The Elaboration of New Space Technologies for Earthquake Predicting

***Kharitonov A.L.*[1], *Hassan G.S.*[2]**

[1] *Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of Russian Academy of Science, e-mail: ahariton@izmiran.ru,*
[2]*National Institute of Astronomy and Geophysics, Helwan, Egypt*

The results of the interpretation of MAGSAT satellite geomagnetic measurements which are indicative of a capability of allocation of radon diffusion field in seismic active zones are presented. The results of the geophysical analysis of temporary changes of a radon diffusion field obtained in seismic active zone of Pacific region, and their connection with the earthquake epicenters are considered, too. It is show, that the similar radon diffusion areas, observed within the limits of seismic active zones of Pacific region and migration of temporary variations of a radon diffusion field is one from developments of difficult processes connected to radon emissions and migration of front of elastic pressure. Is shown, that the control behind the intense radon diffusion processes from tectonosphere in seismic regions can be executed with the help of satellite geomagnetic measurements. Study of results of the interpretation of repeated radon diffusion measurements allow to make a conclusion that in seismic active regions there are observed periodic changing zones with high and low radon diffusion from the earth's crust, connected with seismic processes around earthquake epicenter. The analysis of outcomes of recalculation in the lower half-space of the magnetic field measured in the ionosphere, aboard a MAGSAT satellite, at mean altitude about 400 km is conducted, at the moment of origin of strong earthquakes in Californian region of Pacific seismic active belt. The formation extracted aboard the satellite data of large-scale magnetic heterogeneities, connected with increased values of radon concentration in the atmosphere (altitude of 0-90 km), above earthquakes epicenter areas is analyzed. From the satellite data, are selected symmetrical concerning equator of a large-scale magnetic heterogeneities in mantle of the Earth are selected. They arise from several days up to a main chock. These heterogeneities can be considered as predictors of earthquakes

Introduction

Preceding researches connected to registration of underground radon concentration and its time change, in connection with the problem of searching predictors of earthquakes, have a long duration history. These researches were considered as a whole number of the scientific and applied publications, which by most interesting of them [1]. In the last activities dynamics a change of a time of radon concentration and its connection with the change strain-deformation of the condition of a massif of rocks were retrospective analyzed.

Therefore purpose of our researches consist of hereinafter development of conducted earlier researches under the analysis of changes of radon concentration not only of time or on the Earth surface, but also under the analysis from aboard satellite of influence these radon-exhalation on an ionization near-surface atmosphere. The attempt is made to trace the propagation of area of anomaly radon concentration on the eve of making dispositions earthquake not only on the Earth surface, as it was made earlier in preceding researches, but also to trace effect from anomaly radon concentration in three-dimensional, spatial measurement, when this effect, is traced in the atmosphere, up to certain altitude. In the results of the solution of a inverse problem – a recalculation of the field in the lower half-space, from measured (in time period 10.11.1979 - 19.05.1980) on a board MAGSAT satellite of the geomagnetic field, he magnetic singularities in a mantle structure or anomalous zones in atmosphere of the Earth are selected. They apparently, can be used as a forerunner of making dispositions earthquake. However, during activity on orbit of a satellite MAGSAT, from 10.11.1979 to 19.05.1980, within the limits of Californian seismic active region was not observed substantial quantities of strong earthquakes and connected with them anomalous radon-exhalation. Therefore statistics of obtained outcomes from joint satellite and ground researches is not great yet. Two were analyzed. Only rather strong earthquakes (January 20-25 and March 5, 1980) of M = 5.8 and M = 4.0, falling in this time period. While it is impossible to conduct co-processing of the satellite geomagnetic and ground data of radon-exhalation for long time period, as the reliable satellite data are available only for separate periods. At the present, when there were reliable geomagnetic data of a satellite CHAMP, working in orbit since a 2001 for a 2008 the authors of the article again make attempt jointly to analyze the satellite and ground data.

The analysis of satellite data of the geomagnetic field and brief technique of their processing

The geophysical predictors of earthquakes are divided into three groups: long-term, intermediate term and short-term ones. This activity concerns to area of study of short-term satellite geomagnetic predictors of earthquakes in good time approximately from 90 minutes to several day.

The retrospective analysis of outcomes of the geophysical interpretation of the geomagnetic data of the artificial satellite of the Earth (ASE) MAGSAT has shown, that during ASE fly over Californian seismic active region of Pacific region, above a place, in which afterwards there were in the subsurface atmosphere, at altitude approximately h = 0 - 90 km, are observed along the Earth surface, isolated spatial electromagnetic heterogeneities of size up to 20000 km along a meridian (fig.1) [2], probable connected with anomalous exhalation of radioactive aerosols, which ionize near surface layers of neutral atmosphere [3], in moments preceding to earthquakes [4]. Theoretically and experimentally these anomalous effects of radon-exhalation aerosols arising on the eve of earthquakes and mountain impacts in mines, are predicted and described in a number of the scientific publications [1]. Thus, for example, by results of the given

article, conducted by the authors, of the geophysical interpretation of the MAGSAT satellite data along a pass № 1227, obtained on January 20 1980 and data along a pass № 1925, obtained on March 5 1980 (Table 1) is visible, that near to arrangement two Californian epicenters of the earthquakes which have occurred January 20 and March 5, 1980 according to magnitude (*M*) and geographical coordinates of epicenters (Table 2): M = 5.8, φe = 37^0 45', λe = - 121^{0}57' and M = 4.0, φe = 36^{0}44 ', λe = -121^{0}18', on geomagnetic sections (fig. 1) are observed, isolated from remaining atmosphere, both on amplitude of the isolines of the field, transformed downwards from a satellite, and its topology, magnetic heterogeneities.

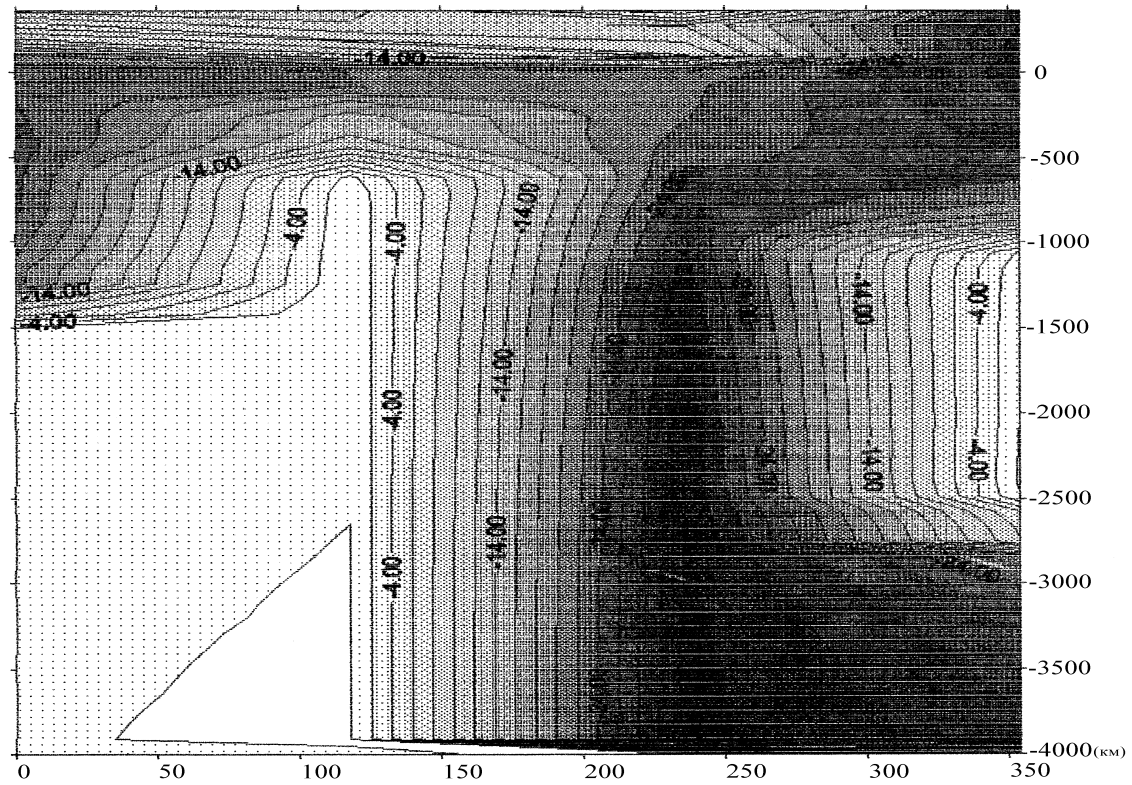

Fig. 1. Geomagnetic section of atmosphere and mantle of the Earth in Californian seismic active zone of Pacific region under the data of MAGSAT satellite pass № 1914 from 04.03.1980. Vertical axis – distanse from the satellite, horizontal axis – the geomagnetic field measure points from 55 S to 55 N latitude

Table 1. Coordinates of centers of magnetic heterogeneities in atmosphere, prepared from the ASE MAGSAT data above a zone anomalous radon exhalation in Californian seismic active region.

Pass	Date of pass	M	Latitude	Longitude
№ 1227	20.01.1980	5.8	37^{0}45'	-128^{0}30'
№ 1925	05.03.1980	4.0	36^{0}44'	-127^{0}00'
№ 1913	04.03.1980	4.7	36^{0}47'	-132^{0}00'
№ 1914	04.03.1980	4.7	36^{0}47'	-144^{0}00'

Table 2. Coordinates of earthquake epicenters

№	Earthquake	M	Latitude	Longitude
1	20.01.1980	5.8	37^{0}45'	-121^{0}57'
2	05.03.1980	4.0	36^{0}44'	-121^{0}18'
3	10.04.1980	4.7	36^{0}47'	-121^{0}22'

Table 3. Coordinates of ground stations of observations of radon concentration in Californian region

№	of Rn-stations	Latitude	Longitude
1	43	37^{0}30'	-122^{0}21'
2	3	36^{0}48'	-121^{0}29'

Centers of these magnetic heterogeneities accordingly on coordinates of an orbit № 1227 satellites MAGSAT: φs = 37^{0}45', λs = -128^{0}30' and coordinates of an pass № 1925: φs = 37^{0}00', λs = -127^{0}00', are probable connected with anomalous radon-exhalation in atmosphere marked in these days by ground services on the stations № 43, № 3-4, № 9-10, № 30 and other (Table 3).

The value of a geographical latitude (φe) of earthquake epicenter and geographical latitude (φs) isolated electromagnetic heterogeneities, observed on a satellite, practically corresponds one another, and value of longitudes (λs) of a satellite and earthquake epicenter (λe) with a maximum of radon-exhalation differs on 6-7 degrees. The authors of the given article assume, that radio active aerosols diffusing in the atmosphere from region of arrangement of earthquake epicenter also are drawed out along an latitude, as well as along a meridian up to 40□, and can be and more on an latitude for the score constantly existing in the atmosphere of latitudinal wind currents.

The outcomes prepared by the authors of the article of the geophysical analysis of geomagnetic sections of atmosphere and mantle from № 1914 satellite pass data, executed on March 4, 1980 (fig. 1) show, that approximately for one day,

on the eve of usual earthquake, with M = 4, occurred on March 5, 1980 in the tectonosphere was generated rather steady on time observed within 90-180 minutes, sub-symmetrical (contrast on a sign of an anomalous field, that is sub-symmetrical of a heterogeneities in a minimum and maximum of a field) concerning a geographic equator a magnetic structure of mantle, exhibiting as two sub-symmetrical concerning equator, but opposite on size (minimum and maximum), ascending from the boundary the core - mantle (d = 2900 km) of vertical band heterogeneities.

The minimum values electromagnetic vertical band of heterogeneities of the field in mean and upper mantle, are called, apparently, electromagnetic heterogeneities have the beginning in the liquid kernel of the Earth, on depth d = 4200 - 2900 km, as it is visible from geomagnetic sections (fig. 1). It is possible to name this band structure with minimum, but positive values of a field and it mirror reflection concerning equator, with maximum negative values of a field - as electromagnetic zones of pressure. That is, the outcomes of the thus article, conducted by the authors, of the geophysical interpretation of the MAGSAT satellite data confirm theoretical representations [6] and mathematical calculations [7] about existence of a global equatorial asymmetry of the intense pressure in the Earth's tectonosphere and it is possible even, in the mantle, and liquid core of the Earth. Above an electromagnetic structure in mantle with positive values of a field also has arisen epicenter of earthquake and maximum radon exhalation. Our conclusions about stability of electromagnetic heterogeneities in the mantle, during as a minimum 1-3 hours obtained by data of the satellite, are confirmed by ground experimental and theoretical researches explained in activities of the academician Letnikov F.A. Pursuant to it by researches is shown, that the Earth, as well as any planet, is a self-organizing dissipative thermodynamic system, which continuously is escaped energy and it a gradually minimize with old. The energy escapes of the Earth depth agrees of the sin-energetic theory of Letnikov F.A. As very fast (1-5 minutes) lets, hot high mineralization and, therefore, high conducting fluids on active, in the given instant and in the given place on a surface of the Earth, depth тектоническим to breaks. Such lets of energy, according to it to researches, are repeated approximately with period 90 minutes. Therefore, as soon as within the limits of some deep fault formed the slot from mantle depth on the Earth's surface, will be arise a gradient of pressure at once and the gases under large pressure from below are pulled out on a surface of the Earth. The gases which are pulled out on a Earth's surface, carry away behind themselves with high mineralization hot hydro-thermal water and melt of magma, forming hereinafter at hardening bar or vein (vertical strip) deposit of ores, similar observed by satellite electromagnetic mantle structures, only is significantly of a greater scale. Besides above active tectonic faults with lets fluids (aerosols) in the atmosphere, arise an electromagnetic field. This field shields propagation of aerosols, because high mineralizing fluids and hydrothermal water are a good electrolyte and very fast conduct electric currents generated in the mantle depth [8]. The comparison of obtained outcomes of the geophysical interpretation of the satellite geomagnetic data [2, 3, 4] has shown, that chosen a spatial electromagnetic heterogeneities in the atmosphere, above seismic active regions of well-known Sun Andreas, Merrey, Molokai tectonic faults in east part of Pacific region (fig. 1), can be connected with the increased contents radon in the near-surface atmosphere [9, 5]. The availability of such heterogeneities in atmosphere is confirmed by independent researches [10].

The radon diffuses in geological rocks of a homogeneous permeability with the constant speed, owing to radioactive decay of natural uran-containing of elements in bowels of researched region. The change of speed of radon diffusion in region with rocks of a homogeneous permeability and its extraction in atmosphere from the Earth surface (exhalation) depends on the several factors dominating which from are fissures of rocks. In turn, fissures in rocks very much hardly depends on strain-deformation condition of rocks of researched region. At origin of deformation pressure of compression of rocks of researched region their permeability is minimized, and at origin of pressure of stretching - the permeability of rocks is increased. Therefore, apparent coefficient of radon diffusion is changed [9, 5]. The analysis of the periodic scientific literature [11] on this problem allows briefly to formulate the following main outcomes concluded in the following. In particular, outside of zones of active seismic activity, radon the gradually will be arise in small quantities from uran-containing (*U238*) rocks (granites, hyper-alkaline rhiolites, oceanic toleite basalts). Therefore, radon is the constituent of some minerals and rocks (granites - 16 %, zircon-containing rocks - 12 %, biotites - 3 %), fluids, and underground waters. Usually migration of radon from Earth depth to Earth surface implements by means of diffusion. The coefficients of radon diffusion in an air are in range of 1.5 - 6.8 x 10-2 (sm2/sek). The coefficients of radon diffusion in an air are sensitive to the contents of humidity, reducing up to 5 x 10-3 sm2/sek at humidity of an air 17%. The radon concentration (Ch) in an air, at a distance of (h) from the Earth surface is determined under the formula:

$$C_h / C_O = \exp(h\sqrt{k/D}) \qquad (1)$$

where radon concentration on a surface of the Earth (Co), D - coefficients of radon diffusion, k - constant of decay.

The relation (C_h/C_o) becomes equal to size 0.01, only after a distance of 710 centimeters of (radon diffusion) from a surface of the Earth, a pursuant to a coefficients of radon diffusion in an air is equal D=5x10^{-2} sm^2/sek. The simple diffuse processes cannot produce significant radon anomalies, similar themes, which are sometimes observed at Karymsky volcano. The radon also frequently is accumulated in seismic active regions, in traps of clay rocks and in a top of natural containers underground water. For rocks with a hydraulic permeability between 10^{-7} and 10^{-8} sm^2, the convective motions in a layer some hundreds meters by a thickness can be the trigger action of normal temperature gradients, at which the radon concentration (C) on a distance (h) is determined under the formula:

$$C_h / C_o = \exp[h.(V/2D - \sqrt{V_2/4D_2 + k/D}\,] \qquad (2)$$

where V - speed of fluid motion.

In an outcome it is possible to assume, that the use of changes of an apparent coefficient of radon diffusion will be

reflected by changes of a strain-deformation condition of an array of rocks, owing to change of fissure of rocks on the eve of origin of a main push of earthquake. Conducted ground measurements of an apparent coefficient of radon diffusion, by means of detectors installed in a near-surface layer of soil, in small-sized slits by depth about 1 meter, in 60 observant items, in a zone of interception of a seismic active Sun Andreas Fault and Molokai Fault [9, 5] have shown, that there is a certain conformity of size of an apparent coefficient of radon diffusion and moment of origin of tectonic earthquakes with magnitude more than M = 4, occurred in a radius of 300 kilometers and more. All radon exhalation were divided into three main groups: near, distant and intermediate.

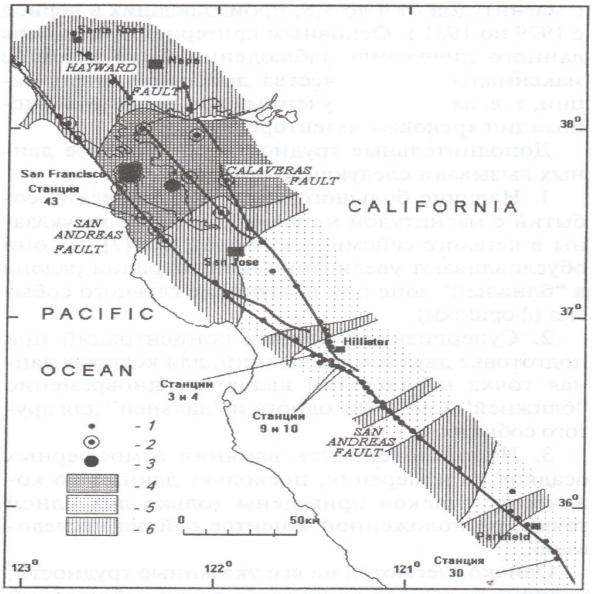

Fig. 2. Map of retrospective change of radon concentration before earthquake. 1 and 2- the standard and base ground station of radon measurements, 3- towns, 4- near radon zone, 5- distant radon zone, 6-intermediate radon zone

The authors [9] constructed maps of spatial distribution radon exhalation in this area of Pacific region (fig. 2). The authors [9] under the radon exhalation data from constructed maps chosen "near" и "distant" zones of assumed epicenter earthquake, which correspond to zones of compression and stretching of these segments Earth's crust, arising on the eve of earthquake, around its epicenter. That is, in a central part of region of earthquake, around its epicenter there is a noticeable drop of radon concentration, and around this central zone the significant increase of radon concentration is on the contrary observed. The effect from this extended area is anomalous of high radon concentration the authors of the given article and observed on a series of passes of a MAGSAT satellite.

Conclusions

The outcomes conducted by the authors of the given article of researches allow to make the following conclusions:

1. The satellite monitoring of the geomagnetic field above seismic active regions can allow to select a characteristic electromagnetic heterogeneities in atmosphere and the Earth's mantle, which can serve temporary and spatial predictors of making dispositions earthquakes on the whole surface of the Earth.
2. Apparently, there is a global equatorial symmetry of the intense condition of the Earth's tectonosphere theoretically predicted by a series of the scientists [6, 7] in places of preparation of strong earthquakes, which is confirmed by satellite researches adduced in the given article.

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