

# Radio Frequency Seismograph

Predicting Seismic Activity by Monitoring Precursor Electromagnetic Disturbances in High Frequency Radio Bands

# What is a Radio Frequency Seismograph

## Why is it a Potential Earthquake Early Warning System?

- The Radio Frequency Seismograph is a radio transceiver system that detects subtle changes and disruptions in the propagation of worldwide radio signals.
- The change is caused by tectonic forces creating Piezoelectric electromagnetic fields emanating out of fault lines, just before an earthquakes occurs.

**These changes a subtle and weak – so we need a large antenna, with a proper feed line, grounding and lighting protection are required.**

- The omni antenna system is 12 meter high
- A special balun that grounds and isolates the antenna to minimize static build-up and discharges
- A Lightning protection system (for 24 X 7 operation)
- Ground is provided via 4 " copper water pipe
- The closer we are to a fault the stronger its effect



# Radio Seismograph Operational Details

## Technical Details

- TS-590 receiver
- LIF-2016 via SMA connector connecting to RX
- Raspberry 3 or 4 and soundcard including RFS SW
- Analog power supply
- 4 Ah battery backup
- Network via CAT5
- Remote controlled via remote desktop
- CAT control via USB and fIRig



# Radio Seismograph Operational Details

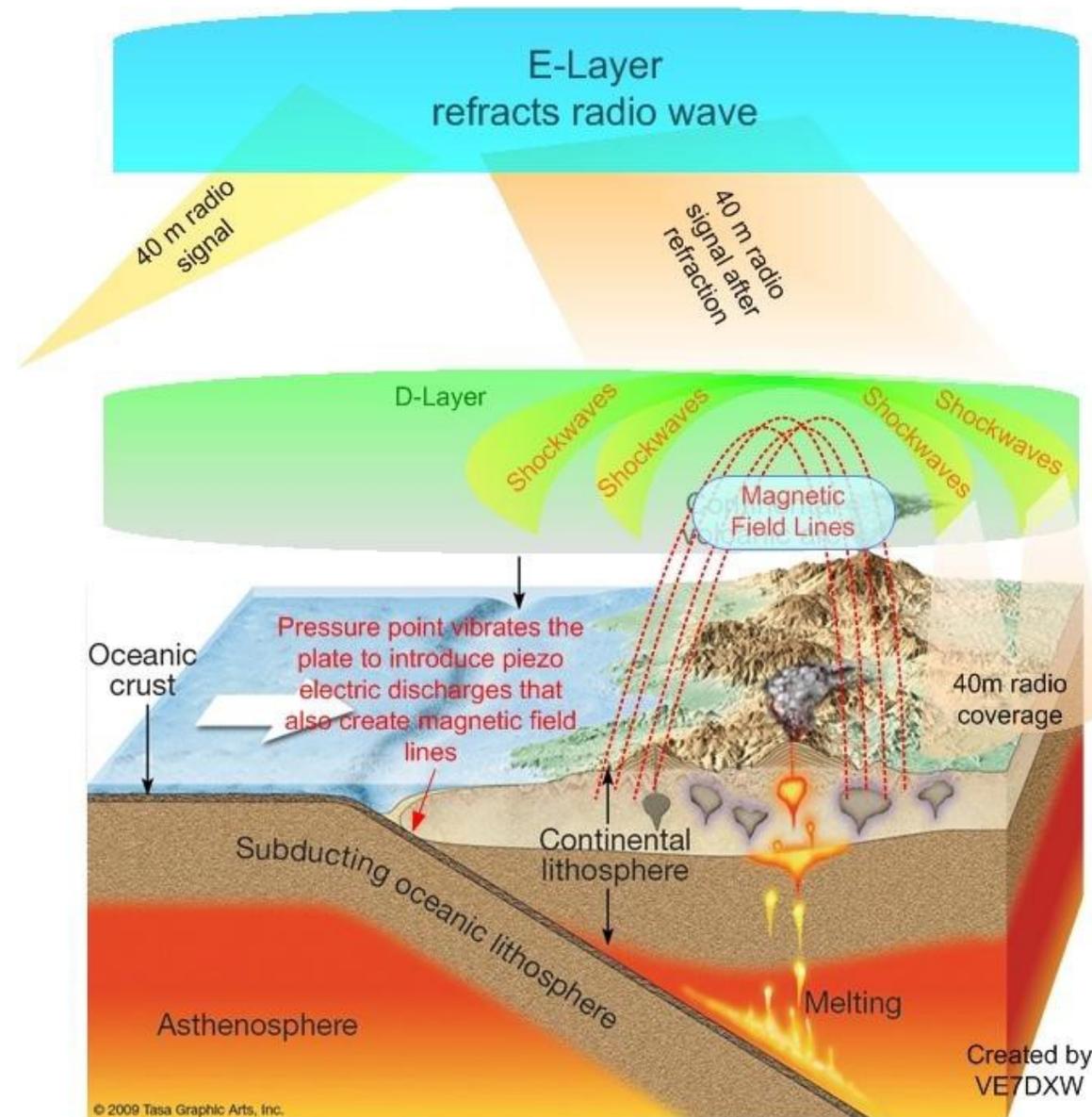
## How does it Work

- The Radio Frequency Seismograph monitors digital shortwave transmissions by amateur radio operators.
- The receiver utilizes special – developed by the RFS team - software to detect disruptions in the propagation of radio signals
- The Radio Frequency Seismograph monitors 6 high frequency bands by scanning and all the changes are recorded.
- The recorded data is then reconciled with the USGS earthquake database and analyzed to determine if there were any disruptions of radio wave propagation just before, during or after an earthquake. Utilizing the RF-Viewer, also developed in house.



# Operating Principal of the RF Seismograph

- High pressures and stress created by tectonic plates colliding with one another, generate piezoelectric currents.
- Piezoelectric currents create very strong electromagnetic fields on or near the fault lines of where the earthquake is about to occur
- The vibrations of the quakes and the ground are concentrated at the faults, which distribute and dissipate the energy over the whole planet



# The Earth is a Power Source

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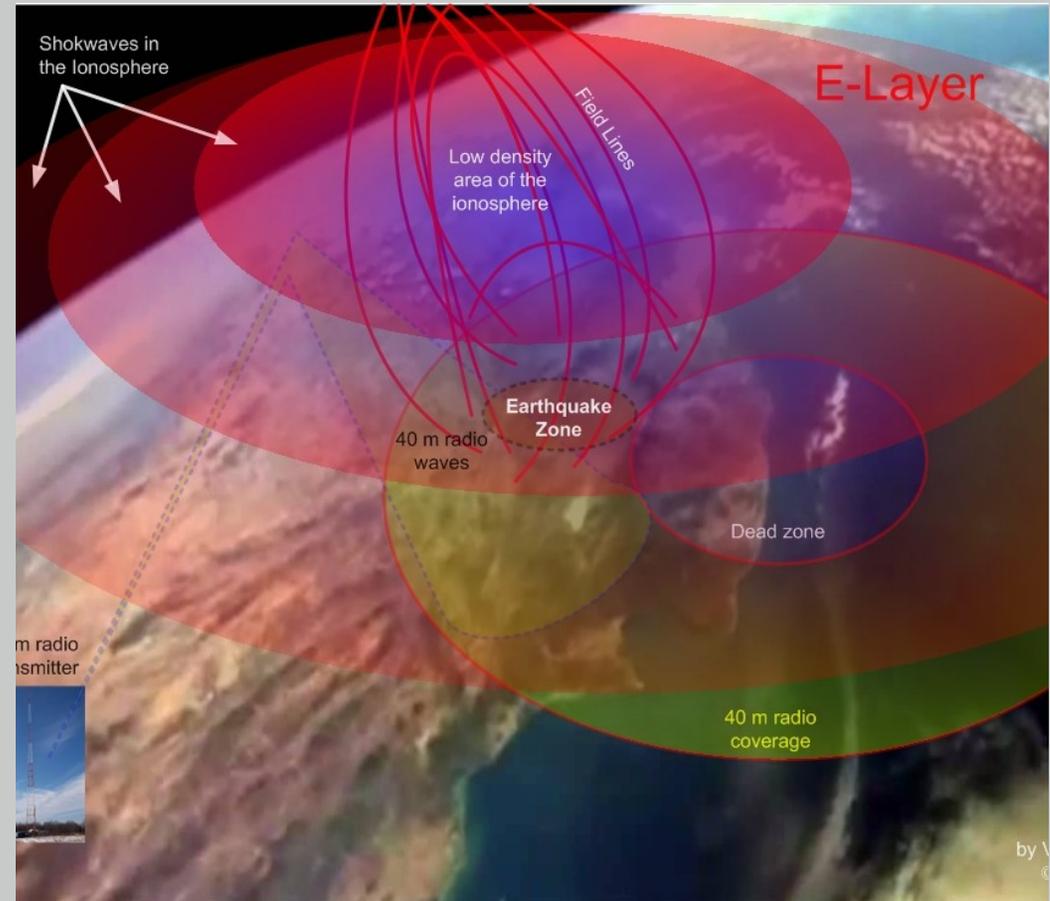


Pictures from USGS Archive

- The explosion at Mt. St. Helens only measured as a M5.1 on a seismograph, but it took off the top of the mountain.
- When the volcanic conditions are right the pressure builds up and a very destructive force can unleash...
- Now that we have a much better understanding on how such events unfold, as it happened again with Hunga Tonga; the force nature is unyielding.
- All these events are using the seismic faults to dampen the effect and severity of the explosive event. To prevent a power buildup in the faults the rocks turn the shaking into EM fields that radiate into space. Since the RF-Seismograph taps into the energy release of the fault lines they become visible as propagation changes and that's while it is important to be close to a fault on field day or when doing Summit on the Air.

# How do smaller local quakes change propagation (M2.0 to M4.0)

- Small quakes create **Electromagnetic** fields strong enough to change the ionosphere in a very gentle way.
- They provide a flickering field that can create shock waves and density changes in the ionosphere across the planet.
- **Small single quakes may have openings of a 30 min and only when they cluster**, the propagation is enhanced and lengthened.
- **The bands that open up, depend on the value of the Solar Flux index.**
- A smaller area of **Electromagnetic** generating fault lines, but in most cases a precursor can be detected?.



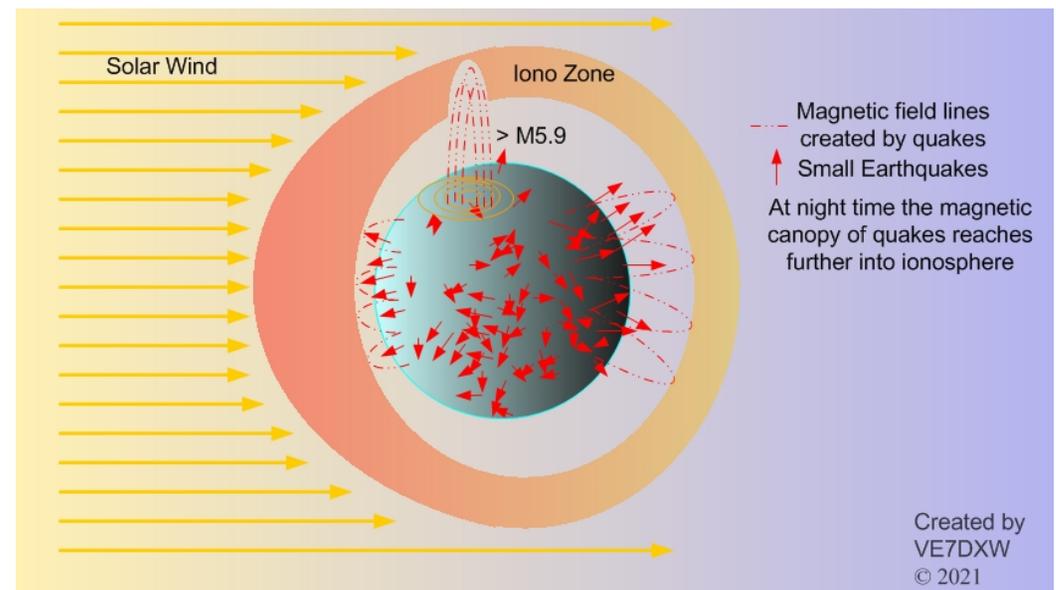
# Earthquakes can create Electromagnetic Tsunamis on Planet Earth (fictional M7.5)

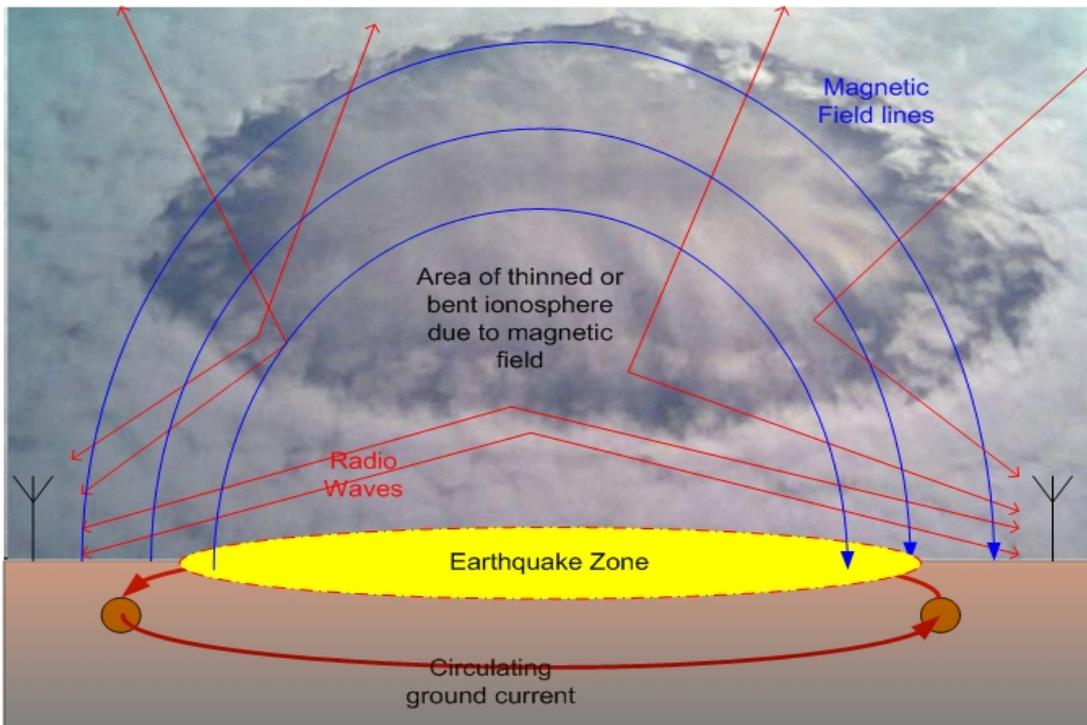


- After the earthquake occurs the radiating wave energy reaches the ionosphere with **11220 TJ?**, it **dissipates** and a radio blackout follows
- **219 EJ ( $10^{20}$ )** of Seismic moment energy rattles the planet and is moving along all the fault lines
- The vibrating rock along the fault lines start to create electricity and **Electromagnetic** fields
- Radio propagation changes **for hours or even days**. The noise level increases as all the fissures radiate with electric fields
- An electric tsunami makes the planet glow and pushes out the ionosphere
- The release of the energy into space keeps the planet from braking apart, dampening the force of the quake

# A view from Space on how earthquakes change propagation

- Earth never stops shaking from quakes.
- The energy created, holds up the ionosphere opposing the solar wind.
- At nighttime the ionosphere moves out, pushed by the quakes.
- Quakes larger than M5.9 create a gap in the ionosphere increasing the amount of solar wind entering past the shielding effect of the ionosphere.
- As the ionosphere is facing the sun it thickens and creates a shield to protect the planet.



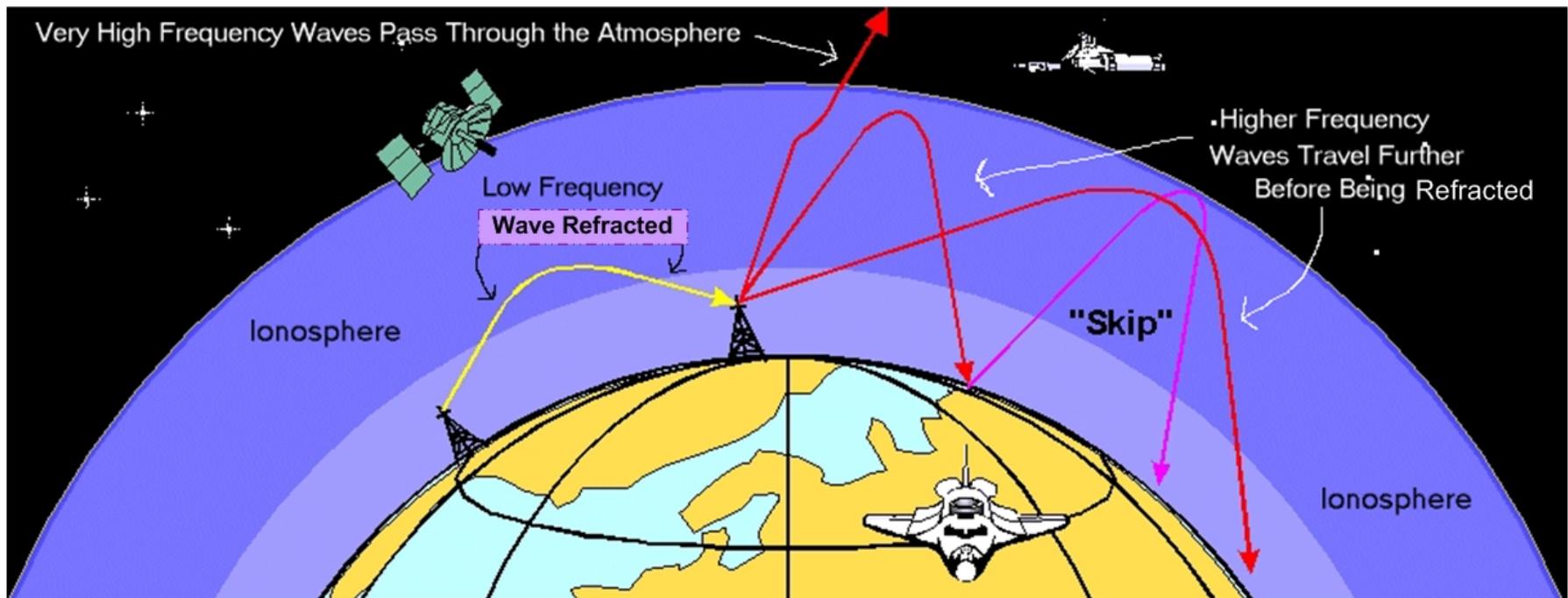


## Operating Principal of the RF Seismograph

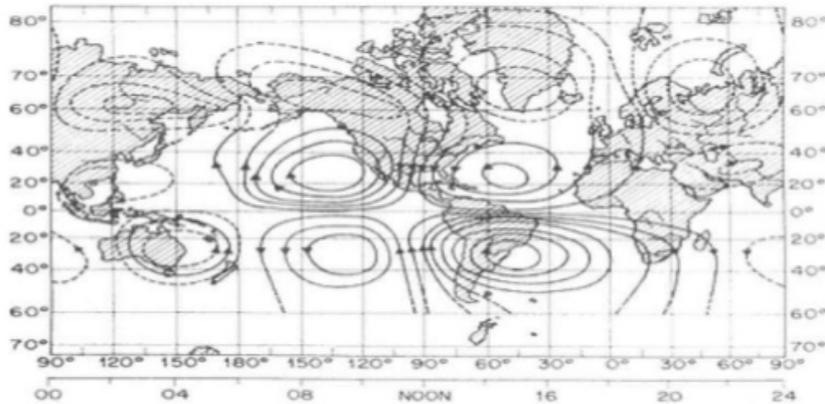
Field lines radiate out of the ground because the permeability of air provides an easier path for field lines

## Unusual behavior of shortwave radio waves in the Ionosphere

- Earth is surrounded by the Ionosphere. It is created as the solar wind and the atmosphere of the planet collide. The most common reaction between UV from the sun creates ozone ( $O_3$ )



## History



Planetary-scale distribution of Telluric currents according to Gish (1936a, 1936b) at 1800 GMT

The crustal electric fields are independent from the main electromagnetic field generated by the core.

The ground flow of electricity (telluric currents) can be visualized similar to the cloud layers that create rain.

Since electrons have mass, they are also subject to the tidal effect of the moon.

# The Earth and the Moon together are a Power Source

The Earth is constantly pulled and stretched by the moon, creating electromagnetic fields via Piezoelectricity.

Piezoelectric effect of rocks sliding and vibrating on top of each other generate electromagnetic fields.

In the shock front' the rocks releasing vast amounts of free electrons create electromagnetic fields.

The earth and the moon are constantly exchanging energy with each other. The amounts dwarf the human impart of the planet.



## The moon has a strong effect influencing earthquakes and volcanic activity

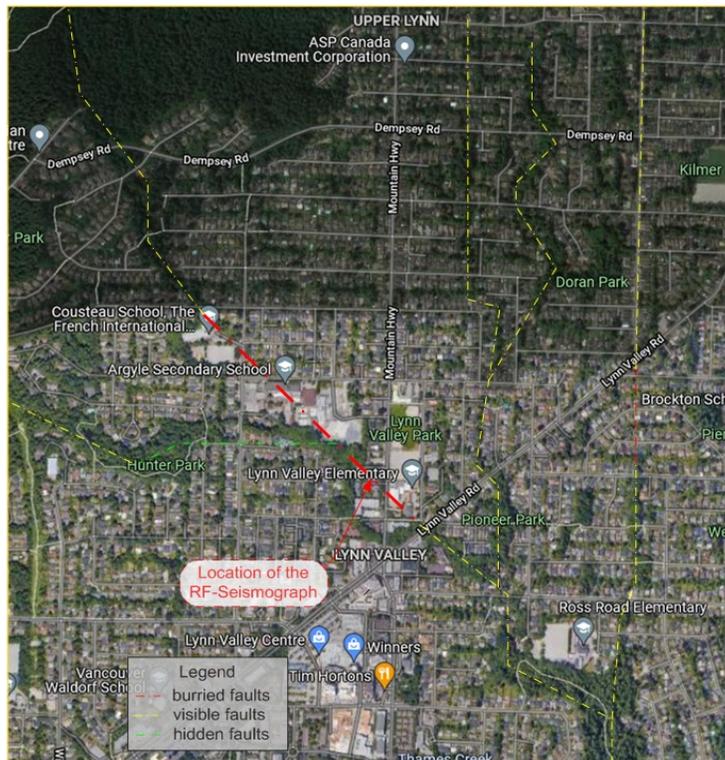
It is supercharging the planet through its tidal cycle

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### Total estimate of Power generated twice a day

- **620000 km of coastline at 21 GW of power that is 13020 TW**
- **The warping of the continents amounts to a lift of plates by the moon**
  - 11.4 to 35.6 centimeters – average 25 cm
  - average depth of the continents is 40 km
  - average crustal density of 2700 kg/km<sup>3</sup>
  - reported area of 150 \* 10<sup>6</sup> km<sup>2</sup>
- Total weight of all the continents:  
 $m = \text{area} \times \text{crust thickness} \times \text{density} = 1.6 \times 10^{19} \text{ kg}$
- Moved by the moon 25 cm  
 $1.5 \times 10^{25} \times 9.8 \text{ ms}^{-2} \times 0.25 \text{ m} = 4 \times 10^{19} \text{ J}$  of energy is required to lift the continents by 25 cm

# Location of the RF-Seismograph



This is the map of the area with the RF-Seismograph in the center. It is located by sheer luck over a deep local fault that was hidden by development. Only if the RF-Seismograph's antenna is over the fault the propagation data becomes interesting and will display quake activity.

**Fault lines in mountainous areas provide a break in the rock and allow the edges of the rock to vibrate. The deeper and longer the cracks are the more area of rock can vibrate. This also creates electricity and magnetic fields when the rock is dry, through piezoelectricity. These are very long slow vibrations and are caused by the moon, volcanic activity and by earthquakes.**

**The depth data provided by USGS seem to indicate as well that quakes above sea level are more likely to create propagation.**



# Detecting Field Lines and Propagation at Fault-Lines

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## Active Fault Lines found in the vicinity of the RF-Seismograph

- All the fault lines are connected and provide an energy release system for the planet and to dump energy back into space.
- The state of a fault can be investigated using a EMF meter, such as the EMF-390 from GQ.
- A good site for field day or Summit on the Air is near or on top of a fault line.

Note: Fault lines stick out from the surrounding area with a strange and unusual landscaping and or rift in the ground.



# References

LIDAR fault line detector for Salt Lake City.

<https://www.abc4.com/news/top-stories/earthquake-fault-lines-new-study-pinpoints-wasatch-fault-zones/>

Website for EMF-390: [www.GQElectronics.com](http://www.GQElectronics.com)

The nature of fault lines <https://www.youtube.com/watch?v=qlk7IfYMufs>

Convert the M Richter scale to metric values into moment and wave energy; ISO values of Joules

<https://earthalabama.com/energy.html#/>

Connection between small quakes and the moon

<https://swisscows.com/video/watch?query=is%20there%20a%20cfonnection%20between%20the%20moon%20and%20earthquakes&region=iv&id=34670A7D6C8F8554937434670A7D6C8F85549374>

Tidal energy <https://energy.techno-science.ca/en/energy101/tidal.php>

The lifting of the continents

[https://www.papertrell.com/apps/preview/The-Handy-Science-Answer-Book/Handy%20Answer%20book/Do-the-continents-move/001137021/content/SC/52cb009082fad14abfa5c2e0\\_Default.html](https://www.papertrell.com/apps/preview/The-Handy-Science-Answer-Book/Handy%20Answer%20book/Do-the-continents-move/001137021/content/SC/52cb009082fad14abfa5c2e0_Default.html)

How much do all the continents weigh

<https://www.quora.com/How-much-does-the-continent-of-Asia-weigh>

Total land mass of planet earth

<https://hypertextbook.com/facts/2001/DanielChen.shtml>

Hunga Tonga

[https://en.wikipedia.org/wiki/2022\\_Hunga\\_Tonga\\_eruption\\_and\\_tsunami](https://en.wikipedia.org/wiki/2022_Hunga_Tonga_eruption_and_tsunami)

USGS Archive <https://www.usgs.gov>

1,000 WORDS: YIBIN, China



AFP/Getty Images

## EARTHQUAKE RESPONSE

Emergency workers carry an injured man from a damaged building Tuesday after a magnitude 6 earthquake struck southwestern China's Sichuan province the night before, leaving at least 12 people dead and 135 others injured, authorities said. Hundreds of firefighters helped rescue at least eight trapped people, the Chinese Ministry of Emergency Management said. State broadcaster CCTV showed soldiers using a chainsaw to cut through a wooden door and rescue a couple under a fallen kitchen wall. More than 4,400 people have been evacuated after 73 houses collapsed, authorities said. The hardest-hit areas included the city of Yibin and nearby Changning County, where aftershocks continued Tuesday.

# For more Information

- Website:

[www.rf-seismograph.org](http://www.rf-seismograph.org)

- IO Groups user Group:

<https://groups.io/g/MDSRadio>

**Alex Schwarz**

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Manny thanks to:

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Joe Joncas NJ7OK

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# References

## Web links:

### Precursor to Earthquakes:

<https://phys.org/news/2021-05-electromagnetic-anomalies-earthquake.html>

Scientific American Oct. 2018: “Earthquakes in the Sky”

[http://www.ep.sci.hokudai.ac.jp/~heki/pdf/Scientific\\_American\\_Vance2018.pdf](http://www.ep.sci.hokudai.ac.jp/~heki/pdf/Scientific_American_Vance2018.pdf)

## Monitoring current earthquake activity:

Earthquakes Canada: <http://www.earthquakescanada.ca>

U.S. Geological Survey: <https://www.usgs.gov/>

## Software for Linux and PC:

Download and Install RF-Seismograph for Linux and Raspberry Pi and instructions

<https://groups.io/g/MDSRadio/wiki/home>

Download MDSR software for PC and to order a LIF-2016:

<https://www.qsl.net/rf-seismograph/>