

Seismic Hazard and Ecological Risks in Mining Regions

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Abstract In connection with the growing anthropogenic impact the protection of environment became the global issue. The portion to the environmental pollution made by the mining industry is significant. The territory of North Ossetia is located in the zone of high seismicity and it is characterized by the greatest seismic risk, since in conditions of high seismic hazard there is the greatest density of population in North Caucasus. In the case of earthquakes with intensity of 5 points the site, folded by some type of soil and occupied by tailings dump (wastes of mining industry), will be under active impact. To assess the pollution of the territory as closely related parameter, the development of neoplasm among the inhabitants of the urbanized mountain territory on the example of Vladikavkaz city was investigated.

Keywords: ecological, seismic, risk, hazard, mining industry, disease, neoplasma

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1. Introduction

In connection with the growing anthropogenic impact the protection of environment became the global issue. The portion to the environmental pollution made by the mining industry is significant.

In conditions of mountainous relief the problem is aggravated even more because of limitedness and closure of space. The factors, which influence the state of environment, under the conditions of highland region bear priority nature because of the special signs of topographical, territorial and geographical plan [1,6,7].

It is also necessary to note that practically all forms of natural phenomena and processes of geological, hydrogeological and meteorological nature are the sources of risks. Earthquakes are some of the most dangerous natural phenomena under the conditions of mountainous relief. From the point of view of their propagation allocation on the territories and the regions the earthquakes are the most dangerous natural phenomena in the territory of Russia (about 20% of the territory potentially is subjected to the impact of earthquakes with the intensity of 7 points on MSK scale and more).

Besides its direct destructive impact in the territories, where industrial enterprises generating or processing dangerous chemical substances are located, the earthquake can become the cause for ecological catastrophes.

The estimations of losses from the earthquakes, made according to world data of the insurance company Munich Re, show that the number of events with the severe consequences in the entire world in the period of 1986-1995 is more than three times increased in comparison

with 1960, and the volume of losses grew almost 15 times. The analysis of causes for an increase in the losses shows that these are the irreversible consequences of the rapid population and industry growth, increase of the infrastructure, commercial and economic activity in the large cities and the industrial centers, located in seismically active regions.

The wastes of output and processing placed in confined area create the ecologically tense situation in the regions and they contribute to the degradation of environment. The ecological capacity of the biosphere of mining systems in comparison with the plains territories is limited; therefore the technogenic interference on the system of mountain landscapes requires balanced approach [2].

2. Objectives

The territory of North Ossetia is located in the zone of high seismicity and it is characterized by the greatest seismic risk, since in conditions of high seismic hazard there is the greatest density of population in North Caucasus [4].

In 2007 on the basis of accounting of possible seismic sources (PSS) zones (Rogozhin E.A.) the probabilistic maps of seismic hazard of the RNO-A territory were constructed by the specialists of Center in collaboration with the Georgian scientists.

According to the maps of seismic hazard in the territory of republic for the important objects, such as the tailings dumps, entire southern part of the republic is located in the limits of 9 MSK intensity (Figure 1) [4,5].

In the case of earthquakes with intensity of 5 points the site, folded by some type of soil and occupied by tailings

dump (wastes of mining industry), will be under active impact. The natural volume of the waste, which contains heavy metals and their salts, frequently irrigated deformed by waves, will obviously noticeably change under the moderate seismic influences, accelerating the leaching of minerals. This will increase the volume of toxic

substances penetration into the soil, which will enlarge the area of pollution. Toxic substances temporarily “preserved” in the bottom deposits, for example river Ardon, will increase the pollution of territory more even though the river flow will take away large part of waste in the estuary.

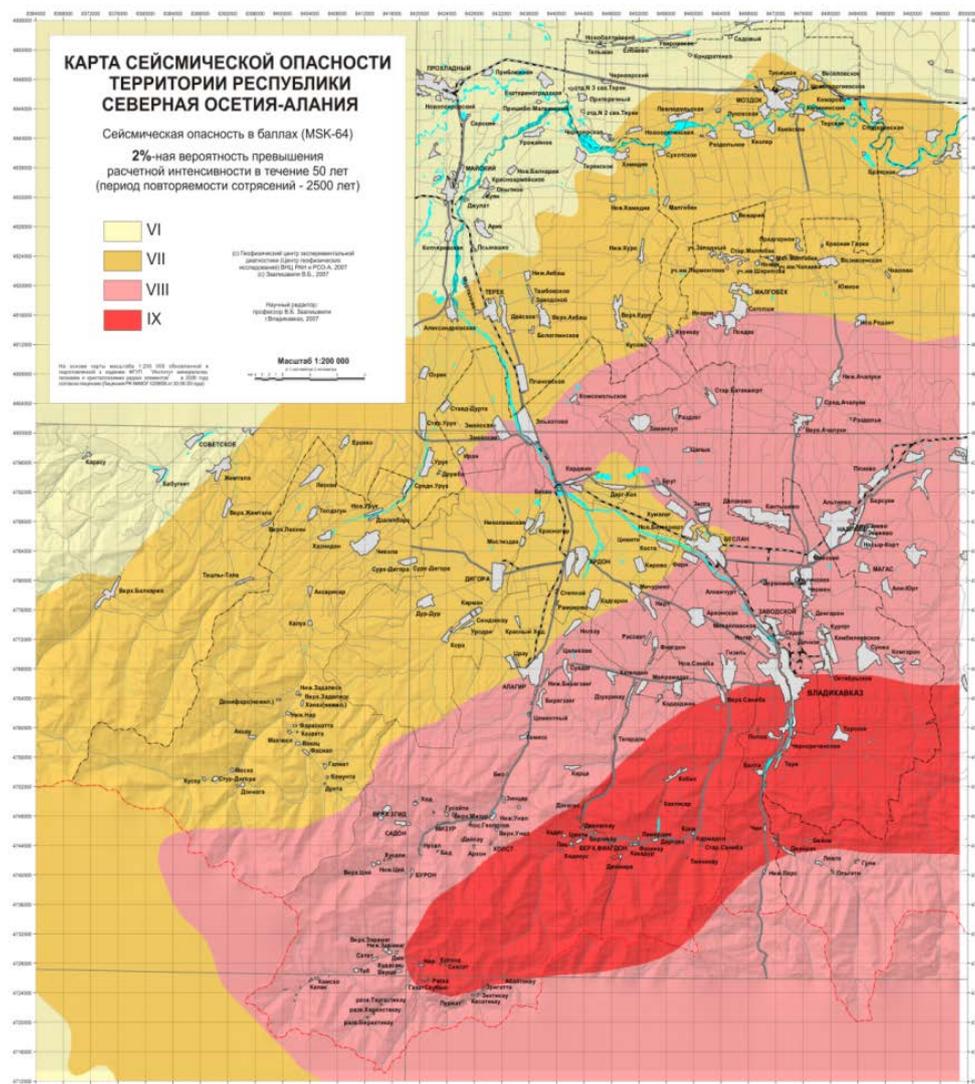


Figure 1. The seismic hazard map of the RNO-A territory in MSK intensity scale

It is known that even in the case of moderate earthquakes so-called second hazards (for example, landslides or fires) can exceed many times the seismic risk from the earthquake. The leaching process of the mining industry wastes will considerably increase in the case of strong earthquakes, and the consequences, formed by such a second hazard, can, exceed many times losses from the primary sources without any doubt.

3. Methods

To assess the pollution of the territory as closely related parameter, the development of neoplasm among the inhabitants of the urbanized mountain territory on the example of Vladikavkaz city was investigated. Morbidity was studied depending on the distance from the metallurgical enterprises and tailings dumps, located in the northeastern part of the city. The dispersion halo of heavy metals from the enterprises is revealed over the area of

approximately 40 km², where the content of metals by an order exceeds the mean concentration.

For the processing and the subsequent analysis of the obtained data about the neoplasm morbidity the special database was developed [3]. We also studied the wind rose to investigate the influence of the air flow on the spreading of pollutants and their possible influence on cancer morbidity of population.

4. Results

Investigating the dependence of the number of diseases from the distance to the sources of pollution, makes it possible to conclude that the number of cases per unit of area decreases with an increase of the distance from the industrial objects and the tailings dump (Figure 2) [3].

The analysis of the constructed maps for different age groups, and also forms of localizations, makes it possible to conclude that the special features of air flow directions

and the immediate vicinity of buildings and construction of industrial enterprises "Electrozinc" and "Pobedit"

(marked as 1 and 2), including tailings dumps (marked as 3) form the maximum negative contribution (Figure 3).

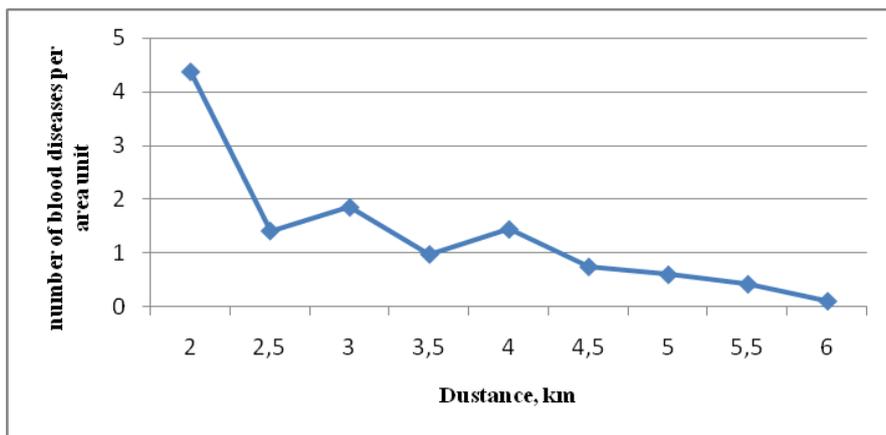


Figure 2. Dependence of the number of blood diseases per area unit on the distance from the industrial objects

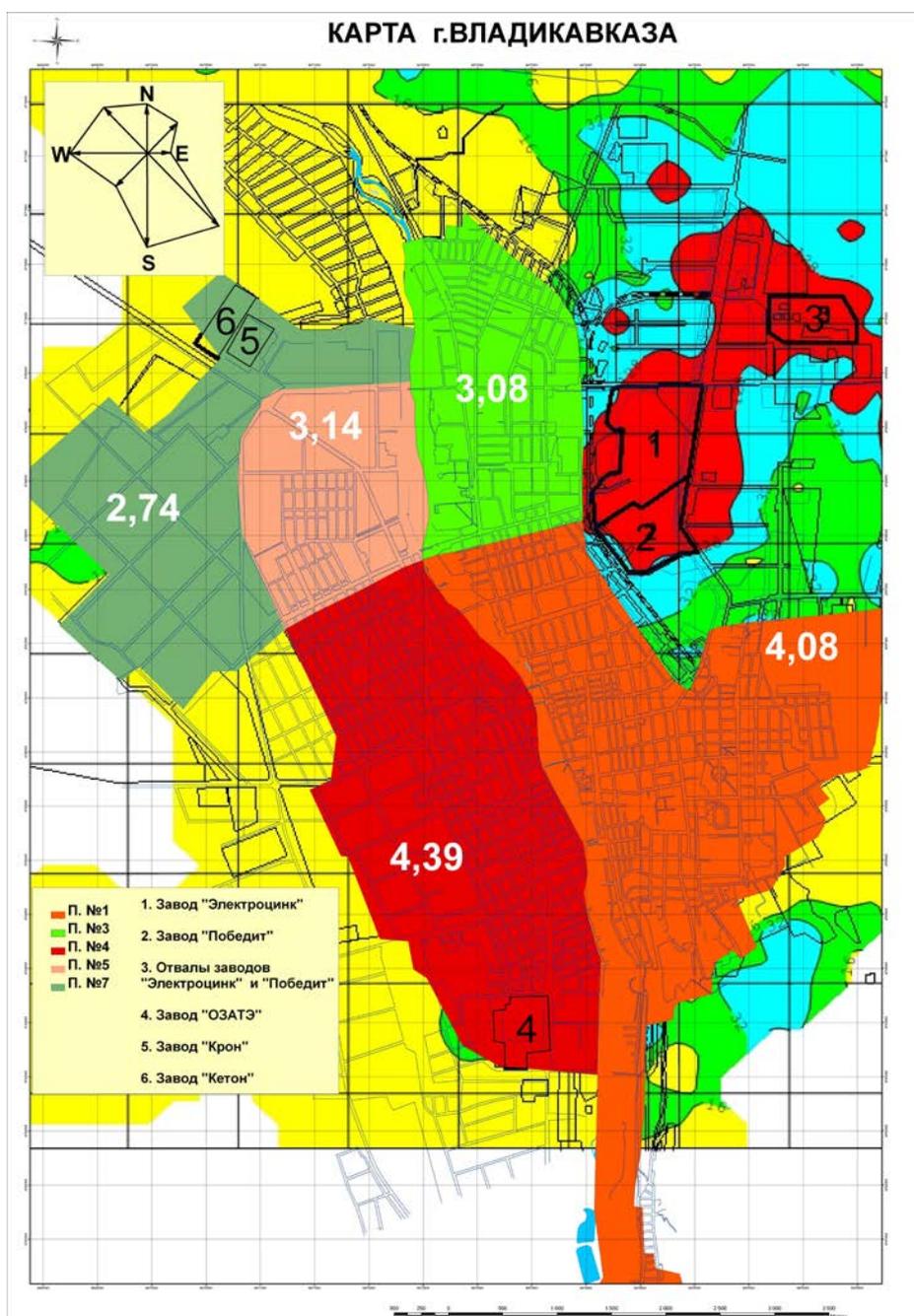


Figure 3. Neoplasm morbidity on data of city polyclinics

5. Discussion

It is found out that the closest correlation of the air flow motion special features of the, which penetrate on the tailings dump and expanding the region of pollution by toxic substances in the territory of city, is observed on cancer morbidity of age class of up to 20 years and on cancer morbidity of some locations for all age classes.

Disease cases distribution showing that tailings dumps are the main sources of pollution on the territory.

6. Conclusions

The territory of North Ossetia is located in the zone of high seismicity and it is characterized by the greatest seismic risk, since in conditions of high seismic hazard there is the greatest density of population in North Caucasus

The map of neoplasm morbidity for the territory of Vladikavkaz city is constructed.

It is found out that the closest correlation of the air flow motion with pollution by toxic substances in the territory of city, and cancer morbidity of age class of up to 20 years.

In the case of sufficiently strong earthquake the emission into the environment of harmful wastes and substances, which will affect ruinously the health of population and environment, can occur.

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