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ON THE QUESTION OF HUMAN LIFE SAFETY IN GEOLOGICALLY ACTIVE ZONES

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К ВОПРОСУ О БЕЗОПАСНОСТИ ЖИЗНЕДЕЯТЕЛЬНОСТИ ЧЕЛОВЕКА В ГЕОЛОГИЧЕСКИ АКТИВНЫХ ЗОНАХ

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Today geological active zones unite active faults of lithosphere especially earth's crust and caused by them zones of increased permeability such as paleo-valleys and underground water flows, karst and geological bodies, that are different in terms of composition and structure from the enclosing rocks. There is an evidence that mortality in geologically active zones increases dramatically, mental instability is detected and road accidents are more frequent. The purpose of this paper is to estimate the frequency of suicides among the residents of Saint Petersburg living above the geologically active zones and outside these zones and the influence of geomagnetic and gravitational disturbances on them.
The dynamics of suicides among residents of 446 high-rise building in the territory of the Kalininsky and Vasileostrovsky districts of the city of Saint Petersburg is analyzed. Geological structure of those buildings was most studied. From 1999 to 2003 there were 268 suicides among the residents of such buildings. The group A included homes that were at least 40 m above the nearest tectonic fault. Group B included residential buildings located above or in the immediate vicinity of the faults. During the geomagnetic storms, full moon and new moon periods the number of suicides in a group A decreased. Magnetic storms and gravitational disturbances did not affect the frequency of suicides in a group B. There is also no significant correlation between dynamics of suicides and daily values of the *K*-index of the geomagnetic field, as well as between dynamics of suicides and the 3-hour geomagnetic activity in both groups.
Results of studies presented in this paper show that there is no evidence of a significant negative impact of tectonic faults on people living above them.

Ключевые слова:
суициды, тектонические разломы, геомагнитные бури, гравитационные возмущения, жилые дома, *K*-индекс, безопасность жизнедеятельности.

В настоящее время к геологически активным зонам относят активные разломы литосферы, особенно земной коры, и обусловленные ими зоны повышенной проницаемости – палеодолины и подземные водотоки, карсты и геологические тела, отличные по составу и строению от вмещающих их горных пород. Имеются данные о том, что в геологически активных зонах резко возрастает смертность, обнаруживается психическая неустойчивость, чаще происходят дорожно-транспортные происшествия. Целью данной работы является оценка частоты суицидов у жителей Санкт-Петербурга, проживающих над геологически активными зонами и вне этих зон, и влияния на них геомагнитных и гравитационных возмущений.
Проанализирована динамика суицидов у жителей 446 многоэтажных домов на территории части Калининского и Василеостровского районов города Санкт-Петербурга, геологическая структура которых наиболее изучена. В период 1999–2003 гг. среди жителей этих домов отмечалось 268 самоубийств. К группе А были отнесены дома, которые находились не менее чем в 40 м от ближайшего тектонического разлома. В группу В были включены жилые здания, находящиеся над разломами или в непосредственной близости от них. В периоды геомагнитных бурь, полнолуния и новолуния число суицидов в группе А снижалось. В группе В магнитные бури и гравитационные возмущения не влияли на частоту суицидов. Отсутствует также достоверная корреляционная зависимость между динамикой суицидов и суточными значениями *K*-индекса геомагнитного поля, а также между динамикой суицидов и 3-часовой геомагнитной активностью в обеих группах.
Результаты исследований, представленные в настоящей работе, показывают, что объективных доказательств существенного негативного влияния тектонических разломов на проживающих над ними людей не выявлено.

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Introduction

Among the main factors that determine the state of a human body the geological component has a big role. Since the past people have been willing to settle in some places and persistently avoid others [1]. A hundred years ago the great Russian scientist V.I. Vernadskiy formulated the doctrine of biogeochemical regions [2, 3]. In the area of the Kursk magnetic anomaly ancient people avoided territories with a high geomagnetic field when choosing places for settlement [4]. To M.P. Zhidkov's and others' mind (1999), active faults of the Russian plate had an impact on the distribution and growth of cities [5]. Today, geologically active zones (GAZ) consider active fractures of the lithosphere, especially the earth's crust and caused by them zones of high permeability such as paleolines and underground watercourses, karsts and geological bodies that are different in composition and structure from the host rocks [6-9]. According to V.A. Rudnik et al. (1996), mortality increases dramatically in GAZ, mental instability is detected and road accidents are more frequent.

Problem description and research purpose

The mechanism of the supposed GAZ effect on biological objects remains unclear. All the real attempts to explain this phenomenon are actually reduced to the effect on living organisms of fluids (radon, methane, aromatic hydrocarbons etc.) or some physical fields of electromagnetic nature. However, the level of physical fields over GAZ by ground-based methods has not been studied enough. Artificial satellites of the Earth at an altitude of 300 km found significant changes in the geomagnetic field over large tectonic faults [10]. Release of gases or aerosols through tectonic faults may provoke an increase in cancer morbidity, but not in road accidents. The number of faults is especially large in mountains, but this does not prevent the mountaineers from becoming long-lived. Medium and large rivers usually flow over tectonic faults. Ancient people, for whatever reason, have always settled along river banks, although instinctively they have always avoided dangerous places. Some other assumptions have a rather pseudo-scientific nature.

The opinion of V.G. Trifonov and A.S. Karakhanyan on the relationship of tectonic processes with cosmophysical factors is of particular interest [11]. By now, there is many data have accumulated on the effect of the Earth's magnetic field on dynamics of incidence and death rate of the population [12-16]. At the same time, records of cases of violent death of a person (murders, completed suicides, accidents) are the most objective. It is known that the number of such cases increases on separate days or periods connected to the mental condition of the population's contingents. However, last years scientists got some disappointment among them caused by the extreme inconsistency of the results obtained, their low repeatability in other studies [17-21]. Such contradictory data was detected earlier, but it was explained by insufficiently correct mathematical-statistical processing or by the need to use more advanced indices of solar and geomagnetic activity. Today, the number of such indices and indicators is more than 40. Despite the fact that the most advanced methods of mathematical and statistical processing have been introduced, the problems remain to be the same.

It is logical to assume that the implementation of solar-terrestrial connections depends on the local geophysical features of territories and the level of artificial electromagnetic pollution of the environment [1, 22-25]. If such is the case, the accumulated complex of contradictions receives some explanation. So far, only single studies have been devoted to regional features of the effects of changes in the geomagnetic field [26-28].

The purpose of this work is to estimate the frequency of suicides among the residents of St. Petersburg living above and outside such zones of GAS and the influence of geomagnetic and gravitational disturbances on them.

Methods and results of the research

Studies were carried out on a part of the territory of the Kalininskiy and Vasileostrovskiy districts of the city of St. Petersburg that have most studied geological structure. There are in the considered zones 446 high-rise buildings where 253 420 inhabitants are registered. During the period 1999-2003 there were 268 suicides among residents of these houses. That roughly corresponds to the average values over the city for this period. The division of the contingent into subgroups taking into account gender and age is impractical due to the limited number (219 men, 44 women and 5 teenagers). Data on the dynamics of suicides in St. Petersburg (4 225 cases) were provided by the city forensic office. The level of geomagnetic activity was estimated by the daily and 3-hour values of the *K*-index (geophysical station "Gorkovskaya"). Phases of the synodic lunar cycle were determined based on the astronomical calendar.

Known tectonic faults were put on a detailed map of the city of St. Petersburg in the studied areas. All the houses in these zones were assigned to one of two groups. The group A included homes that were at

least in 40 m from the nearest tectonic fault. Group B included residential buildings located above the faults or in the vicinity of them (up to 40 m). Next, the number of suicides among those living in the homes of both groups was taken into account (all suicides were also divided into groups A and B, respectively). Unfortunately, we do not have accurate statistics on the types of residential buildings in both groups, but the panel houses more frequently belong to the group B.

Results of the study showed that 234 houses in the territories under consideration should be classified as the group A (located outside GAZ) and 212 houses to the group B (above or near GAZ). There were 136.0 and 117.5 thousand of people respectively registerd at homes of groups A and B.

There were 128 and 140 completed suicides in the houses of groups A and B respectivelly in 1999-2003 reported. It means that the level of suicides among the population in homes above the GAZ at that time was slightly higher than in the homes of group A (outside the faults). Such a difference was statistically significant (probability of error $P < 0.05$). It should be noted that the heavy and expensive brick houses above the GAZ should not be built. In such cases, lighter and cheaper panel residential buildings are built. The social composition of residents living in more prestigious brick and cheap panel houses (respectively in groups A and B) will be different. That can also explain the difference in the incidence of suicide in the groups of interest.

The next stage of our work was devoted to assessing the influence of lunar rhythms on dynamics of suicides in both groups considered. To solve this problem, the frequency of suicides in groups A and B was studied with allowance for the phases of the lunar cycle. All cases of suicide were attributed to one of the five-day intervals of the synodic lunar month. The suicide rate in group A was highest during periods of minimal gravitational perturbations and reliably ($P < 0.01$) decreased to new moon and full moon. At that time the Sun and Moon were on the same axis with the Earth and gravitational perturbations were maximal. A similar pattern was found in the analysis of the entire set of suicides in the city of St. Petersburg.

The pattern found in group A was practically not determined in the group B, and no statistically significant relationships were found in this contingent. Given above allows to conclude that the tidal effects on the person living above the GAS is weakening.

At the next stage of the work, it was desided to study features of influence of geomagnetic activity on dynamics of suicides in GAZ and beyond. Dynamics of suicides in each group was compared with values of the *K*-index of the geomagnetic field using the correlation analysis. The results are given in the Table 1.

Table 1

Correlation dependence of suicidal dynamics in GAZ on 3-hour values of geomagnetic activity

Time of *K*-index registration	A. Outside the faults		B. In the zone of fault	
	Correlation coefficient *r*	Error probability *P*	Correlation coefficient *r*	Error probability *P*
0–3 h	–0.0067	0.7871	0.0360	0.1296
3–6 h	–0.0206	0.7017	0.0917	0.0404
6–9 h	–0.0332	0.5486	0.0843	0.0676
9–12 h	–0.1131	0.0513	0.0608	0.1989
12–15 h	0.0053	0.9275	0.0613	0.1928
15–18 h	–0.0378	0.5003	–0.0022	0.9613
18–21 h	–0.0601	0.2653	0.0069	0.8759
21–24 h	–0.0493	0.3624	0.0481	0.2713
Day value of the *K*-index	–0.0778	0.1635	0.1126	0.0174

As it seen from the Table 1, low but reliable values of the correlation coefficient were revealed in the group B between the dynamics of suicides and daily values of the *K*-index of a geomagnetic field ($r = 0.1126$, $P = 0.0174$) as well as between dynamics of suicides and geomagnetic activity in the pre-dawn hours ($r = 0.0917$, $P = 0.0404$). Such patterns can not be considered statistically significant. Any reliable laws were not found in the group A.

The frequency of values of the *K*-index of a geomagnetic field on the day of committed suicide in the compared groups is given in the Table 2.

Table 2

Frequency of K-index values of a geomagnetic field on the day of committed suicide in GAZ

Studied groups of suicides	*K*-index of the geomagnetic field			
	0-1	2	3	4 and more
In the houses of the group A outside the zones of faults. Number of suicides $n = 128$	16.4	42.9	24.2	16.4
In the houses of the group B in zones of tectonic faults. Number of suicides $n = 140$	20.0	50.7	20.7	8.6
P	–	–	–	< 0.05
Total for days of 1999-2003. Number of suicides $n = 268$	18.0	45.6	24.0	11.9

As it seen from the Table 2, significant differences were found only in the frequency of the *K*-index equal to 4 or more ($P < 0.05$). Since the control has an intermediate value between the values

of groups A and B, statistically significant differences from the control (frequency distribution of *K*-index of geomagnetic activity for 5 years) were not detected. At the same time, the obtained data allow to note the multidirectional influence of geomagnetic disturbances on the number of suicides in living above the tectonic faults and outside them.

Conclusion

There is a single-direction influence of geomagnetic and gravitational perturbations outside GAZ on the dynamics. The number of suicides in active periods is decreased. It seems that there is in GAZ an unknown factor blocks the mechanism of the influence of geomagnetic and gravitational disturbances on humans. The data obtained to some extent correlates with results of a study of about 80 000 suicides in Australia [29, 30]. During the period 1968-1997 the dependence of suicidal dynamics on geomagnetic disturbances was determined but there were no statistically significant patterns in 1998-2002. That is associated with the increasing electromagnetic pollution of the environment, including through the widespread implementation of cellular communications. An unknown factor in GAZ has a similar effect on a person. It does not block different types of physical fields, which is difficult to imagine, but acts as a dominant for some center of human sensitivity to a number of external fields and radiations and block the last one. For example, high values of geomagnetic activity, gravitational perturbations in the new moon and full moon reduce the risk of suicide (possibly due to antidepressant action on the central nervous system). But over the GAZ these effects are blocked and the incidence of suicides does not change. To verify such judgments, further research is required, but three facts seem obvious now that are as follows:

1. The level of suicide among the people living in GAZ is slightly higher than among the people living outside GAZ.

2. There is an unknown factor in GAZ affects a person, blocks the effect of magnetic and gravitational fields on the body.

3. The findings do not prove the judgment of a significant threat to a person living above tectonic faults.

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