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EARTHQUAKE PREDICTION USING SHORT RADIOWAVE TECHNOLOGY

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Abstract

An earthquake prediction must define 3 elements: 1) the date and time, 2) the location, and 3) the magnitude. Yes, some people say they can predict earthquakes, but here are the reasons why their statements are false: They are not based on scientific evidence, and earthquakes are part of a scientific process. Earthquake prediction is a branch of the science of seismology concerned with the specification of the time, location, and magnitude of future earthquakes within stated limits, and particularly "the determination of parameters for the next strong earthquake to occur in a region". An earthquake is the shifting of the Earth's plates, which results in a sudden shaking of the ground that can last for a few seconds to a few minutes. Within seconds, mild initial shaking can strengthen and become violent. Earthquakes happen without warning and can happen at any time of year.

Keywords: *Earthquake, Radio wave, microwave, X-ray, visible light, Transmitter, Receiver, Electromagnetic Field*

Introduction

They are both signs of seismic movement within the earth. The difference is the intensity of the movement. Earthquakes are more intense than earth tremors. When a tremor exceeds five on the moment magnitude scale — a scale between 0 to 10 — then. There are four different types of earthquakes: tectonic, volcanic, collapse and explosion. The magnitude scale is logarithmic. This means that, at the same distance, an earthquake of magnitude 6 produces vibrations with amplitudes 10 times greater than those from a magnitude 5 earthquake and 100 times greater than those from a magnitude 4 earthquake. A few people may get unlucky and have objects fall on them, but modern well-built buildings should have no difficulty riding out magnitude 6 quakes. In areas that build using load-bearing masonry or use a lot of masonry cladding, a magnitude 6 quake is enough to cause significant damage and may cause some deaths. Megathrust earthquakes occur at covergent plate boundaries, where one tectonic plate is forced underneath another. The earthquakes are caused by slip along the thrust fault that forms the contact between the two plates. These interplate earthquakes are the planet's most powerful, with moment magnitudes (M_w) that can exceed 9.0. Since 1900, all earthquakes of magnitude 9.0 or greater have been megathrust earthquakes. The thrust faults responsible for megathrust earthquakes often lie at the bottom of oceanic trenches; in such cases, the earthquakes can abruptly displace the sea floor over a large area. As a result, megathrust earthquakes often generate tsunamis that are considerably more destructive than the earthquakes themselves. Teletsunamis can cross ocean basins to devastate areas far from the original earthquake.

Figure 1. Terminology and mechanism

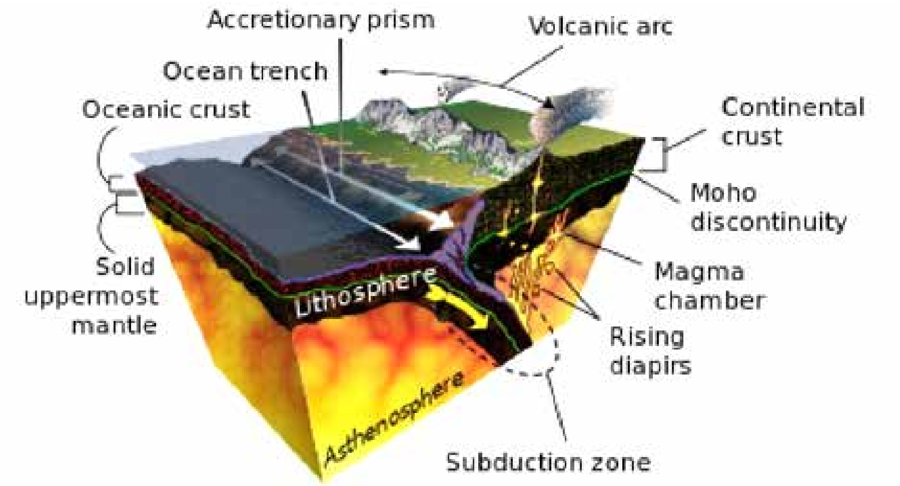
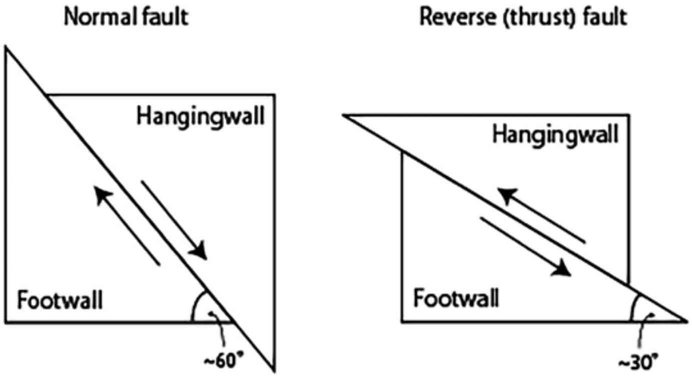


Diagram of a subduction zone. The megathrust fault lies on the top of the subducting slab where it is in contact with the overriding plate. The term *megathrust* refers to an extremely large thrust fault, typically formed at the plate interface along a subduction zone, such as the Sunda megathrust However, the term is also occasionally applied to large thrust faults in continental collision zones, such as the Himalayan megathrust. A megathrust fault can be 1.000 kilometers (600 mi) long.

Figure 2. Cross-sectional illustration of normal and reverse faults



A thrust fault is a type of reverse fault, in which the rock above the fault is displaced upwards relative to the rock below the fault. This distinguishes reverse faults from normal faults, where the rock above the fault is displaced downwards, or strike-slip faults, where the rock on one side of the fault is displaced horizontally with respect to the other side. Thrust faults are distinguished from other reverse faults because they dip at a relatively shallow angle, typically less than 45°, and show large displacements. In effect, the rocks above the fault have been thrust over the rocks below the fault. Thrust faults are characteristic of areas where the Earth's crust is being compressed by tectonic forces. Megathrust faults occur where two tectonic plates collide. When one of the plates is composed of oceanic lithosphere, it dives beneath the other plate (called the *overriding plate*) and sinks into the Earth's mantle as a *slab*. The contact between the colliding plates is the megathrust fault, where the rock of the overriding plate is displaced upwards relative to the rock of the descending slab. Friction along the megathrust fault can lock the plates together, and the subduction forces then build up strain in the two plates. A megathrust earthquake takes place when the fault ruptures, allowing the plates to abruptly move past each other to release the accumulated strain energy.

Occurrence and characteristics

Megathrust earthquakes are almost exclusive to tectonic subduction zones and are often associated with the Pacific and Indian Oceans. These subduction zones are not only responsible for megathrust earthquakes but are also largely responsible for the volcanic activity associated with the Pacific Ring of Fire. Since the earthquakes associated with these subduction zones deform the ocean floor, they often generate a significant series of tsunami waves. Subduction zone earthquakes are also known to produce intense shaking and ground movements for significant periods of time that can last for up to 3–5 minutes. In the Indian Ocean region, the Sunda megathrust is located where the Indo-Australian Plate is subducting under the Eurasian Plate and extends 5.500 kilometres (3.400 mi) off the coasts of Myanmar, Sumatra, Java and Bali before terminating off the northwestern coast of Australia. This subduction zone was responsible for the 2004 Indian Ocean earthquake and tsunami. In Japan, the Nankai megathrust under the Nankai Trough is responsible for Nankai megathrust earthquakes and associated tsunamis. In North America, the Juan de Fuca Plate is subducting under the North American Plate creating the Cascadia subduction zone which stretches from mid Vancouver Island, British Columbia to Northern California. This subduction zone was responsible for the 1700 Cascadia earthquake. The Aleutian Trench, of the southern coast of Alaska, and the Aleutian Islands, where the North American Plate overrides the Pacific Plate, has generated many major earthquakes throughout history, several of which generated Pacific-wide tsunamis, including the 1964 Alaska earthquake; at magnitude 9.2, it remains the largest recorded earthquake in North America, and the second-largest earthquake instrumentally recorded in the world. The largest recorded megathrust earthquake was the 1960 Valdivia earthquake, estimated magnitude 9.5, centered off the coast of Chile along the Peru-Chile trench, where the Nazca Plate is subducting under the South American Plate. This megathrust region has regularly generated extremely large earthquakes. The largest megathrust event within the last 20 years was the magnitude 9.1 Tōhoku earthquake.]The largest possible earthquake that is estimated to occur is a magnitude 10, with some scientists even estimating that a magnitude 11 earthquake could occur, though extremely rare. Where they would take place is most likely to be a combined rupture of the Japan Trench and Kuril-Kamchatka Trench A study reported in 2016 found that the largest megathrust quakes are associated with downgoing slabs with the shallowest dip, so-called flat slab subduction. Compared with other earthquakes of similar magnitude, megathrust earthquakes have a longer duration and slower rupture velocities. The largest megathrust earthquakes occur in subduction zones with thick sediments, which may allow a fault rupture to propagate for great distances unimpeded.

Prior to large earthquakes the Earth sends out transient signals, sometimes strong, more often subtle and fleeting. These signals may consist of local magnetic field variations, electromagnetic emissions over a wide range of frequencies, a variety of atmospheric and ionospheric phenomena.

What happens to the Earth before an earthquake? Before an earthquake, the buildup of stress in the rocks on either side of a fault results in gradual deformation. Eventually, this deformation exceeds the frictional force holding the rocks together and sudden slip occurs along the fault. The tectonic plates are always slowly moving, but they get stuck at their edges due to friction. When the stress on the edge overcomes the friction, there is an earthquake that releases energy in waves that travel through the earth's crust and cause the shaking that we feel.According to the US Geological Survey, computer models by Richard Gross (Jet Propulsion Laboratory) indicate that the quake shifted the continental plates enough to speed up the planet's spin (through the conservation of angular momentum) by some 0.0000027 second per day.

Perhaps no seismic subject is as irksome to seismologists as discussions of earthquake size. There often seems to be no end of confusion, misunderstanding, and over-interpretation of what are really prettycrude metrics. And when news announcers mention the "Richter Scale" seismologists the world over begin gnashing their teeth.

Magnitude

A familiar analogy to help understand earthquake size metrics is to think about a light bulb. One measure of the strength of a light bulb is how much energy it uses. A 100-watt bulb is brighter than a 50-watt bulb, but not nearly as bright as a 250-watt bulb. The wattage of a bulb tells you about the strength of the light source. In the same way, an earthquake's *magnitude* is an objective measurement of the energy radiated by an earthquake. However, earthquake magnitude has no physical units, nor a meaningful 0. This is because we can't easily measure the energy the way we can with an electric circuit, so seismologists commonly use a relative measure. It is easier to choose a particular earthquake recorded at a particular distance as a "standard" earthquake and call it a magnitude 1. An earthquake that causes ground motion at a seismic station (when corrected for distance) 10 times larger than the reference earthquake is M2. An earthquake causing motion at that distance 10 times larger than an M2 is an M3, and so on. To achieve this ten fold increase in ground motion requires about 32 to 33 times the energy. When referring to the power or energy released in an earthquake this 32 multiplier is used. An earthquake that releases about 33 times less energy and causes motion 10 times smaller than an M1 is an M0–and magnitudes can even go negative.

Intensity

Earthquake *intensity* measures how strongly the earthquake impacts a specific location. In the light bulb analogy, it is the brightness with which you perceive the light at a place in a room. Can you read a fine-print book by the lamp? Pick up a needle? Perform delicate surgery? Depends on the wattage of the bulb, and how far you are from it, right? If you mapped out the brightness in terms of what you could accomplish at the light level in a room, you'd have an intensity map.

Well, you can make a map of earthquake impacts using the Modified Mercalli Intensity Scale (MMI), which derived from an earlier ten-degree Rossi-Forel scale, later revised by Italian vulcanologist Giuseppe Mercalli in 1884 and 1906 to quantify (somewhat) the earthquake's effects. Further refinements for more modern construction were published in 1931 by the American seismologists Harry Wood and Frank Neumann. Measurements of intensity using the Modified Mercalli scale, are composed of 12 increasing levels that range from imperceptible shaking to catastrophic destruction, usually designated by Roman numerals, which stresses their semi-quantitative nature. Whereas an earthquake will have one magnitude (well, as noted below, there are likely to be several different estimates of the magnitude of an earthquake depending on the type of estimate etc.), for each individual earthquake there will be a range of intensities depending in part on the magnitude of the source, but also the location of the site at which the intensity was observed.

More about Magnitudes – The 3 Approaches

If you've had some time to think a bit about the Earthquake/Light bulb analogy you probably have come up with some questions, like: But some bulbs are blue and some white and some yellow, what gives with that? And, fluorescent fixtures put out really different quality light than incandescents, and are brighter for the same wattage, eh? And, what about a flash bulb from my camera which is incredibly bright...but just for a fraction of second? And, if my room is filled with steam or smoke, is the intensity still the same? These are all good points; it turns out that similarly for earthquakes the complexities and variability of earthquake rupture processes and of seismic waves as they travel through Earth (and evolving seismometer design and sensitivities) there are different methods for measuring the magnitude of an earthquake. These may return a slightly different number when used to estimate the energy released in an earthquake. In overview, there are three approaches to using seismograph recordings to quantify earthquake sizes, with numerous flavors of each. One approach is to use some measure of peak amplitudes recorded on seismograms. A second is to use the duration of shaking recorded. A third is to try to match the actual waveform wiggle-for-wiggle with a mathematical model (a "synthetic seismogram"), and report the size of the modeled earthquake.

Amplitude based Magnitudes (Local, Body Wave, Surface Wave)

The oldest and most famous magnitude measurement method, the *Local Magnitude* (it used to be referred to as the Richter magnitude), was developed by Dr. Charles Richter and Beno Gutenberg of Cal Tech in 1935. Written as M_L, it remains the go-to method for measuring small- to medium-sized earthquakes within 600 km from the recording seismograph. Richter used seismograms recorded on a particular instrument, the Wood-Anderson torsion seismograph. Today, we use more modern instruments and account for their response to mimic what the historical Wood-Anderson seismograph would have produced. Richter's motivation for creating the local magnitude scale was to measure the ratio of small- to medium-sized earthquakes. It was never intended to measure large or distant earthquakes. All amplitude-based magnitudes rely on a base-10 logarithm of the peak amplitude measured by a seismograph. This is because there are many factors of 10 difference between the smallest and largest amplitudes of observed ground motions. An earthquake that measures 5.0 on the Richter scale has a shaking amplitude 10 times larger and corresponds to an energy release of 31.6 times greater than one that measures 4.0.

Body wave magnitude is a similar concept, but applied usually to teleseisms – earthquakes more than 3000 km from the recording station – and good for deep and shallow earthquakes.

Surface wave magnitudes measure the surface waves that are generated by large regional to teleseismic earthquakes, and that travel long distances without losing much energy from absorption.

In general local magnitudes "saturate" (lose resolution) for earthquakes exceeding M5.8 or so, body waves stay on scale to somewhat larger magnitudes, while surface wave magnitudes saturates at about M8 or so. This is in general because of the frequencies of the seismic waves that each use. The higher-frequency methods (local, duration) can't see the difference between larger earthquakes, while the low frequency measures (surface waves, moment magnitude) characterize the long-wavelength energy that radiates from a bigger rupture surface.

Duration Magnitudes (coda magnitude)

Another estimate of magnitudes is particularly useful when recordings "clip" and you can't measure the peak amplitude. This is called the coda magnitude, or duration magnitude, and is derived from the observation that the ratio of peak amplitude to the duration of shaking from an earthquake are related. PNSN often calculates the size of PNW earthquakes using the durations averaged from a number of seismograms to obtain "Md" estimates. In the past a seismic analyst picked the duration on each seismogram by eye independently, which was somewhat subjective and variable, as the background noise varies greatly. The modern method, made possible by faster computers, is to model the decaying amplitude of the seismogram in order to automatically and objectively define a duration.

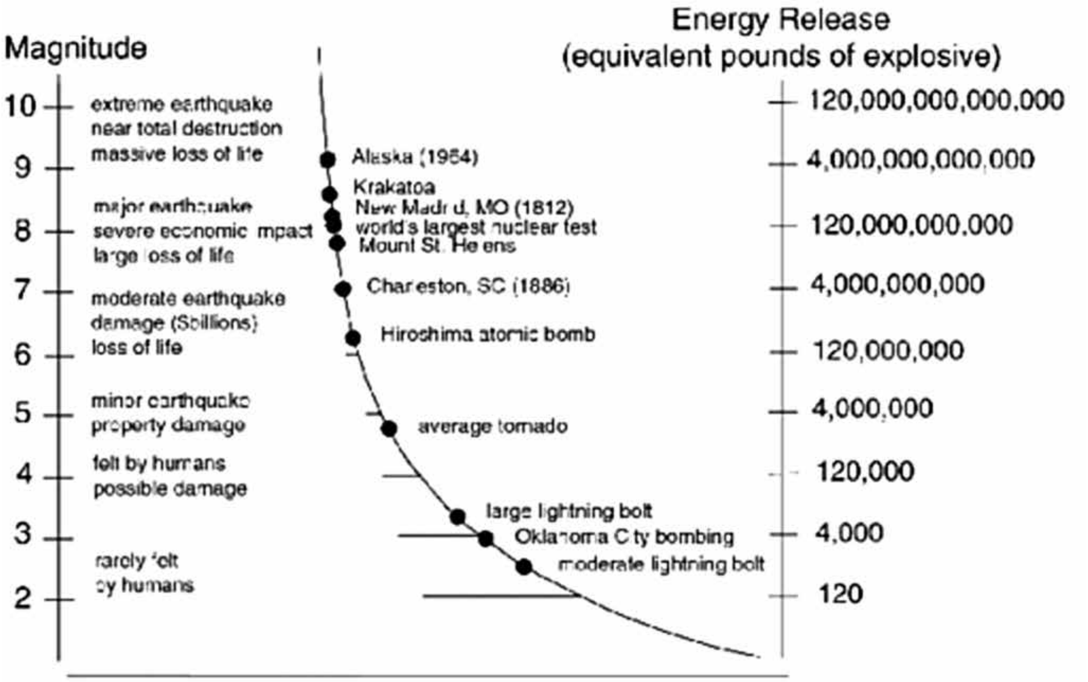
Waveform Modeling (moment magnitude)

Modern digital seismic instrumentation, modern seismic theory, and most of all modern high-speed computers have permitted us to be able to model seismograms wiggle-for-wiggle. To do this, we use a standard model of the Earth and of the source to generate synthetic seismograms, and the computer adjusts the location, size, and orientation of the rupture to match the observed waveforms. The magnitude that is derived from waveform modeling is called the *Mo-*

ment magnitude, and it is in some ways the most precise estimate of earthquake size – and the only one applicable to great earthquakes M>8. Of great interest is that since we can observe the deformation of the Earth from such big earthquake ruptures, we have an independent estimate of the energy they released, so that we can (finally!) relate the magnitude to the energy released during rupture.It is worthwhile to note that all of these approaches have been calibrated and defined with respect to each other such that they all agree, on average, in the ranges in which they overlap. So for general purposes an M8 is an M8 is an M8, regardless of the method that generated it. But also it is interesting that Richter's original local magnitude was the one that all the other techniques generally matched up with (since it was first) so, in a sense, the "Richter Scale" that news reporters often cite (to the chagrin of us seismologists) is really a pretty apt homage.

Below is a representation, from the Geological Society of America, of earthquake magnitudes and the equivalent energy release. (For the life of us, we don't know why the geologists used pounds of explosive as a proxy for energy instead of a real physical unit of energy, such as Joules! But the figure makes the point, anyway.)

Figure 3. Richter Scale



Magnitude and Energy

Notice the relationship is not linear? The change in the amount of energy released from one magnitude to the next is greater as the earthquake magnitude increases. For example, the difference in amount of energy released from a magnitude 5 to a magnitude 10 is not double, it is 30 million times as much!

Need some further practice relating Earthquake Magnitude to Energy? No problem, the USGS calculates the difference between a 5.8 and 8.7 earthquake and has a calculator where you can input your own numbers to see how much bigger an earthquake can get with different magnitudes.

Magnitude Vs. Intensity

The chart below claims to compare Richter Scale magnitudes with intensities in a very generalized way – as if a "Richter magnitude" was somehow measuring the same thing as a "Mercalli intensity". Now that you know the basics of earthquake Magnitudes and earthquake Intensities, you know that this chart makes no sense. If you see it or a similar representation, you can be assured the provider of the information is unencumbered by knowledge of the basics.

Figure 4. Mercalli vs Richter Scale (2)

Richter	Mercalli	Earthquake Effects
2	I	**Instrumental.** Not felt except by a very few under especially favourable conditions detected mostly by Seismography.
	II	**Feeble.** Felt only by a few persons at rest, especially on upper floors of buildings.
3	III	**Slight.** Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck.
	IV	**Moderate.** Felt indoors by many, outdoors by few during the day. At night, some awakening. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing motor cars rock noticeably.
4	V	**Rather Strong.** Felt by nearly everyone; many awakened. Some dishes, windows broken. Un-stable objects overturned. Pendulum clocks may stop.
5	VI	**Strong.** Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
	VII	**Very Strong.** Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in ordinary structures; considerable damage in poorly built or badly designed structures.
6	VIII	**Destructive.** Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of factory stacks, columns, monuments, walls. Heavy furniture overturned.
7	IX	**Ruinous.** Damage considerable in specially designed structures; well designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
	X	**Disastrous.** Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bend greatly.
8	XI	**Very Disastrous.** Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bend greatly.
	XII	**Catastrophic.** Damage total. Lines of sight and level are distorted. Objects thrown into the air.

One Final Word – a Plea for Understanding

Now that you know how many different approaches there are to measuring an earthquake, and how it depends on the traces that you use, and instrument types that you have available and how far they are from the earthquake, and how many there are…

Perhaps you'll understand why our magnitude estimates change with time immediately after an earthquake as we try to be both as fast and as accurate as possible. And why different organizations will post somewhat different magnitudes for the same earthquake.

A rule of thumb, perhaps, is that in the early minutes (or tens of minutes) after an earthquake up to a half a magnitude unit of difference between estimates will generally be shrugged off by seismologists as reason-able scatter. But differences larger than that usually mean that there was a fairly serious problem...like the entirely wrong technique was used, or critical data were omitted.

Is there a magnetic field before an earthquake?

Electromagnetic variations have been observed after earthquakes, but despite decades of work, there is no convincing evidence of electromagnetic precursors to earthquakes.

What are the electromagnetic fields of earthquakes?

Seismo-electromagnetics are various electro-magnetic phenomena believed to be generated by tectonic forces acting on the Earth's crust, and possibly associated with seismic activity such as earthquakes and volcanoes.

How does electromagnetic energy change?

ELECTROMAGNETIC WAVES

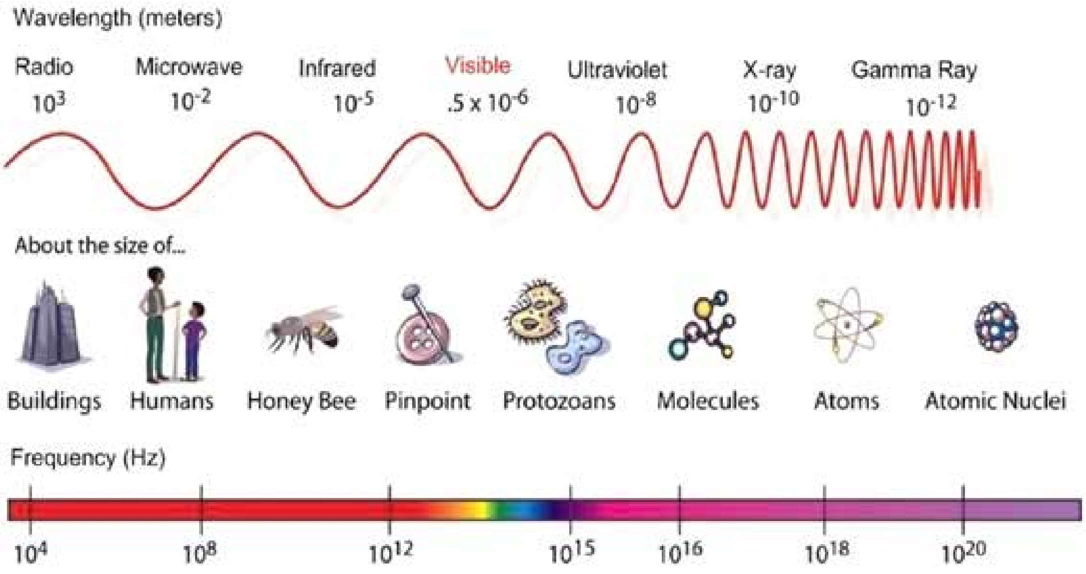
A changing magnetic field will induce a changing electric field and vice-versa – the two are linked. These changing fields form electromagnetic waves. Electromagnetic waves differ from mechanical waves in that they do not require a medium to propagate.

What causes electromagnetic fields?

They are generated by natural phenomena like the Earth's magnetic field but also by human activities, mainly through the use of electricity. Mobile phones, power lines and computer screens are examples of equipment that generates electromagnetic fields.

What are the 7 types of electromagnetic waves?

Figure 5.



There are seven types of electromagnetic waves: radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays.

Chapter 2. Electromagnetic Fields Generated by Earthquakes

Introduction

Independent knowledge of the physical processes that occur with seismic events can be obtained from observations of electric and magnetic fields generated by these complex processes. During the past few decades, we have seen a remarkable increase in the quality and quantity of electromagnetic (EM) data recorded before and during earthquakes and volcanic eruptions. This paper describes the most significant recent data and the implications these data have for different generating mechanisms. We note that, despite several decades of relatively high quality monitoring, clear demonstration of the existence of precursory EM signals has not been achieved, although causal relations between coseismic magnetic field changes and earthquake stress drops are no longer in question. This paper extends discussions of tectonomagnetism and tectonoelectricity, over the various parts of the electromagnetic spectrum from radio frequencies (RF) to submicrohertz frequencies.

Statement of the Problem

This chapter reviews recent results of magnetic, electric, and electromagnetic disturbances apparently associated with earthquakes and discusses the physical mechanisms likely to have produced them. Although some observations are larger than expected, the best field observations are generally in agreement with calculations. Some observations are suggested as precursors yet have no corresponding co-event signals and some have co-event signals yet no precursory signals.

Summary of Physical Mechanisms Involved

The loading and rupture of water-saturated crustal rocks during earthquakes, together with fluid/gas movement, stress redistribution, and change in material properties, has long been expected to generate associated magnetic and electric field perturbations. The detection of related perturbations prior to fault rupture has thus been proposed frequently as a simple and inexpensive method to monitor the state of crustal stress and perhaps to provide tools for predicting crustal failure.

Basic Measurement Limitations

The precision of local magnetic and electric field measurements on active faults varies as a function of frequency, spatial scale, instrument type, and site location. Most measurement systems on the Earth's surface are limited more by noise generated by ionosphere, magnetosphere, and by cultural noise than by instrumental noise. Thus, systems for quantifying these noise sources are of crucial importance if changes in electromagnetic fields are to be uniquely identified.

Recent Results

Although both electric and magnetic fields are expected to accompany dynamic physical processes in the Earth's crust, simultaneous measurements of both fields are not routinely made. I will therefore discuss separately, electric fields, magnetic fields, and electromagnetic fields during and preceding earthquakes. Magnetic and electric fields generated by earthquakes are termed "seismomagnetic (SM)" and "seismoelectric (SE)" effects. Those preceding earthquakes, or occurring at other times, are and now How can we predict the earthquake.

Can we feel Earth's magnetic field?

A new study hints that humans have magnetoreception abilities, similar to some other animals. ANIMAL MAGNETISM Like birds, bacteria and other creatures with an ability known as magnetoreception, humans can sense Earth's magnetic field (illustrated), a new study suggests.

When did Earth have a magnetic field?

Earliest appearance. Paleomagnetic studies of Paleoarchean lava in Australia and conglomerate in South Africa have concluded that the magnetic field has been present since at least about 3,450 million years ago.

Can we feel electromagnetic fields?

Exposure to electric, magnetic and electromagnetic fields (EMF), if they are strong enough, can lead to short term health effects. Exposure to low frequency fields that are strong enough can lead to dizziness, seeing light flashes and feeling tingling or pain through stimulation of nerves.

Do earthquakes cause electromagnetic disturbances?

Earthquake taking place in a fluid-saturated porous medium can generate electromagnetic (EM) waves because of the electrokinetic effect.

Do tectonic plates cause magnetic field?

No. The tectonic plates are continually moving because of the convection currents in the mantle, which is a viscoelastic solid. The magnetic fields are generated by convection currents in the outer core, which is completely liquid.

What does frequency do to earthquakes?

The corner frequency is inversely correlated with magnitude. Therefore, small earthquakes have a proportionally greater content of high frequencies. Humans can hear sound waves mainly in the range of 20 to 20,000 Hz.

What frequency causes earthquakes?

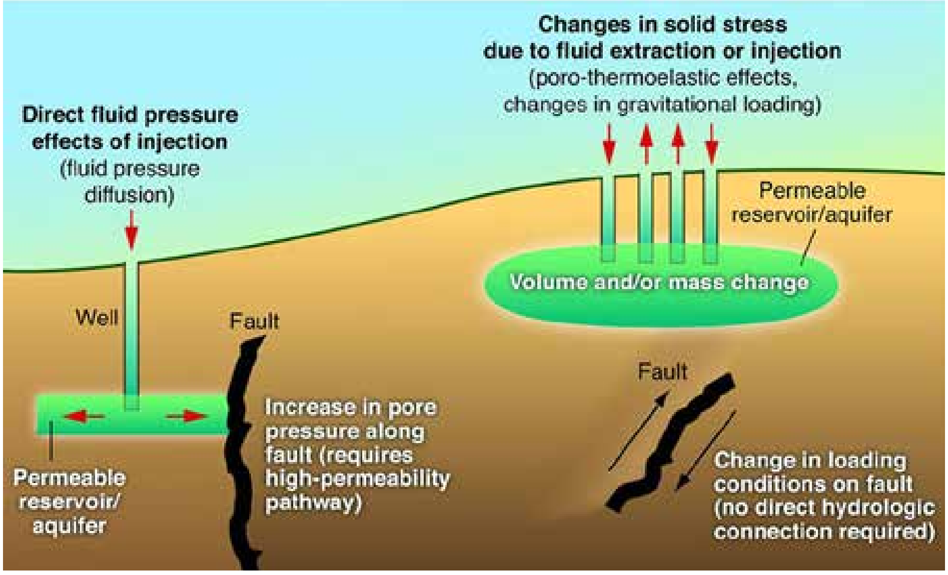
0.2 Hz to 20 Hz

Earthquake Motion

The movement during fault rupture produces a range of vibrations, or seismic waves, that are radiated outwards. The vibrations of engineering significance occur at frequencies from less than 0.2 Hz to 20 Hz (periods from about 5 seconds down to about 0.05 seconds).

Can earthquakes be triggered artificially?

Figure 6.



Injecting liquids into waste disposal wells, most commonly in disposing of produced water from oil and natural gas wells, has been known to cause earthquakes. This high-saline water is usually pumped into salt water disposal (SWD) wells.

So we start, the frequency of earth is 11.79 Hz.

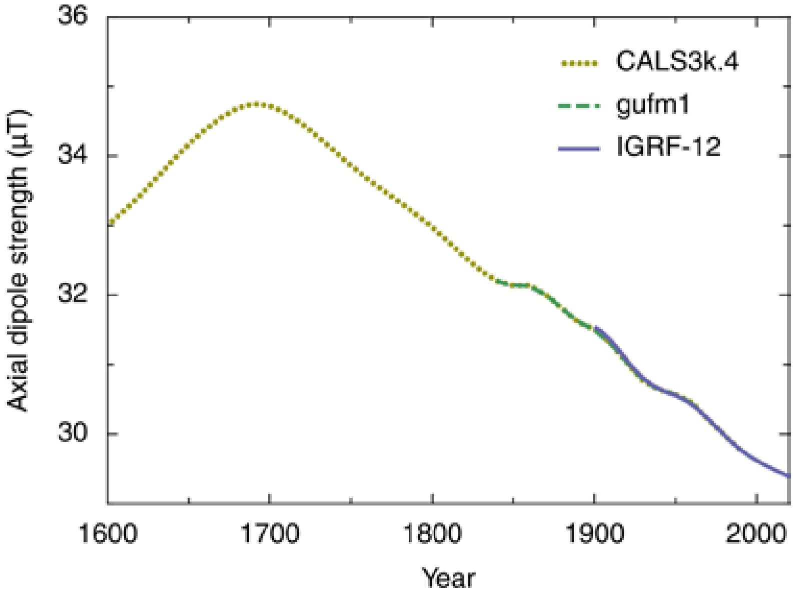
The earth's magnetic field has a frequency of 11.79 Hz (cycles per second). There is also a second frequency within the earth's ionosphere called the Schumann Resonance, which resonates at 7.83 Hz. This frequency is created mainly by lightning strikes… approximately 7 million per day.

What frequency is a magnetic field?

The magnitude (intensity) of a magnetic field is usually measured in Tesla (T or mT). Static magnetic fields do not vary over time, and as such do not have a frequency (0 Hz). Examples are the fields generated by a permanent magnet or the Earth's magnetic field.

What is the magnetic field constant of the Earth?

Figure 7.



The Earth's field ranges between approximately 25 and 65 μT (0.25 and 0.65 G). By comparison, a strong refrigerator magnet has a field of about 10,000 μT (100 G). A map of intensity contours is called an isodynamic chart.

I got this from my grade 12 physics notes. It says that Earth, having a mass of 6.0 × × 10^25kg and a speed of 3.0 × 10^4 m/s, when plugged into the wavelength equation λ = h/(mu) (where u is speed), has a wavelength of 4 × 10^-63 m. Then, does this mean it has a frequency of 7.5 × 10^70 Hz? If so, then it also means that the Earth's wave's energy is 4.97 × 10^37 J. My main confusion is that I always hear scientists say that quantum mechanics has practically no effect on the macroscopic world (except for some things like bucky balls and superconductors). I would think that a wave with the energy of 4.97 × 10^37 J would have to have an enormous effect on something or even the Earth in an interference pattern using the Sun and other planets as its own really large double slit experiment.

Shortwave radio frequency energy is capable of reaching any location on the Earth as it is influenced by ionospheric reflection back to the earth by the ionosphere, (a phenomenon known as "skywave propagation"). A typical phenomenon of shortwave propagation is the occurrence of a skip zone where reception fails.

What frequency is short wave?

How far can radio waves travel through the ground?

The range of the ground wave (up to 1.600 km [1.000 miles]) and the bending and reflection of the sky wave by the ionosphere depend on the frequency of the waves. Under normal ionospheric conditions 40 MHz is the highest-frequency radio wave that can be reflected from the ionosphere.

How far can radio waves travel from Earth?

Ground stations can communicate with satellites and spacecraft billions of miles from Earth.

Can microwaves reach Earth?

Microwaves have a long wavelength, though not as long as radio waves. The Earth's atmosphere is transparent to some wavelengths of microwave radiation, but not to others. The longer wavelengths (waves more similar to radio waves) pass through the Earth's atmosphere more easily than the shorter wavelength microwaves.

We all want good, stable and reliable communication. Some make certain sacrifices for this, drilling into the roofs of their iron horses, cutting in powerful antennas, installing expensive stations, amplifiers, and doing their best to raise the class of communication equipment in order to provide themselves with this very connection. However, for some reason, everyone forgets about such a subtle thing as the ether, in which, in fact, radio waves propagate, and whether you can establish contact with the correspondent you are interested in or not depends 100% on the "mood" of this very ether. We need to start with the fact that Ether and its state is a spontaneous phenomenon and does not depend on our desires and aspirations. Everything that happens on the air is subject to the strict laws of physics and we are unable to influence one or another aspect of the passage of radio waves through space. You just need to accept this, just like accepting that gravity exists on earth, and apples from an apple tree will always fall to the ground and not fly into space.

Why can shortwave radio signals go worldwide?

Shortwave radio frequency energy is capable of reaching any location on the Earth as it is influenced by ionospheric reflection back to the earth by the ionosphere, (a phenomenon known as "skywave propagation").What I found from the history, that prior to earthquake (appr. 2 hours before) magnetic filed of the Earth is being changed, and it becomes more,, transparent,, for some radio frequencies' the 2 portable radio transmitters can communicate in the distance of 1.6 km maximum.

Shortwave radio received its name because the wavelengths in this band are shorter than 200 m (1.500 kHz) which marked the original upper limit of the medium frequency band first used for radio communications. The broadcast medium wave band now extends above the 200 m / 1.500 kHz limit.

What is this? Although it's always been controversial, the idea that the magnetic field may shift before earthquakes has been around for a while. The survey states that "despite decades of work, there is no convincing evidence of electromagnetic precursors to earthquakes."

Does the magnetic field change before an earthquake?

My answer is Yes. Recently, researchers who study the formation process of large and intermediate earthquakes have discovered that two to three days before the earthquake actually happens, there is a change in the local magnetic field. In theory, geological forces would already be at work, deforming the crust, even if in subtle ways.

Do earthquakes affect magnetism?

Earthquakes can affect magnetic fields on the Earth, but they do not necessarily do so. For example, if you have a bunch of magnets set up on a table and there is an earthquake, then the magnets may get knocked over or moved around.

What is a device detecting changes in the magnetosphere which precede an earthquake?

The present invention, a magnetometer, measures the change in the magnetosphere that occurs before large seismic events and gives notice that an earthquake will occur shortly. A drop in the strength of magnetosphere occurs generally within a 24 hour period before a large quake.

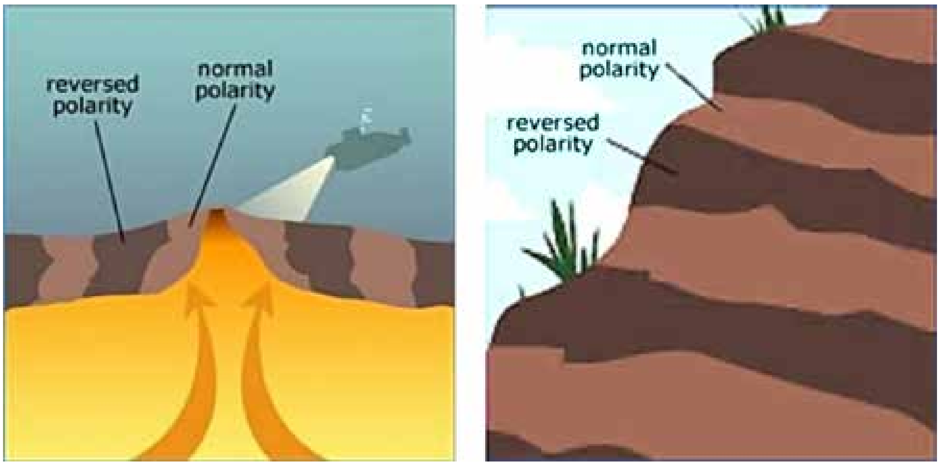
Please note that the magnetometer can predict with in 24 hours, monitoring with SHW technology will allow to predict the earthquake on earlier stages.

Do magnetic fields affect tectonic plates?

No. The tectonic plates are continually moving because of the convection currents in the mantle, which is a viscoelastic solid. The magnetic fields are generated by convection currents in the outer core, which is completely liquid. The magnetic field does not affect the convection currents in the mantle.

Does Earth's magnetic field affect plate tectonics?

Figure 8.



One of the key pieces of evidence supporting plate tectonic theory was the discovery that rocks on the seafloor record ancient reversals of the Earth's magnetic field: as rocks are formed where plates are moving away from one another, they record the current direction of the Earth's magnetic field, which flip-flops …

Can the earthquake be man made?

Induced seismicity is typically earthquakes and tremors that are caused by human activity that alters the stresses and strains on Earth's crust. Most induced seismicity is of a low magnitude.

Can mankind create earthquakes?

Both the fracking process and wastewater disposal have been shown to trigger earthquakes. These aren't the only human activities that can trigger earthquakes, though. Scientists point out that earthquakes can also be triggered by other human activities, such as construction of skyscrapers and nuclear explosions.

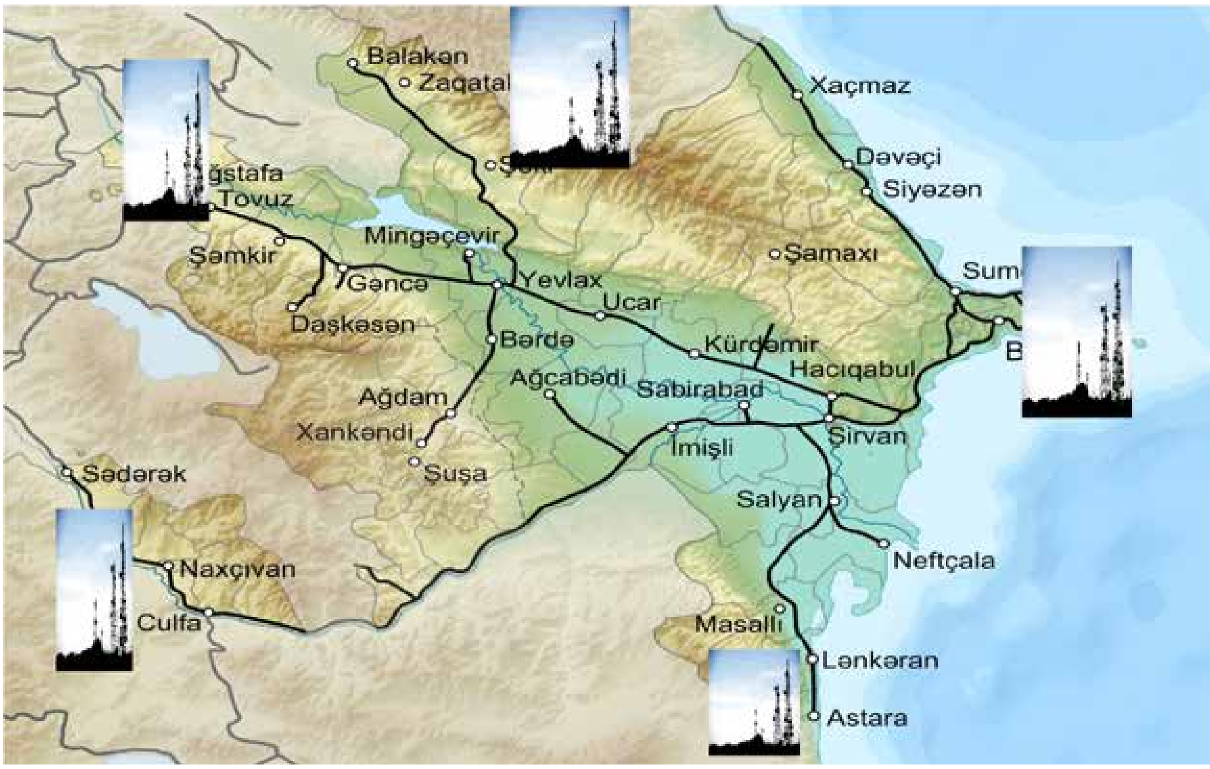
What device predicts earthquakes?

A seismograph or seismometer is the measuring instrument that creates the seismogram. Almost all seismometers are based on the principle of inertia, that is, where a suspended mass tends to remain still when the ground moves.

Can bombs cause earthquakes?

Even huge amounts of explosive almost never cause even small earthquakes, and it would take hundreds and thousands of small earthquakes to equal a large one, even if it could be done.

Figure 10.



Can phone detect earthquakes?

Each Android smartphone is equipped with tiny accelerometers that can act as mini seismometers. When a phone is plugged in and charging, it can detect the very beginnings of earthquake shaking.

What is the range of short radio waves?

3.000–30.000 kHz

Definition: Shortwave radio refers to radio broadcasts on a portion of the radio spectrum in the frequency range of 3.000–30.000 kHz (3–30 MHz).

I used the Azerbaijan map for instance just to explain the philosophy. We locate 5 portable radio stations in 5 different cities, Baku, Lenkoran, Nakhchivan, Tovuz, Balaken.And every transmitter/receiver will send a signal let's say every 2 minutes. In normal conditions there will not be any changes, and bo signals will be received due to long distance.

Also signal stregnth will be monitored continuesly. Sisgnal stregnth during transmitting/receiving is equal to 5mV (roughly) depens on station modification. But we can accept 5 mV.

And if we observe full signal receiving, or chaging in MV, let's say between Baku and Tovuz, it will mena that there is a possibility of grounf disturbance on that direction. Distance between Baku and Tovuz is 560 km, having signal strength f.e. 2.5 mV, will mean that the possibility of ground disturbance on the middle of direction. This map can be extended and citites from neibour contried can be added, f.e. from Turkey, Russia, Georgia etc.

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