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Research Article

The Sun Is an Energy Generator Volcanoes and Earthquakes

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Abstract

The Sun is the main source of energy supply for planet Earth. The sun emits energy over a very wide frequency range. Seismic activity of the earth's crust is formed by the radio frequency range of radiation from the Sun. There are two known methods for converting the energy of electromagnetic waves into thermal energy: absorption spectra/emission spectra and induction heating by eddy currents. In nature, the radiofrequency range of solar radiation manifests itself in the temperature of mining mines and the presence of sources of geothermal fluids. Extremes in the spectral density of the radio frequency range of solar radiation are observed during geomagnetic storms. Researchers of solar-terrestrial magnetism have learned to predict geomagnetic storms a month before they manifest themselves in the form of earthquakes and volcanic eruptions. The article provides a table demonstrating the presence of a correlation between the seismic activity of the earth's crust and geomagnetic storms for the period 2022 - 2023. Spelling prospectus arrangement for research and action to reduce seismic activity in the earth's crust is proposed.

Keywords

Geothermal Energy, Volcanoes, Earthquakes, Geomagnetic Storms, Solar Radiation

1. Introduction

From the point of view of thermodynamics, planet Earth is an open system, which means: the Earth exchanges energy with the Cosmos. But first of all, with the Sun, since it is part of the Solar System. The Sun is the main supplier of energy to planet Earth. The Sun emits electromagnetic waves in an extremely wide range of frequencies (see reference books and Encyclopedias, article Solar radiation) [1, 2]. The ultraviolet, optical and infrared ranges of radiation are widely known, but their effects are limited to the surface of the Earth. The radio frequency range of solar radiation is limited to $2*10^9$-$3*10^{10}$ Hz, but it to run through the entire planet and essentially energetically provides the seismic activity of the earth's crust.

There are two known methods for converting the energy of electromagnetic waves into thermal energy: absorption spectra/emission spectra and induction heating by eddy currents [3].

All chemical substances and compounds are characterized by individual emission (emission) and absorption (absorption) spectra. It is by these that chemical substances are identified.

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(See reference books on spectroscopy).

Induction heating is a method of non-contact heating of electrically conductive materials with high frequency currents.

Radio astronomers use the spectral radiation flux density, which is measured in W/(m^2*Hz), to estimate the amount of energy entering the Earth in the form of radio frequency radiation.

2. How Is Action of Radio Frequency Solar Radiation Detected

The Sun has been supplying energy in the form of radiation for billions of years around the clock. The Sun lives its own life, which is why the energy flow in different frequency ranges is not stable.

When flares occur on the Sun, a sharp surge in the spectral flux density of radiation is observed at certain frequencies. The Earth's magnetic field reacts to solar flares with geomagnetic storms. Let us observe the results of this directly on planet Earth.

2.1. Geothermal Fluids

Sources of geothermal fluids are widely known in different places on the planet and at different latitudes.

Today, many kitchens use microwave ovens, which are capable of heating water and water-containing food using radio frequency radiation. The emitter of the kitchen microwave oven is set to a frequency of 2,45*10^9 Hz. This is the frequency of natural oscillations of water molecules (absorption spectrum). The water molecule, having received an additional impulse of energy from the emitter, rises to a higher energy level. But, since this level is unstable [4] under given thermodynamic conditions (temperature, pressure, concentration of chemical agents), the water molecule returns to its previous energy level, emitting “extra energy”, but at a different frequency (emission spectra). This frequency lies in the infrared region, that is, the region of thermal radiation. Thus, every molecule of water in a microwave oven becomes a heater.

It is appropriate to measure the spectral flux density of radiation during magnetic storms directly at sources of geothermal fluids in different places of the world. At the same time, to measure the temperature of the geothermal fluid. This will allow: 1. Test the proposed hypothesis. 2. Establish a quantitative relationship between the temperature of the geothermal fluid and the spectral flux density of a specific frequency. In fact, calibrate the strength of a concrete magnetic storm.

2.2. Temperature in Mines and Shafts

The temperature of halite and sylvinite mines is characterized by high stability (±1 degree). Crystals of sodium chloride and potassium chloride are dielectrics, that is, they are not electrically conductive. Therefore, induction heating of such deposits with radio frequency radiation is impossible. But the crystals may have a geterogeneous color. There are red, pink, blue and orange crystals. This is explained by the fact that during the crystallization of salts, impurities were admixture in them. Subsequently, the different colors of the colorless sodium chloride crystal, for example, are caused by the ionization of impurities. But where can ionizing radiation come from in a mine at a depth of 300 - 400 meters? Answer: radiofrequency radiation from the Sun, penetrating the thickness of the earth's crust, ionizes impurities included in the colorless crystal. Halotherapy is an alternative treatment that involves breathing salty air. Some claim that it can treat respiratory conditions such as asthma, chronic bronchitis, and allergies. Others suggest it can also ease smoking-related symptoms such as a cough, shortness of breath, and wheezing [5].

2.3. Coal Is Electrically Conductive

On average, in coal-bearing deposits the temperature of the rocks increases by 1 degree Celsius for every 30-35 m of mine depth [6]. The air temperature in a coal mine depends on the concentration of non-conductive rock, that is, on the amount per unit volume, the electrical conductivity of coal, as well as on the heat released during the oxidation of coal, on the temperature, humidity and volume of incoming outside air, and on the water abundance of the mine. It is advisable to measure the spectral density of radiation flux during magnetic storms and the temperature gradient along the depth of the mine. This will allow: 1. Test the proposed hypothesis. 2. Establish a quantitative relationship between the temperature in a coal mine and the spectral density of a specific frequency. In fact, calibrate the strength of a specific magnetic storm for a given deposit.

The permanently active Iwojima volcano, located in the southernmost part of the Izu-Ogasawara arc, is characterized by surface thermal manifestations. Small phreatic explosions (water entering magma) have been frequently recorded over the past 100 years, most recently in 1999 and 2001 [7]. Judging by the fact that the total CO_2 emission from the Iwojima volcano is estimated at 760 tons/day, the volcano is located on coking coal deposits. The soil temperature at a depth of 30 cm was 60°C. The coking temperature of anthracite is about 900°C. At a temperature of 350°C, hydrocarbons volatilize. Gas chromatography of escaping gases would make it possible to determine the nature of the ancient vegetation of the area. I can assume that the heating of the depths of the Iwojima volcano is continuously carried out by radio frequency radiation from the Sun.

It is advisable to measure the spectral density of radiation flux during magnetic storms and the soil temperature at a depth of 30 cm. This will allow: 1. Test the proposed hypothesis. 2. Establish a quantitative relationship between temperature and the spectral density of a specific frequency. In fact, calibrate the strength of a specific magnetic storm according to the occurrence of a given region.

2.4. Iron Is Electrically Conductive

In Sweden, not far from Mount Kirunovara, the world's largest iron ore deposit is exploited [8]. The iron content in the ore reaches 70%. It is advisable to measure the spectral flux density of radiation during magnetic storms and the temperature inside an iron ore mine. This will allow: 1. Test the proposed hypothesis. 2. Establish a quantitative relationship between the temperature in an iron ore mine and the spectral density of a specific frequency. In fact, calibrate the strength of a specific magnetic storm based on iron ore deposits.

3. Geomagnetic Storms and Seismic Activity

A geomagnetic storm is a disturbance in the geomagnetic field of planet Earth lasting from several hours to several days [9].

The sun is not a stable source of energy and geomagnetic storms of varying levels of energy intensity are observed constantly. It is natural to assume that bursts of solar energy activity can manifest themselves in seismic activity in the earth’s crust.

Researchers of the Sun and solar activity have learned to predict geomagnetic storms, as well as their intensity, to the month ahead. These forecasts from various scientific centers: The National Aeronautics and Space Administration (NASA) USA [10], the Institute of Geomagnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences (RAS), Moscow [11]; Institute of Solar-Terrestrial Physics of the Siberian Branch of RAS, Irkutsk [12]; Department of Geophysics of Kyiv University, are regularly published in the media, for example on YouTube. Information about volcanic eruptions and earthquakes that have occurred is also published there.

Table 1 below contains forecasts [13] of geomagnetic storms for 2023 and 2024 and media reports about volcanic eruptions and earthquakes.

Column 1 presents forecasts from various research institutions about expected geomagnetic storms. Column 2 presents media information about actual observed volcanic eruptions and earthquakes.

Table 1. *Correlation of geomagnetic storms with volcano eruptions and earthquakes.*

Forecasts Geomagnetic storms	Volcanic eruptions&earthquakes
1	2
20.11.22	20.11.22 Kamchatka. Eruption of two volcanoes. 21.11.22 Indonesia. Volcano eruption 22.11.22 South America. Volcanic eruption
5.02.23	5.02.23 Türkiye, Syria. Earthquake 7.02.23 USA. New York State, earthquake.
8-11.03.23	10.03.23 North of Colombia earthquake 5.9 points 11.03.23 Indonesia and Türkiye earthquake 7.7 points 15.03.23 Türkiye earthquake 4.8 points
19-21.03.23 Index 5	18.03.23 Ecuador earthquake 6.9 points
1-2.04.23	2.04.23 Papua New Guinea earthquake 7.2 points
10-11.04.23	10.04.23 Kamchatka. Bezymyanny Volcano eruption 11.04.23 Kamchatka. Volcano Shiveluch eruption
16-17.04.23	16.04.23 Mexico. Volcano Popocatepetl eruption
	25.04.23 Indonesia Earthquake in Sumatra 26.04.23 New Zealand. Hawke's Bay area near Dannevirke. Earthquake 5.2 magnetude 27.04.23 Ukraine. Yaremcha, Ivano-Frankivsk region. Earthquake 2.2 magnitude
11-12.05.23	10.05.23. Japan. Ishikawa Prefecture. Earthquake 5 points
23-27.05.23	21.05.23 USA off the coast of Northern California Earthquake 5.5 points. Aegean Sea. Island of Crete. Earthquake 4.3.

Forecasts Geomagnetic storms	Volcanic eruptions&earthquakes
	Northern Kuril Islands Shikotan and Kunashir. Earthquake 5 points. 26.05.23 Japan. Tokyo and Eastern Japan. Earthquake 6.3 points 26.05.23 Poltava region Earthquake 3.5 points
6.06.23	6.06.23 Romania. Arad. Earthquake 3 points
30.06.23	30.06.23. Indonesia. Java Island. Earthquake 6.4 points
8-9.07.23	3.07.23 - 4.07.23 Iceland. Reykjanes Peninsula. Earthquakes 4 – 5 points
12-22.07.23	25.07.23. Türkiye Adana Province. Earthquake 5.5 points.
4-6.08.23	6.08.23 China. Shandong Province. Earthquake 5.5 points.
10-16.08.23	11.08.23. Japan. Hokaido Island. Earthquake 6 points 12.08.23. Türkiye. Two earthquakes of 4.8 and 4.5 points
18-21.08.23	18.08.23. Colombia. Bogota. Earthquakes 6.3 points 21.08.23. Northern California. Earthquake 5.1 points
25-31.08.23	29.08.23. Indonesia. Bali island. Earthquake 7 points.
8-10.09.23 K3	8.09.23. Morocco in the High Atlas Mountains. Earthquake 6.8 points
1-2.10.23	3.10.23 Nepal. 2 earthquakes with an amplitude of 6.3 and 5.3 points 3.10.23 Italy, magnitude 4 earthquake north of Naples
5.10.23	7.10.23. Afghanistan. Two earthquakes of magnitude 6.3
2-9.11.23 K4	2.11.24, Philippines earthquake of magnitude 7.5. The outbreak lay at a depth of 63 kilometers, the epicenter is located 19 kilometers in the municipality of Tagbina, Due to powerful tremors, the Philippines and Japan warned of a tsunami threat. 3.11.23 Nepal. Earthquake of magnitude 6.4. Another research center indicates 5.7
9-11.23 4 points	12.11.23 Iceland. Reykjanes Peninsula. Thousands of tremors have been recorded in the Fagradalsfjall volcano area. Before the 2021 eruption, it remained without volcanic activity for 800 years.
21-24.11.23 K4 24-26.11.23 Medium K5	23.11.23. Eastern Turkey, Malatya province. Two tremors of magnitude 5.3 and 4.7. The epicenter of the seismic event was located 30 km southeast of the city of Malatya. The outbreak lay at a depth of 6.9 km. 23.11.23. Ukraine. In the Novoselytska territorial community of the Chernivets region (Bukovyna), an earthquake of magnitude 2.0 occurred.
1.12.23 K7 2.12.23 K5 4-7.12.23 K4 5.12.23 K5	On December 3, the most active volcano in Indonesia erupted, Mount Merapi (on the island of Sumatra). The height of the volcano is 2891 meters. The eruption lasted about five minutes, throwing a column of ash to a height of more than 15 thousand meters.
17 – 18.12.23 K4-K6	17.12.23. Northern Turkey earthquake of magnitude 4.3. The epicenter is 26 km north of Erzincan at a depth of 15 km. 18.12.23 BBC report. Iceland. Reyk'janes Peninsula. After several earthquakes, the volcano began to erupt. Geothermal health resorts located near the volcano were closed.
1-2.01.24 – K4	1.01.24. The Japan Meteorological Agency reported earthquakes off the coast of Ishikawa and nearby prefectures this morning, one with a preliminary magnitude of 7.6. A tsunami with a wave of up to 5 m is possible.
11-14.01.24 Weak	15.01.24. In Iceland, on the Reykjanes Peninsula, the town of Grindavik is on fire. The seismic activity of the volcano has increased sharply over the past 24 hours, and an eruption occurred.
23-24.01.24	23.01.24 On Tuesday, an earthquake of magnitude 7.1 occurred in the border region of Kyrgyzstan and the Chinese province of Xinjiang. In Kazakhstan, the Ministry of Emergency Situations reported the latest earthquake of magnitude 6.7.

Forecasts Geomagnetic storms	Volcanic eruptions&earthquakes
23.11.24 K index 4 point	24.11.24 Morning 7:13. Seismic region of Vrancea in the southeast of Romania, 53 km from the city of Buzeu. Depth 128 km. Magnitude 4.1 points
17-24.12.24 K= 5- 6	24.12.24. Kilauea Volcano on the Big Island of Hawaii has begun spewing fresh lava, according to the Hawaii Volcano Observatory.

4. Measures to Reduce Seismic Activity of the Earth's Crust

Table 1 convincingly proves the existence of a correlation between geomagnetic storms and seismic activity of the earth's crust. This illustrates the role of radiofrequency solar radiation as a carrier of solar energy.

4.1. The Equation of Gas State, and the Reasons for the Increase in Pressure in the Earth's Crust

Let's repeat the circuit again. Radio frequency radiation, penetrating into the earth's crust, is transformed into heat according to the mechanism of absorption spectra/emission spectra in the case of dielectric rocks or induction heating in the case of electrically conductive rocks. The released heat increases the volume, and therefore the pressure, in the heating zone. The increase in pressure is especially significant if there is water in the heating zone or if gaseous substances are formed as a result of chemical reactions occurring with increasing temperature. For example, when heated, limestone decomposes into calcium oxide and carbon dioxide. Coking coal recrystallizes into coke, releasing hydrocarbons.

The pressure of gaseous substances increases when heated in accordance with the Law of the Gas State of Boyle-Marriott, Gay-Lussac and the Mendeleev correction

$$P*V = n*R*T \quad (1)$$

where P, T, V, R, are, respectively, pressure, temperature (in degrees Kelvin), volume, universal gas constant, and n number of kilogram molecules of gas. The variable n was introduced by Mendeleev into the equation of the gaseous state due to the fact that, in accordance with Avogadro’s law, a kilogram-molecule of any substance in the gaseous state under normal conditions occupies a volume of 22.4 m^3.

One kilogram-molecule of liquid water occupies a volume of 18 liters or 0.018 m^3. But one kilogram-molecule of water vapor at room temperature and atmospheric pressure occupies a volume of 22400 liters = 22.4 m^3. Thus, the volume of water in the gaseous state increases in comparison with the volume of water in the liquid state by 22400/18 = 1244 times. In addition, the pressure in the zone of heating of the earth's crust by radio frequency radiation from the Sun will further increase linearly with increasing temperature.

$$P = (n*R/V)*T \quad (2)$$

For example, at thermal power station in the superheater of a steam turbine plant at a temperature of 500°C, the pressure is 300 kPa, that is, 300 times higher than atmospheric pressure under normal conditions. But in a steam turbine здфте, the amount of water vapor n is a constant value, but in the earth’s crust it is a variable value due to an increase in the amount of gases released with a continuous increase in temperature. So if you want to know what pressure is possible when the radio frequency radiation of the Sun heats the region of the earth’s crust from the moment of formation of gaseous substances, use equation (2), in which there are two variables: n - the number of kilogram molecules of gaseous substances and T temperature in degrees Kelvin. The accuracy of calculations according to equation (2) can be improved if the Mendeleev correction n is refined by the composition of the gas phase;

$$n \text{ generalized} = \sum_1^m pi \times ni \quad (3)$$

where ni is the amount of the i component of the gas mixture, pi is the statistical weight (relative amount) of the i component of the gas mixture.

4.2. Thermal Fields on the Earth's Surface

To predict volcanic eruptions, volcanologists began to use analysis of the localization and direction of thermal fields on the Earth’s surface based on satellite monitoring data [14]. Taking into account all of the above in this article, it is advisable to pay special attention to such monitoring during periods of geomagnetic storms, measuring the kinetics of the increase in temperature of the earth's surface in combination with measurements of the spectral density W/(m^2*Hz) of solar radiation. That is, by measuring the amount of energy transferred to a surface area during a geomagnetic disturbance. This is especially important from the point of view of earthquake forecasting.

The fact that the localization of the source of seismic disturbance activated by a specific magnetic storm is detected at different depths indicates a connection between the mineralogical (chemical) composition of the activated zone and the power of the part of the solar radiation spectrum of a specific geomagnetic storm. That is, the role of the absorption/emission spectra of a seismically active region.

Let's not forget that chemicals and compounds in the earth's crust are distributed randomly. This leads to the fact that at high temperatures and pressures initiated by radio frequency radiation from the Sun, new mineral compositions previously unknown to geologists and mineralogists can be formed [15]. This may lead to the fact that, due to a change in the absorption/emission spectrum of a given region of the earth's crust, subsequent seismographic disturbances will occur at a different spectral flux density of the solar radiation in frequency.

4.3. Radio-frequency (RF) Shielding

A possible means of at least reducing the strength of seismic activity in the earth's crust could be a metal mesh spread on the surface of the area of expected seismic disturbance. In this case, induction heating of the metal mesh with radio frequency radiation from the Sun will allow heat to dissipate on the surface. It is quite easy to test this idea by analyzing the history of seismic activity in town Tokyo area. The Bulletin of the Vulcanological Society Japan frequently publishes articles on the history of seismic activity in Japan. Since modern building structures rely heavily on metals, it is important to find out when significant seismic activity occurred in the greater Tokyo area.

Previously mentioned was the active volcano Iwojima, located in the southernmost part of the Izu-Ogasawara arc, which is characterized by surface thermal manifestations. Small phreatic explosions (water entering magma) have been frequently recorded over the past 100 years, most recently in 1999 and 2001 [7]. The area around this volcano can be used as a proof ground for metal structures, that is grids that dissipate heat from the radio frequency range of solar radiation.

The article [7] describes a method by which the soil temperature was measured at a depth of 30 cm. Since the spectral radiation flux density $W/(m^2*Hz)$ changes over time, increasing sharply during geomagnetic storms, it is advisable to continuously record the soil temperature under the grid and the spectral radiation density. And of course, record forecasts of geomagnetic storms.

4.4. Directions for Further Research and Action

Roughly, the plan for developing methods for monitoring and managing earthquakes and volcanic eruptions is as follows:

1) It is necessary to organize a service for measuring the Spectral flux density of radio frequency radiation from the Sun. Perhaps such measurements have long been carried out by specialists in the field of solar-terrestrial physics, terrestrial magnetism, ionosphere, and radio wave propagation.
2) Establish a correlation between the intensity of seismic activity, the spectral flux density of radio frequency radiation, the intensity of a magnetic storm and the mineralogical (chemical) composition.

This model will be a tool for predicting seismic activity in the Earth's crust.

Abbreviations

NASA	The National Aeronautics and Space Administration
RAS	The Russian Academy of Sciences
RF	Radio-frequency

Conflicts of Interest

The authors declare no conflicts of interest.

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