cover can shield a TIR anomaly from satellite detection.

V. Discussion

The various medical studies suggests that humans can experience maladies when exposed to the EM emissions produced in an earthquake zone. When researching material for ref. (24), it became apparent that the neurological effect various types of EM emissions have on the human body needs extensive additional study. Until the full EM spectrum produced by earthquake activity is properly instrumented, it will be difficult to identify the EM spectrum and intensity that is causing the human problems.

Whenever we are exposed to an EM emission, we are subject to the electric field and the magnetic field. It is important to know how specific biological structures react to intensity and frequency and whether it is the electric or magnetic field that is producing a reaction.

For centuries, EM processes and their associated forces were never considered a part of earthquake processes. The scientific community now recognizes that earthquakes are producing SEMSIG and these can be detected directly or indirectly. At present, the most reliable element of the SEMSIG are the EM waves produced by p-hole action, as these waves can be detected by ground or satellite instruments regardless of cloud cover. It is patently obvious that a suite of instrument types are needed to reliably detect the presence of an impending earthquake. Relying on seismic instruments alone will not give adequate warning. The size of a pending earthquake that can be detected will depend upon instrument sensitivity.

Every seismologist should be asked, “Are there any instrument detectable indicators that an earthquake is about to occur before the earth actually moves?”

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