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SEARCHING OF EARTHQUAKES ACOUSTIC EFFECTS ON THE GEORGIA TERRITORY

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Abstract:
To fully understand the process of earthquakes it is necessary to consider all factors which take part into earthquake preparation.
Interesting that during an earthquake there is emission of low frequency waves. Witnesses are proving this fact, because there is a hum during an earthquake.
Our work is about one of few important former factor acoustic wave emissions.
Observation on acoustic waves before earthquake is an actual topic in studying the connection of lithosphere-atmosphere-ionosphere layers. It is found that there is possibility to describe electromagnetic field modifications in E-layer using magnetohidrodynamic theory.
This subject reveals cave in western part of Georgia which satisfy condition to be able to act as an acoustic resonator.

INTRODUCTION

It is well-known that some electromagnetic emission and acoustic nose with very low frequency (VLF) are fixed before earthquake quite often. In other words electromagnetic and acoustic emissions take place and the main rezone of it is the changes in tectonic stress in area of future earthquake [2, 3, 4, 5].

These two events is very different from physical point of view and are considered as the most effective indicators from possible earthquakes precursors. In spite of qualitative differences there is relationship between electromagnetic and acoustic waves definitely. This is revealed in many effects. One example is emission of magnetospheric - ionospheric very low frequency and ultra low frequency (ULF) that are fixed as in electromagnetic so in acoustic records [6, 7, 8, 9, 10].

The rezone of this in electromagnetic records is effect of cyclotron instability in magnitospheric plasma. In acoustic records this event can be considered as accompaniment. In this environment are propagated also the acoustic – gravity waves. It is accompanied by magnetic disturbance in the range of magnetic sound waves. So the primal and back actions take place between electromagnetic and acoustic waves. Of cause it is trough just in the frequencies range (100 – 20 000 hertz) that is common for both ones. This is representative frequency and it can be extended in some diapason towards infra or ultra sounds.

Now days the problem concerning to investigation of relation between electromagnetic emission and tectonic process in the earth crust is very important. The main indicator of this effect is fluctuation of electron concentration in ionosphere section. The maximum of this fluctuation is achieved in F layer, on the height of critical frequency. Practically this is the millstone of long-standing cosmic experiments DEMETER [10].

It is known that VLF emission from Earth is the agent that cause resonance on electronic – cyclotronic frequencies in ionosphere. This effect can be caused by energetic electrons of solar wind [12] caught in magnetosphere trap [13].

But these two events can be distinguished with very effective instruments. Notably, emission from earth does not depend on the magnetosphere activity and probability of appearance of energetic electrons on ionosphere levels does not depend directly on the degree of magnetosphere disturbance. Electromagnetic emission from the Earth can be considered as reason of ionosphere disturbance, especially if it is fixed parallel to acoustic emission.

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The main goal of this work is to understand the mechanisms of electromagnetic and acoustic emissions from the Earth to show possible common mechanical mechanism of their generation. For this we will consider the model. The main basement of this model is assumption of existence of some small cavities in the zone of future earthquake source. This means that the Earth is not the uniform environment, but it is the porous electro conductive one, where exist some dielectric clusters like bubble marks. From physical point of view this can be compare to water and rubber. It is known that in the water exist some small bubble marks. Hydro location principle is based exactly on existents of this one. The basement of this principle is resonant amplification of acoustic waves. But except amplification is possible converse effect – decay of sounds. This phenomenon is obvious on the example of rubber isolator that contains the air clusters like water. In this case clusters are generator of acoustic waves with vice versa phase. They perform screening of acoustic waves by superposition with outside noise.

It is known that VLF electromagnetic emission relate to surface polarization charge [14, 15] that appears during the tectonic movements. This charge is arisen due to appearance of fracturing. It can be arisen due to the movement of layer. But in this case the acoustic waves can be also generated. All this is fixed very often in reality. As we mentioned above, the problem exist in the electromagnetic and acoustic waves spectra. In case both type waves with some kilohertz are fixed some correlation between them must exist. But this can be true if the linier dimensions of the area where the polarization charge is accumulated is similar to the linier dimensions of earthquake source zone. The correlation between main frequency and linier dimensions of the earthquake source zone can approve this consideration. This correlation in deterministic case is [16]

$$\omega \sim c/l, \qquad (1)$$

Where l is length, c is velocity of light. This equation can be used in laboratory, when the electromagnetic emission effect is considered during the impact on form with small linier dimensions.

It is known that frequency spectra obtained in laboratory is as usual 1 -100 MHz. This is comparable with equation (1). So it is necessary to show identity of VLF and acoustic emissions mechanism as in maximum linier dimensions, so in those dimensions where generation of low frequency acoustic waves and higher frequency electromagnetic emission take place.

DESCRIPTION OF MODEL

It is permit that air cluster in earthquake source zone represents as acoustic resonator so volume resonator. This last one can be called as electromagnetic wave - conducting. If on the surface of acoustic resonator is formed polarization charge, we can permit existence of system with capacitance and induction elements. As we mention above, such polarization effects is possible only if mechanical voltage is increased. This can cause acoustic resonator action. So we permit that generation of electromagnetic and acoustic waves will be generated in the same volume. In this case the character of acoustic waves has to be determined by equation of mechanical resonator.

$$\omega = \frac{V_1}{2\pi} \bullet \sqrt{\frac{S}{VL}} \qquad (2)$$

Where V_1 is sound velocity, S is the square of section of analog acoustic resonator throat, L is the character length of resonator, V is volume.

The equation (2) means substance with regular form (sphere, cylinder and other), while the air cluster can be any form. Character dimensions of resonator throat always must be less then character dimensions of resonator main volume. It is obvious that some substance with regular form has to be used for modeling. In our case the cube will be used. For characterization of this object is sufficient to fix one side as like sphere. Our goal is to obtain rough quantitative estimation on the basis of model. It implies differences in obtained and real value even in one order. It is easy to say, character frequency of any form resonator with the same volume can be located in such range of errors.

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First character frequency of acoustic wave will be estimated. Let us permit that we have air cluster with volume 10^6 sm^2. The cube resonator with this volume has the throat with cylindrical form. The diameter length of this throat is less in one order ($S = 10^2$ sm^2) then the length of cube side ($L = 10^2$sm). If environment in the Earth is considered as absolute noncondensable, the sound velocity will be infinitely large. But this is not mathematical abstraction, the Earth is elastic and the sound velocity is finite size.

Of cause sound velocity is various in various rock, but it is obvious that this parameters in size must be comparable with seismic wave velocity.

To take character value 2 x 10^5 cm/sec. Taking into account the value mentioned above ω = 20 Hertz.

It is possible to calculate more accurate range of differences of sound frequency taking into account spreading of sound velocity in rocks. It is well known that sound velocity is about 6 km/sc in volcanic and metamorphic rocks and 1.5 – 3 km/sc in sediment [17, 18].

On the basis of this value using equation (2) the following value of frequency will be obtained correspondingly - ω = 955 Hr $\approx 10^3$ Hr (In case of sound velocity 6km/sc) and $\omega \approx 24$ Hr (in case of sound velocity 1.5 km/sc).

Character sound frequency of acoustic resonator with given size is the lower limit of hearing.

Using equation (1) the character frequency of electromagnetic resonator with the same volume will be ω_0 = 300 MHz.

Concerning $\omega \approx 10^3$ Hr that is perceived by human ear is emitted by claster, which throat square is less in four order then the multiplication of claster volume and side length. Ultra sound is emitted when the claster throat square is more in two order then multiplication of it volume and side.

The character frequency of electromagnetic resonator by equation (1), in case of the same size of side as above, is ω_0 = 300 Megahertz. As we see there are differences between character frequencies of acoustic and electromagnetic waves.

It is important to indicate following: inside of air resonator with small size is possible existence of VLF waves generation probability with the frequency that is character for acoustic waves. Let us permit that inductive, polarization charges on the opposite surface of electromagnetic resonator create ensemble of elementary, electric dipoles. It is obvious that in case of elementary dipole is a possible change of shoulder in time or for our model - -side of cube. If sound is resonated on character frequency due to the tectonic process, L also will be changed with the same frequency. In other words coincidence of VLF and acoustic wave frequency take place. But such cases is very rare as mechanical vibration decay more rapidly then electromagnetic vibration inside resonator. The main rezone of it is following: the first effect is depends on thermodynamical character of environment. They determine the strong dissipation in rock. Vice versa of this the second effect depends on electromagnetic conductivity. This last one depends on viscosity quantity much more less then the coefficients of mechanical friction heat conduction.

GOAL AND RESULTS

Our goal was to separate caves which are capable of taking play of resonators in the earthquakes occurring moment on the territory of west Georgia (upper and lower Imereti).

There are studied caves as acoustic emission resonators in the west Georgia, namely Tskaltubo, Kutaisi districts and Kvirila river caves.

Locations of these caves are shown on the map (Fig.1).

Data of caves are taken from the collected articles “Cadastre of Georgia Karst Caves”[1].

The results of calculations are given in the table I.

In accordance with computation, in case of earthquake, 22 caves from all considered 25 ones, may take role of acoustic resonators.

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CONCLUSION

Offered model presents the possibility of synchronous generation of low frequency acoustic waves and electromagnetic waves in diapason 1-100 megahertz.

To qualitative analysis and rough numeral estimation it is supposed existence of little size (10^2cm) air clusters in the Earth crust where may synchronously act as acoustic so electromagnetic resonators.

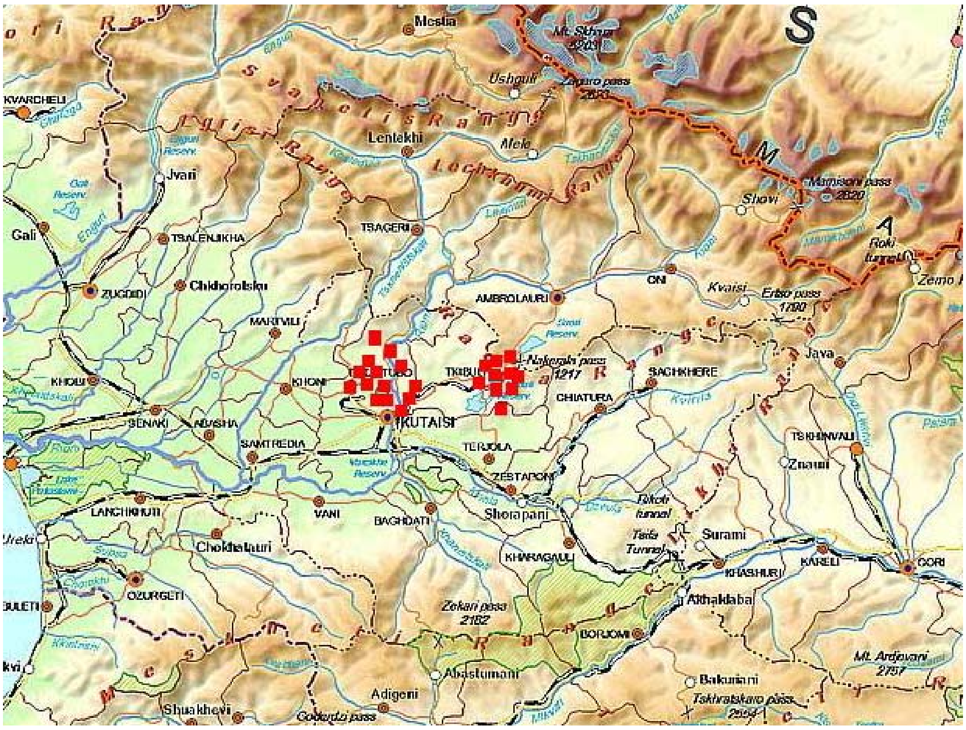

Fig. 1

Table 1

Name	Volume (m^3)	Square of the Entrance (m^2)	Frequency (Hz)
Tskaltubo cave	200000	452	9
Gliana cave	22000	159,9	21
Opocho cave	68800	50,24	92
Orpiri cave	750	12,56	67
Satsurblia cave	450	50	115
Solkota cave	27600	452	24
Didgeli cave	6000	7	18
Bgeri cave	148000	64	6
Melouri cave	200000	706,5	3,8
Tkibula -dzevrula cave	35000	96	16
Sataplia cave	8000	50	26
Sataplia II cave	2800	80	76,4
Sataplia III cave	4500	96	80
Sataplia IV cave	450	113,04	143,3
Sataplia cha cave	75	7	162,4
Olaskuri cave	150	50	191,1
Bizoni (cuckhvati III) cave	350	3,14	67
Brinjao(cuckhvati IV) cave	1080	102,05	960
Cuckhvati V cave	360	50	134
Datvi (cuckhvati VI) cave	48	3,14	162,4
Gamurebi (cuckhvati VII) cave	432	3,14	57
Moajiriani (cuckhvati VIII) cave	36	3,14	191
Porphyria (cuckhvati IX) cave	15	0,79	210
Cuckhvati upper (cuckhvati X) cave	19	1,77	229
Bejiastba (cuckhvati XI) cave	180	1,77	76

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