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THE HYPOTHESIS OF THE RELATIONSHIP BETWEEN THE CURRENT SEISMIC PROCESS AND THE GEOMAGNETIC FIELD PULSATIONS

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Abstract. With respect to the increased frequency of the seismic activity symptoms and their disastrous aftereffects and taking into account the publications devoted to severe earthquakes in the Antarctica (1998), Kaliningrad oblast (2004), China (2008), Kirghizia (2008), South Pakistan (2008) and other places, the paper presents the analysis of the influence of the seismic process on the effects in the circumterrestrial plasma. The authors propose a new hypothesis of the relationship in the lithosphere – geomagnetic field system which is based on the interaction between the moving tectonic plates and the Earth's magnetic field. Alongside with the seismic process development the linear velocity of the tectonic plate deformation is increasing which results in the change in the shape of the geomagnetic field intensity line, which, though elastic, is trying to take its initial shape. The changes in the shape of the geomagnetic field intensity line bring about the appearance of the oscillation process of the latter (the so-called stationary wave). In the critical moment of time, when the rock reaches its ultimate stress limit, one can observe the discontinuity or the Earth's crust fault which is accompanied by a rapid increase in the oscillation amplitude of the force geomagnetic line. The paper also presents the results of modelling the pulsations of the geomagnetic field Z-component, the above testifying to a direct relationship and the disturbance of the Earth's magnetic field. The estimates obtained are nicely coordinated with the results of geomagnetic field pulsation measurements which were carried out on the Academician Vernadsky station before the severe crust earthquake in the Antarctics on the 25th of March 1998 (Bakhmutov, Sedova, Mozgovaya, 2003).

Key words: acoustic and gravitation waves, earthquake, Earth's magnetic field, pulsations of the geomagnetic force line *Z*-component.

Реферат. В связи с участившимися случаями проявления сейсмической активности и их катастрофическими последствиями, с учетом опубликованных материалов о сильных землетрясениях в Антарктиде (1998 год), Калининградской области (2004 год), Китае (2008 год), Киргизии (2008 год), Южном Пакистане (2008 год) и многих других представлен анализ влияния сейсмического процесса на эффекты в околоземной плазме. Предложена новая гипотеза связи в системе литосфера–геомагнитное поле, основанная на взаимодействии движущихся тектонических плит с магнитным полем Земли. По мере развития сейсмического процесса увеличивается линейная скорость деформации тектонической плиты, что приводит к изменению формы силовой линии геомагнитного поля, которая, обладая упругостью, стремится принять свою первоначальную форму. Изменение формы силовой линии геомагнитного поля приводит к возникновению колебательного процесса последней (стоячая волна). В критический момент времени, когда достигается предел напряжения прочности пород, происходит нарушение сплошности, или разрыв, земной коры с резким увеличением амплитуды колебаний силовой геомагнитной линии. Представлены результаты моделирования пульсаций *Z*-составляющей геомагнитного поля, подтверждающие прямую связь между протекающим сейсмическим процессом и возмущением магнитного поля Земли. Полученные оценки хорошо согласуются с результатами измерений пульсаций геомагнитного поля на станции Академик Вернадский перед сильным коровым землетрясением в Антарктиде 25 марта 1998 года (Бахмутов, Седова, Мозговая, 2003).

Ключевые слова: акустические и гравитационные волны, землетрясение, магнитное поле Земли, пульсации *Z*-составляющей геомагнитного поля

Гіпотеза зв'язку протікаючого сейсмічного процесу з пульсаціями геомагнітного поля.
Ю.Б. Бродський, В.П. Ганношин
Реферат. У зв'язку з випадками прояву сейсмічної активності, що почастішали, та їх катастрофічними наслідками, з урахуванням опублікованих матеріалів про сильні землетруси в Антарктиді (1998 рік), Калінінградській області (2004 рік), Китаї (2008 рік), Киргизії (2008 рік), Південному Пакистані (2008 рік) й багатьох інших представлено аналіз впливу сейсмічного процесу на ефекти в навколоземній плазмі. Запропоновано нову гіпотезу зв'язку в системі літосфера–геомагнітне поле, засновану на взаємодії рухомих тектонічних плит з магнітним полем Землі. В міру розвитку сейсмічного процесу збільшується лінійна швидкість деформації тектонічної плити, що призводить до зміни форми силової лінії геомагнітного поля, яка, маючи пружність, прагне прийняти свою первинну форму. Зміна форми силової лінії геомагнітного поля викликає виникнення коливального процесу останньої (стояча хвиля). У критичний момент часу, коли досягається межа напруги міцності порід, відбувається порушення суцільності, або розрив, земної кори з різким збільшенням амплітуди коливань силової геомагнітної лінії. Представлено результати моделювання пульсацій *Z*-складової геомагнітного поля, які підтверджують прямий зв'язок між протікаючим сейсмічним процесом і збуренням магнітного поля Землі. Отримані оцінки добре узгоджуються з результатами вимірювань пульсацій геомагнітного поля на станції Академік Вернадський перед сильним коровим землетрусом в Антарктиді 25 березня 1998 року (Бахмутов, Сєдова, Мозгова, 2003).
Ключові слова: акустичні та гравітаційні хвилі, землетрус, магнітне поле Землі, пульсації *Z*-складової геомагнітного поля

1. Introduction

One of the most important problems of ecological safety connected with the modern prediction of the coming earthquake still remains unsolved. Catastrophic after-effects of this natural phenomenon put forward a task of informative earthquake forerunners search. Such task presupposes exposure of different geophysical effects arising during seismic process, their further interpretation with the aim of new prediction method development.

Earthquake is a rather lasting process which is accompanied by different geophysical phenomena, manifesting themselves not only in bowels of the earth, separate parts of lithosphere, but in hydrosphere, biosphere, atmosphere, including bits upper layers – ionosphere. That is why earthquake should be considered as an event that leads to the misbalance in the system of connected Earth forms and near-Earth area.

Up to now two opposite views of the researchers have been formed as for the forerunners of the coming earthquake. The first one is based on the fact that the earthquake source is in the earth's crust, the second one is based on the fact that the earthquake source is the geophysical influence of Sun and interplanetary magnetic field.

In this connection the authors focused their investigations on the explanation of the hypothesis suggested – the interaction between the moving tectonic plates and pulsation of geomagnetic field before and during earthquake.

2. Short analysis of known interaction hypothesis in the system lithosphere-atmosphere- ionosphere

We'll consider and analyze the known hypothesis in the system lithosphere-atmosphere-ionosphere in the preparation period and earthquake origin (Липеровский, 2006). Alongside it is necessary to take into account that up to now there is no generally accepted physical model of interconnection between the seismic process and phenomena in the near-earth cosmic space.

“Echo” hypothesis of electromagnetic interconnection in the system lithosphere-ionosphere presupposes that transmittance of electromagnetic energy from lithosphere into ionosphere, heating and further effecting E-area takes place while stimulating hypothetic resonator in the system

lithosphere- ionosphere. However there is no experimental prove testifying the benefit of "echo" model. That is why, knowing about the possibility of resonance ionosphere effect manifestation, we can presuppose that these effects are not crucial in lithosphere-ionosphere interconnection.

"Acoustics-gravitation" hypothesis. According to this hypothesis atmosphere acoustics-gravitational waves (AGW) are generated in the area of earthquake origin near the earth surface, which are spread through atmosphere reaching the ionosphere tops lead to ionosphere disturbance due to the collision of ions and neutral molecules. AGW generation can be connected with reciprocating movement of earth's crust having block structure with non-stable heat anomalies caused by hothouse gases going out into the atmosphere of earth's crust breaking zones, as well as with non-stable entrance of lithosphere gas masses into atmosphere. The process of AGW generation has not been investigated experimentally yet.

The hypothesis of "lithosphere-ionosphere relationship" is based on the effect of radioactivity and transmittance increase, that leads to the "modification of quasi-stable electric field" in the near-earth layer of the atmosphere. However, it is impossible to explain the increase of the maximum layer F2 height and decrease of the electron concentration maximum value within a day before earthquake in the framework of the hypothesis suggested.

"Acoustic-electric" hypothesis of the disturbance of Es-generators and mini-current systems in the night E-area of ionosphere under the influence of acoustic impulses coming from the earth is one of the last hypotheses not confirmed by observations. The latter explains effects of ionosphere at rather short distances within several hundreds kilometers from the future epicenter, according to this hypothesis the existence of acoustic impulses is presupposed, they spread from the area of earthquake preparation to ionosphere height and generating electric current in sporadical layers.

According to "gravitation-electrostatic" hypothesis impulsive radon isolation takes place in the area of earthquake preparation. If aerosol provided, Freckle local electro gravitational generators and mini-current systems appear for several minutes and horizontally for the ten of meters. Non-stationary charge distribution and creation of mini-current system in separate elements, on the one hand, lead to the splash of infra-red radiation, and, on the other hand, to the transmittance of corresponding disturbance upward into ionosphere.

Proceeding from the existing hypothesis, it is possible to suppose, that in the period of seismic process appearance and development a complex of different physical mechanisms are in action, that leads to the corresponding geophysical effects, consideration of which can give a wide range of earthquake forerunners.

3. Hypothesis of lithosphere-geomagnetic field relationship

Any earthquake appears as a result of a sudden release of a considerable number of energy in some volume inside the Earth. As a rule, in some earth areas destruction and some other irreversible rock deformation.

Proceeding from theoretical preconditions based on "the theory of elastic output" (Reid, 1911), rotation model of earthquake origin, in case of the irregular turning blocks chain with friction (Викулин, Быков, Лунева, 2000), caused by "freezing in" line of force of the geomagnetic field in earth substance (Бочкарев, 1985) and the latter "freezing in" ionosphere (Физика космоса. Маленькая энциклопедия, 1986), the hypothesis of tectonic slabs deformation influence on the amplitude change of Z-component in the Earth magnetic field lies in the following.

At the initial moment (the moment of seismic process origin) the stretching power begins to influence the element of geomagnetic line of force, situated in the Earth's crust from the side of deforming tectonic blocks. The other end of geomagnetic line of force is fixed. The stretching power is slowly increasing in time from 0 till its critical value – $\phi_{кр}$ the break time of homogenic tectonic blocks. Prolongation of geomagnetic line of force (geomagnetic line of force possesses elasticity),

geomagnetic line of force tends to become straight. The attempt to take its original form on the side of geomagnetic line of force leads to the fact that variations appear in every point of geomagnetic line of force length.

At the moment of $\phi_{кр}$ time tension of rock strength reaches its strength limit, the rock break will occur. In its turn it will lead to the following, on the break side there will be a hit on the geomagnetic line of force, as the result of it a firm wave will spread with big amplitude of hesitation, than before $\phi_{кр}$ time.

4. Modelling the relationship of the current seismic process and geomagnetic pulsations

Within the framework of the hypothesis suggested we'll consider the behavior of Z-component of Earth geomagnetic field as a function of distance x (m) from earthquake epicenter along the magnetic line of force, time t (day) from the moment of seismic process origin and height h (km) from earth surface. In this connection we'll consider the wave equation – equation of string hesitation:

$$a_1^2 \frac{^2Z}{x^2} \quad \frac{^2Z}{t^2}, \tag{1}$$

where

$$a_1^2 \quad \frac{T}{\_};$$

T – tension on all string points;

c – linear sting density.

Equation solving (1) using Furrier method, meeting a combination of exceeding and initial conditions usually looks in such a way (Пискунов, 1985):

$$Z_n(x,t) = \sum_{n=1}^{\infty} (C_n \cos\frac{a_1 n\pi}{l} t + D_n \sin\frac{a_1 n\pi}{l} t) \sin\frac{n\pi}{l} x, \tag{2}$$

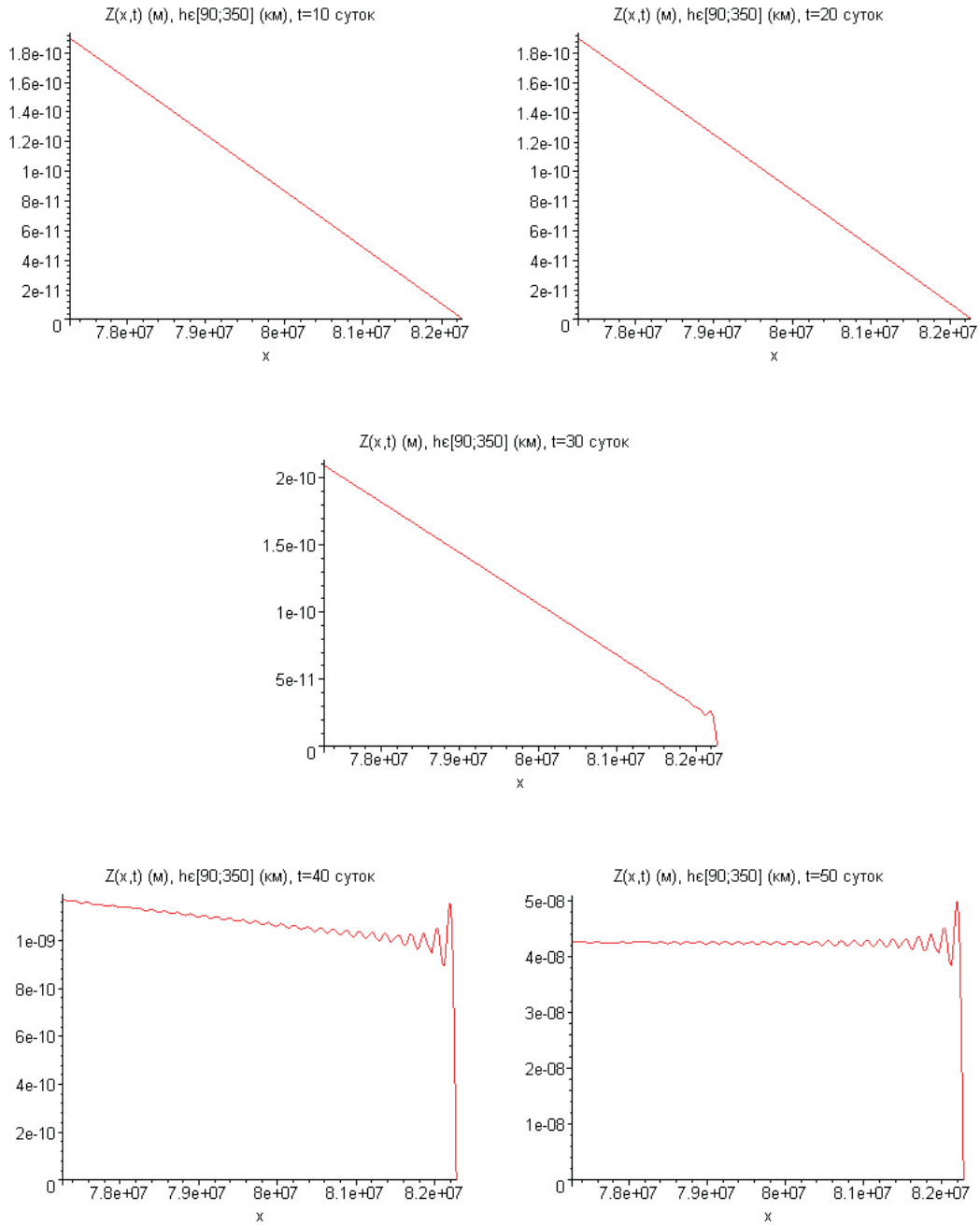
where

$$C_n = \frac{2}{l}\int_0^l f(x)\sin\frac{n\pi}{l} x dx;$$

$$D_n = \frac{2}{a_1 n\pi}\int_0^l \varphi(x)\sin\frac{n\pi}{l} x dx.$$

A string form $f(x)$ is a form of geomagnetic line of force, the speed function $\varphi(x)$ is a linear speed of tectonic blocks deformation.

The results of modeling the amplitude of pulsations $Z(x, t, h)$, the component of the earth geomagnetic field, as a result of seismic process for maximum atmosphere model (Исаев, Пудовкин, 1972) and magnitude M = 5,0 points are shown in the picture.



Picture. Dynamics of the development of Z-component geomagnetic field pulsation.

Conclusions

Within the framework of the hypothesis suggested and the results given modeling of the geomagnetic field response to the current seismic process it is possible to make several conclusions:

1. At the initial moment of seismic process origin tectonic block undergoes deformation that must lead to the form change of geomagnetic force line. However, insufficiency of power effect from the side of deforming tectonic block on the element of geomagnetic force line, which is in earth's crust, does not contribute to the development of the geomagnetic field wave process.

2. As the seismic process develops the speed of tectonic block deformation increases. On the 25^{th} day of seismic process the peak outlet of tectonic block deformation linear speed takes place alongside with loading decrease without breaking earth integrity with the further increase of tectonic block deformation linear speed. The increase of the latter leads to the change of geomagnetic force line form. Possessing strength geomagnetic force line tends to take the initial form, that as a result causes a standing wave along geomagnetic force line (pulsation of geomagnetic field Z – component).

3. On the 30^{th} and 50^{th} day tectonic block deformation linear speed suddenly increases, earthquake or the outlet of accumulated tensions takes place, which occurs as a result of non-stable deformation localization. Amplitude of pulsation of geomagnetic field Z-component during earthquake (50^{th} day) is from 420 till 500 mkm.

4. The given results of modeling pulsation of geomagnetic field Z-component confirm the relationship between the seismic process and earth magnetic field. The results obtained accord with the results of measuring pulsations of geomagnetic field at the station of Academician Vernadsky, which preceded the strongest earthquake in Antarktida on March 25, 1998 (Бахмутов, Седова, Мозговая, 2003).

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