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Chapter 10

Applied Medical Geology

During the second half of the last century, various medical and geological tasks had to be solved. That is why nowadays, behind applied medicine, from the one side, and applied geology, from the other, voluminous useful materials and attained results are present, while more and more significant part is related to concrete problems concerning *geological environment - natural environment - human ecology* relationship. Parallel development of medical ecology, dealing with complicated interrelationships between human being and factors of the external environment is suitable opportunity. From the other side, methods of applied geological exploration are intensively developed, taking into consideration various geoecological aspects of the environment. Besides, multidisciplinary approach of medical and geological sciences, including technical accomplishments, becomes predominant and more fruitful. In that way, using contemporary methods and practical solutions of biology, chemistry, physics, veterinary medicine, medical geography and other sciences and scientific disciplines, ecological mosaic is closed, with *applied medical geology* as new applied discipline.

GEOMEDICAL RISKS AND TASKS OF APPLIED MEDICAL GEOLOGY

Areas where we grew up as well as land where we live make almost pleasant impression of extraordinary stability and unchangeability on us. But, on the contrary to the stability giving tricky impression of unchangeability, a series of occurrences throughout the world, very often

sudden and violent, sometimes disastrous for population, directs to noticeable mobility of the land. Besides, areas destroyed by catastrophic earthquakes, where the coasts are demolished and moved by sea waves, and numerous settlements are under the permanent risk of giant volcanoes eruptions, or where coastal parts of the land are sinking so rapidly, that the coast has to be protected from sea penetration by embankments, are not so rare. *"And in that way, almost everywhere, in all points of the Planet, close to the illusory peace and stability, a series of processes, weaker or more intensive, of local or regional significance, constantly building or demolishing, which started soon or lasting for the hundreds of millions centuries, and which result is today's form of the Earth, distribution of the continents and oceans, relief and all features of its surface, is underway"* (B. Milovanovic, 1949).

During extremely long geological time, nature was, among all, making equilibrium in chemical content of atmosphere, lithosphere and hydrosphere of the Earth. The equilibrium was, however, locally disturbed, not only in natural way, but also as a result of the human activity. Unfortunately, human work was expressed through more and more destructive forms, with serious consequences on the environment and, particularly, human ecology. Note that development of medicine (medical ecology), which succeeded mainly to clear up influence of unhealthy surroundings on development of disease, even these which can be hardly overcame by contemporary medicine, has a very important role in educating related to catastrophic influences of human beings on the environment.

One of the tasks of applied medical geology is to define a role of geological factors within an ecosystem, interconnected system of living organisms and the natural environment, but also to distinguish factors - carriers of some diseases and perform zoning of the interesting area according to degree of negative (or positive) influence of geological environment on human health (Fig. 10.1.). It is understandable that, nowadays, the discipline is also dealing with the role of geological environment expressed to anthrop; orogenic activity, which is also very important task; especially because *contaminant migration predominantly depends on geological properties of rocks, soil and groundwater as media where the process develops.* Geological medium is, namely, under such conditions that all three potentials important for providing human standard and survival are endangered:

1. *soil formation* presents certainly the most important result of rock weathering; global problem is increasing degradation of that geological resource because of intensive chemisation and improving of erosion processes;

2. *groundwater forming,* as the most result of permeability properties of rock masses; by contamination processes and overexploitation, contemporary global problem of providing high - quality drinking water was made;
3. *Forming of important deposits of energetic and other mineral raw materials* - one of the main supports of economic development; global problem is not only overexploitation of the mentioned restorable resources, but also contamination of the environment during exploitation.

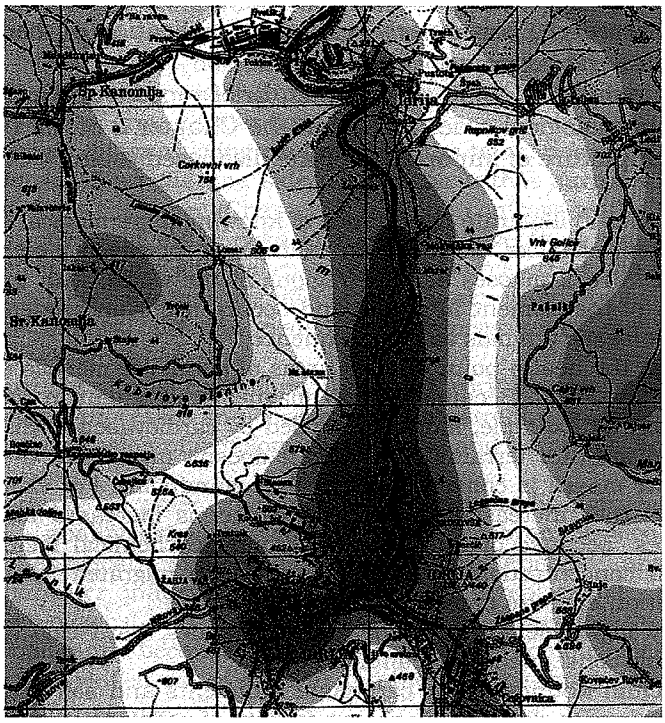

Fig. 10.1. Geochemical map of mercury distribution in soil in the territory of Idrija, Slovenia. Maximal Hg content over 140 mg/kg (M. Gosar, R. Sain, 2001).

Besides, *heavy metals releasing from rocks* presents one of predominant processes in the nature. Geochemical point of view, present in the global scale, with serious medical consequences because of existence of

undesirable elements, has to be explored to fulfilling level,serving as a basis for making medico - geological evaluation of the interesting area[118].

It seams to be paradoxical that consciousness on significance of geological medium and necessity to study protection of its values is still stunted, which is in the contrary to real needs of mankind - particularly because under natural conditions, living world is subjected to many geomedical and other risks (Chapter 2). According to the author's opinion, because of expressed intimacy and complexity, relation between geological environment and human health presents very important area of future geomedical research, particularly related to application of medical geology in health cure and economy.

Let us remind of some paragraphs, brief reports and examples, presented in chronological order mainly in the Chapter 2 of the book. Goal is to get a clear picture of importance of the discussed topic.

1. In order to illustrate importance of knowing mineralogical and chemical content of rocks, we noted an example of increased molybdenum content in rock masses of some regions in the world, with increased content of the element in plants and occurrence of molybdenum toxicosis in domestic animals as a consequence.
2. From the health point of view, areas of peridotite massifs are very suitable for living. Because of high magnesium content in rocks, soil and water, for example, mortality caused by cardiovascular diseases is less than in other terrains. However, it doesn't mean that the whole peridotite massif is convenient from that standpoint. For example, indications that increased mortality of cancer is increased along the fault zones, because of influence of certain geochemical factors, potential high concentration of some gasses which migrated from the Earth's interior, etc., are present.
3. Very high selenium content in black shales, hard coal and oil cause visible consequences on animal health.
4. Calcium abundance in carbonate sediments and soil near St. Petersburg is with direct influence on fertility of pedological soil and development of plants and animals.
5. Soil made by weathering of rocks rich in minerals with high copper content is poisonous for plant world.
6. Characteristics of plant and animal world in humid tropics are significantly consequence of lack of calcium and wealth in iron, aluminum and silica in soil (coloring, high Si content in various tropical plants, etc.) (Fig. 9.6.).
7. Positive and negative influences of pedological soil on plants, animals and human beings are extremely different and numerous, with specific

118 Chemical transfer of health risks is performed through with increased or decreased content of elements important for life. Natural wase of elements migration are through soil, water, plants and animals (Fig. 2.40.).

place belonging to the role of microelements (toxic effects; various microelementoses; occurrence of cancer and other diseases caused by deficiency in important elements, etc.).

8. Influence of geomorphologic forms on living conditions and health level of human beings is outstanding, regardless if speaking about either indirect or direct influence (mountain disease and other diseases of humans staying in high mountains; suitability of low mountains for recreation and tourism; treating for tuberculosis, bronchial asthma and other diseases, etc).
9. Dependence of living world on geological (geomorphologic) environment is particularly expressed in spacey karst areas (Figs. 9.10. and 9.11.), with risks in any domain of anthropogenic activity (drinking water shortage; breaks; risks during constructing artificial reservoirs and regulation of groundwater flow, etc.).
10. Extremely different living conditions at the territories of old shields and platforms, from the one side, as well as within surrounding tectonic belts, from the other (Chapter 9). On the contrary to the old terrains, destructive and other risks in zones of active fault structures in the areas of volcanic and seismic activity, expressed at the territories of mobile belts; also positive effects of volcanic eruptions on air, soil and water quality, thermal waters occurrences and large reserves of hidrogeothermal energy.
11. Disturbing normal conditions of life and work by developing exogenous geological processes and occurrences (catastrophic rock masses sliding; intensive erosion of pedological soil; risks and harmful effects of stone - mud flows).
12. Importance of water on living world is extremely high, particularly of high - quality drinking water. In dependence on physico - chemical, microbiological and radiological characteristics and purpose, groundwater influence is visible through irreplaceable physiological, epidemiological and hygienic role, but also some negative influences, predominantly because of surplus or deficit of some elements in water. Effects of skilled use of mineral and thermal waters, gasses and peloids are mainly positive[119].
13. Nowadays, mineral resources, according to their significance in the field of improving living conditions of the whole population on the Planet, rank second place, just after agriculture. Energetic raw materials (oil, natural gas, coal) are the main potential necessary for presence and

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[119] Giving a lecture related to mineral waters and spas in Vrnjacka banja in 1912, J. Zujovic expressed also risks on carbondioxid (carbon acid), desired gas in mineral water. *"When speaking on the topic, Dog cave near Naples is usually mentioned, on which floor content of carbon acid is so high, that dogs are died out, but man can stand without risk, because that gas doesn't rich his nose. - In village Leskovica near Zepce in Bosnia, there is Otrovnica settlement, where extreme quantity of carbon acid occurs at the ground surface, causing livestock fades away, and that is why the name of the place is Otrovnica. - In Java and in Northern America, "Death valleys" are known, which deserve such name, because even human beings are died out".*

development of the contemporary society, the most valued mineral product. On the contrary to advantages, deposits of mineral raw materials, with their aureoles of scattering and fields of exploitation and refining, are the areas of disturbed environment. Under the certain conditions, human health is endangered by air, water and soil, polluted by ecologically toxic elements, but also through catastrophes in mines caused by methane.

14. Nowadays, uranium, as energetic raw material, is extremely responsible for previous, present and future radioactive contamination of the Planet, contamination which is the most alarming problem of the present. When taking safety and population health into consideration, for this global problem, beside anthropogenic component of radiation level of biosphere, natural radioactivity of the lithosphere is responsible (effect of small doses in the areas of chemical aureoles (anomalies); radon risks, etc.). Note also positive effects of radioactivity phenomena in health services, including also positive radon effects during balneological treatments.
15. Precondition for presence indispensable macro - and microelements in the food chain of plants, animals and human beings are their existence in rocks, soil and water. Significant part of the text (Chapter 2) is treated this topic, and it could be concluded how wide range of influence of elements on the body is, including also numerous effects of irregular nutrition.

For needs of population and health cure, knowing of mentioned and many other elements of geological medium has to be raised on adequate level. After all, we are witnesses that questions of providing, use and protection of geological potentials, but also consequence of various geological forces, processes and occurrences, biological and medical role of macro - and microelements, practically present in daily life all over the world; about this questions, everyone is concerned, laymen are discussing the matter in various newspapers, without mentioning that such questions are from domain of geology. Geosciences and geomedical discipline have to force on correct viewpoints related to the nature and its relationships, in order to support, by its social mission, education of politicians, economists and businessmen, as well as wide range of population. Also, by appropriate scientific activities and results, to contribute to correcting some approaches in human treatment and health cure in general.

Let us conclude that good knowing of the elements of geological environment is very important, necessary if we want to perform prophylactic activities in the field of fight for healthy population. Among all, anomalous rayons unsuitable for living have to be defined, as well as the ways to improve them, in other words - which areas are ecologically suitable. Task of applied medical geology is to solve such questions, which

is possible to do if takes advantage of fund materials, information and knowledge, if outlines concrete territories according to interesting geological components and distinguishes rayons with extreme contents of some elements, perform multidisciplinary exploration in order to make close correlation of geological factors with medical symptoms.

MEDICO - GEOLOGICAL EVALUATION OF THE ENVIRONMENT

Analysis of geomedical characteristics of interesting area within general regional regularities looks very reasonable. In other words, that means that the area has to be studied through belonging to some of the first order geomedical units, that is - through geological characteristics and disease preconditions existing in the regional unit. In Chapter 9, there was a discussion about geotectonic (geomedical) units and their extreme zones, when clear difference between consolidated and mobile areas of the Earth's crust was emphasized (Table 9.1.). It was also stressed that, beside geological, geomorphologic, hydrogeological and climatologically features, each of distinguished units is characterized by appropriate pathology, physiology and epidemiology.

When position of the interesting area was defined within the first order unit to which it belongs, we are one step closer to its basic medico - geological characteristics and regularities. The second important step is determining the state of belonging of the area to corresponding geological formation, that is - tectonic structure, from which characteristics of geological column and texture of the terrain, as well as a series of geological regularities influencing on position and features of geochemical, pedological, hydrogeological, climatologically, biogeographic, floristic, geomedical and other areals are originated. For example, if the interesting area belongs to certain geological formation, appropriate petrologic, geochemical, hydrogeological, engineering - geological and other characteristics can be assumed with high certainty. Distinguishing geological features of the terrain is of outstanding support in planning and performing exploration, which goal is to present geomedical evaluation of the interesting area, in other words - of the environment.

Hence, in order to evaluate the environment, reliable restricted geological base has to be made, that is - to define all significant geological factors - petrologic composition, fault structures (Figs. 2.15. and 8.1.), geochemical features of rocks, soil and groundwater, geomorphologic characteristics of the terrain, geophysical fields, pedological soil characteristics, potential effect of endogenous and exogenous forces, existence of landslides, hydrogeological conditions of the terrain, presence

of the sources of low - mineralized, mineral and thermal waters and their quality, presence and characteristics of deposits of mineral raw materials (including energetic ones), natural radioactivity of the lithosphere, presence of radon and risks, etc.

The second stage of exploration is presented by geomedical study of the area, where the methods described in the Chapter 8 are applied. On the basis of the material of the previous exploration and results of complementary studies, it is possible to make basic geomedical map and other restricted maps, as map of medicogeological evaluation of the environment and map of population health, as the most reliable integral criterion for influence of environmental characteristics on human body. Further, different types of zoning, first of all - synthetic medico - geological zoning of the concrete area, that is - classification of the area into rayons with different characteristics and intensity of influence of geological factors on population health, origin and distribution of diseases are very useful. By using elements of the geological environment, from the one side, and leading pathology as one of basic indicators of real health level of population, from the other, conclusion related to degree of living comfortability of the area is possible to make.

Conceptual approach to solving the given task and range of graphical presentation methods depend on concrete geomedical conditions and problems which are to be solved. Distribution of necessary macro - and microelements and presence of anomalies of toxic microelements or increased radioactivity has to be placed on a higher level very often. Within such geomedically risky rayons, detailed exploration is obligatory.

Let us discuss an example of high *radon concentrations*, for which it is realized that causes the strongest radiation. It is known that, after inhaling, decay products of the gas are deposited in bronchi and lungs, influencing by radiation the surrounding tissue, with present risks from lung cancer. In order to define space distribution of the rayons, systematic and very detailed exploration is necessary, because level of the dangerous gas extremely depends on local geological conditions (lithological composition, presence of uranium - bearing formations, and position of fractures). For example, areas with high radon risk in Great Britain are predominantly made of rocks with high uranium content, as granites in southeastern England and parts of Scotland, phosphate rocks near Northampton shire, black shales in Wales, or famous Quaternary coal - bearing series. High radon values are present over the limestones in Derbyshire, because of high permeability (N.H. Woodcock, 1994).

Methodological approach to cartography referring to radon is presented according to experiences of experts from the former CSSR. Wide research activity in the country directed to solving population protection from radon, started in 1989, performed through three stages:

- I stage - regional exploration of radon, in scale 1:200,000;
- II stage - exploration of radon for needs of land - use planning, 1:25,000 to 1:10,000;
- III stage - detailed exploration of radon at localities determined for housing construction (V. Kulajtn, 1990).

As a result of exploratory works, all three stages are *maps of radon risk*, where the following three categories of rayons are distinguished: with high, medium and low radon content; within rayons of medium and high risk, contrast anomalies can occur (Table 10.1.). Special category of extremely high risk, which was not stated in the Table 10.1., is related to presence of anomalies along fault zones or parts of the terrain with macroscopic uranium occurrences, etc.

TABLE 10.1.

Risk category	Total Rn_{222} activity in air from soil (kBq m^{-3}), in soil, in foundations permeable for water and gas.		
	Low	Medium	High
Low	30	20	10
Medium	30 - 100	20 - 70	10 - 30
High	100	70	30

During radon exploration in detailed scales, in the former CSSR started with measurements along the 20 x 20 m network, in order to eliminate parts of the area with low content of the gas, and in the rest of the terrain, detailed exploration in scale 1:1,000 was carried out (at the beginning, along 10 x 10 m network, then with 5 x 5 m network for anomalous zones with extremely high concentrations). In that way, necessary basis for planning appropriate building constructing protection from radon, except for types of ground belonging to category of extremely high risk, where constructing is not recommended.

Geochemical maps of content and distribution of micro - and macro elements in rocks, soil and water can be made in similar way, but also distinguish zones of different risk degree for human health. Maps of space distribution of some interesting microelements, for example selenium, or fluoride or iodine, too. All such maps are significant for evaluation of the concrete environment.

ROLE OF MEDICO - GEOLOGICAL EXPLORATION IN IMPROVING THE ENVIRONMENT AND HUMAN HEALTH PROTECTION

The world presents a global ecological system, where all living creatures, including human beings, are submitted to certain biological regularities. When adapted himself to the influences of the natural (geological) medium, man with his activity caused essential changes within the system without necessary forecast, disturbing more and more ecological links and causing almost irreparable damages to the environment, where biological equilibrium was kept during several millennia until then. That is why knowledge of ecology, one of the fundamental disciplines of multidisciplinary character, acquired outstanding significance for applied activities in domain of preserving and maintaining healthy environment. It is understandable that, in order to protect the environment efficiently, beside a need for intensifying and coordinating activities from all countries on the Planet, necessity for wide action in the field of education and specializing of physicians, geologists and other professions occurred, showing as equal partners in solving complex tasks of protection the environment.

With unseen rapid development of civilization, geological environment becomes very important integral part of the environment, as hydrosphere, atmosphere and biosphere, entering more and more into interaction with anthropogenic activity and producing material basis for direct change of matter and energy between man and nature. So, four qualitatively different groups of relationships between human beings and appropriate geological environment came into the first plan: 1) *basic raw materials and energetic resources necessary for socio - economical development are obtained from the lithosphere;* 2) *natural geodynamical processes are endangering human lives and capital values;* 3) *man is more and more forced to ensure harmonious interaction of building and other constructions with geological environment in advance and rationally;* 4) *human beings are more and more aware of necessity for defending geological environment from contamination and disturbing* (M. Matula, 1990)[120].

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[120] During seventies of the last century, in accordance with forming geological tasks in producing and protection of the environment, in the former CSSR, the following four groups of *geofactors of the environment* were distinguished:

1. *geofactors enabling suitable development of the society* (mining and non-mining raw materials, energy resources, groundwater, cultivable soil, high-quality ground for constructing, building materials, convenient areas for waste disposing, etc.);

Significance of *geofactors* was distinguished during sixties of the 20th Century, when, as a result of higher level of knowledge related to necessity to protect the environment, need to evaluate anthropogenic influence on the environment (Environmental Impact Assessment) occurred. At that time, USA Government concluded that it was necessary to make a mechanism of decision making, ensuring some kind of analysis of all large projects from the standpoint of influence on the environment. In January 1970, the law called **National Environmental Policy Act (NEPA)** was accepted by the administration[121].

Evaluation of potential influences on the environment is made by application of the most convenient methodology. According to regulations in Yugoslavia, it is necessary to evaluate the following influences from the domain of geology:

1. loss and damage of geological, palaeontological and other objects of geological heritage;
2. influence on rocks and soil (changes in local morphology, soil erosion, rock masses and soil sliding; influence of emissions and precipitation on soil; waste disposal);
3. influence on water (changes in groundwater and surface water regime; influence of contamination, waste and waste disposal);
4. Influence of mineral raw materials presence and exploitation (consequences formed by raw materials, water, energy and other geological potentials exploitation).

Before start to analyze role of medico - geological exploration, experiences of medical geography are discussed.

Medico - geographic evaluation of the territorial systems of the surrounding environment is made according to classifications of the

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2. *geofactors endangering human lives and their products* (volcanic eruptions, destructive earthquakes, catastrophic landslides, floods, toxic and radioactive working, etc.);
3. *geofactors reducing efficiency and safety of technical objects functioning* (foundation ground of low capacity, instable rocks - chemically and in volume, unstable and labile slopes, softening of foundation ground, seismic active terrains, etc.);
4. *geofactors damaging the environment by negative anthropogenic activity* (terrain sinking caused by underground exploitation and pumping, raging because of surface exploitation, material disposing, groundwater and rocks pollution caused by agricultural production, landfills, soil softening or drainaging because of constructing, etc.).

[121] From the middle of 1970, in Netherlands evaluation of influence on the environment is obligatory, and from 1986, there is also a law. Complex regulation was issued in Canada in 1973. European economic union issued **Directives for evaluation of influence of certain public and private projects on the environment** in July, 1985. The similar legislation was issued by many countries over the world.

components (factors) of the environment defined according to various standpoints: according to periodicity of influence on living activity of human beings; according to possibility of rejecting influences of the environmental factors to living activity of human beings; according to possibility of making interactions with other components of the environment and reinforcing or weakening their effect on living activity; according to the degree of direct participation in influencing on work, rest and population health (Keller et al., 1993). Influence intensity of the environmental components on population health can be: 1) *weak*; 2) *medium*; 3) *strong*; 4) *critical or limiting.* Critical or limiting parameters of the environment, which can complicate or even make impossible work, everyday life and rest of the human beings, are particularly interesting. That is why special systems of life insurance are required.

Nowadays, it can be stated that two types of comparative evaluations of regional characteristics referring to work, everyday life, rest, population health are distinguished within medical geography. *The first* - quantity or half - quantity evaluation of factors with enough correct numerical parameters. This type of evaluation was significantly taken on from hygiene and is referring to distinguished sides of population life. *The second type of evaluation* - quantitative, that is - relative evaluation given over point number, applicable for cases of integral sanoecological processes and occurrences. The mentioned two approaches are closely interconnected.

Among sides of population living activity, population nutrition, quantity of heat isolation of apartments and clothes, constructing expenditures, etc. The questions were treated by Keller with assistants (1993).

Among traditional methods, *comparative method,* with comparative evaluation of different geographical processes and occurrences according to population health level as an integral part, is used within medical geography for a long time. According to Keller and associates, medico - geographic evaluation can be treated as scientifically based defining of the role and degree of influence intensity of some environmental factor of the concrete territory or their reflection on population health level, character of distribution of different diseases, human productivity or rest. It is understandable that, within evaluation of a series of factors, important contribution can be obtained by appropriate experts. Making *medico - geographic evaluation,* as a product of exploration activity for the concrete area, is one of very important functions of medical geography, which should have in mind.

Majority of medico - geographical papers contains preliminary, first of all - oral evaluations of some occurrence. So, in evaluation of natural conditions to which population has to be adapted, it is very difficult to say how they would influence on each man. But, tendency on the basis of comparative analysis of different territorial systems according to population adaptation can be discovered and evaluated. As a result of similarity analyses, complex or simpler evaluation scale appears. Note the next, very simple scale: 1) territories with very bad adaptation conditions; 2) territories with bad adaptation conditions; 3) territories

with satisfactory adaptation conditions; 4) territories with convenient adaptation conditions; 5) territories with very convenient adaptation conditions. Or, even much simpler, if oral characteristics are changed by score characteristics, and adaptation conditions of new coming population would be: 1, 2, 3, 4, and 5 scores.

For example, in similar way, circulation intensity of naturally - focal infections and invasion carriers can be evaluated. In a series of cases, evaluation is based on 2 - , 3 - score scales.

According V.A.Bakalov (1976), several *natural factors* are evaluated - climate, relief, hydrography, soil and engineering geological conditions, as also living conditions of Baikal area according to degree of their suitability for living. On the basis of the developed methodology and analysis of evaluated parameters, evaluating tables for each observed component of natural environment are presented in scores, in comparison to their suitability for temporary living of population. As a result, significant part of exploratory area was evaluated with low score mark, and that is why it was classified into unsuitable and low - suitable rayons for permanent stay of human beings.

When speaking about *anthropogenically contaminated territory*, highest allowed concentrations of the mostly distributed and chemically active substances involved into the environment are used as standards of environmental contamination. From the other side, evaluation of potential ability of the territorial complex for self - cleaning is made. Comparing potential capabilities of the geosystem for self - protection (self - cleaning) with factual contamination of the natural (living) environment, makes evaluation of ecological conditions for observed important group of factors possible. On the basis of general stability according to anthropogenic interventions, natural comples are evaluated with one of six scores: 1) extremely stable; 2) stable; 3) poorly stable; 4) decreased stability; 5) stable; 6) very stable. It is reasonable that extremely inconvenient demoecological conditions are formed during high factual contamination of natural comples and low ability of self - cleaning.

If start from the role of numerous geofactors, it can be assumed that, in domain of improving the environment and preservation of human health, high contribution is expected from **medical geology**. That goes without saying that that geological environment is previously explored in detail and that influence of appropriate factors is specially studied and spacey determined. Also, in application of *comparative method*, experience and results of medical geography are used. Comparative method will certainly find a place in evaluating medico - geological influences of different geological processes and occurrences on population health level of the interesting area, too.

By application of medico - geological exploration methods, consequences of different risks can be evaluated and their areals cartographically distinguished. Role of fundamental and applied methods in outlining certain risks, that is - improving the environment and preservation of human health, is illustrated by several examples, while

example related to compiling maps of radon risk has already been presented.

1. For evaluation of *aquifer vulnerability to contamination*, inevitable raw materials for drinking water supply, several ways are known, and it is possible to perform satisfactory evaluation of terrain zoning when speaking about contamination from the terrain surface very often (S. Komatina, 1995, 1998). However, in order to protect aquifers endangered by contaminant front (plume), in USA, numerous methods of exploration and technological measures of rehabilitation are developed. Principal goal is to destroy focus, in other words - to prevent further penetration of the plume, by application of technologies based on solving the problem without contaminant extraction from the subsurface (various barriers in front of the plume, technologies with gas injecting, bioremediation, etc.). Preserved quality of drinking water is a main precondition for population health protection. Besides, results of hydrogeological exploration, as well as of hydrogeochemical and hydrogeomedical investigations, will give the answer to questions referring to how much groundwater is present and of which quality, where potential aquifers are, in other words - how to evaluate effects of consumed water from the health standpoint, etc.
2. Exploration of *risk of amphibole asbestos, tremolite, wollastonite, zeolite and other fibrous mineral and their dust* are of medico - mineralogical character[122]. They directed to stronger or weaker influence on malignant lungs tumor occurrence, but also lungs fibrosis (asbestosis), so - more and more attention is paid to them. By geomedical methods, not only potentially risky geological formations, as well as specially risky rayons (mine deposits, mines, aureoles of scattering), can be distinguished, but also safe rayons outlined, consequences of living in risky areas explored and measures for reducing risks of that type of contamination suggested.
3. It has been already mentioned that *microelements* act within numerous and different functions in all organisms and that their deficiency or surplus causes diseases. Contribution of geochemistry is which has been suddenly developed starting from the sixties of the last century, to classify these elements in rocks, soil and water into ethiological factors of the primary importance. That is why it is possible to define geochemically risky rayons, as well as rayons suitable from the medical standpoint and to determine measures for improving the environment. Bioinorganic research can be very helpful in this domain, particularly when speaking about correlation of toxic elements with medical symptoms and prevention of contaminating the environment by toxic elements and their compounds.
4. Numerous human victims and financial losses caused by *earthquakes* gave to the scientists a pretext for study of possibilities to construct

[122] Among all, it was determined that risk of diseases depends significantly on the type of asbestos, more precisely - amphibole asbestos is much dangerous than serpentine chrysotile asbestos.

safely from the aseismic standpoint, so the science nowadays contains wide range of methods. As geological, hydrogeological and engineering geological feature of rocks (soil) influence to a greatest extent on degree of the objects damaging, necessity of making map of microseismic zoning, that is - outlining rayons characterized by different degree of seismic intensity, has been adopted for the terrains from the mobile belts of the Earth's crust which are interesting from the standpoint of urbanization[123].

By the right choice of medico - geological exploration methods, as well as by successful use of cartography, it is possible to direct to significant part of medical problems endangering the environment and health of the population. Medicine must and can to obtain contemporary (high quality) *medico - geological basis*, with enough precise evaluation of negative and positive geological factors and rayons outlined according to degree of suitability for living. By such base, the right way to prophylactic action and performing other measures necessary within population health cure will be found.

[123] Starting from seventies of the last century, in China, former USSR, Japan and USA, organized work on earthquake forecast started; however, with partial success. It was realized that very important information can be obtained by application of hydrogeoseismological methods (hydrogeochemical and hydrogeodynamical methods), while important indicator can be electromagnetic changes characterizing stage of tectonic movements. For example, as hydrogeochemical indicators, gasses (radon, helium, argon, etc.) are used, as also various isotope relations. Trace elements and all other parameters of groundwater chemical content, if there changes before and during the earthquake are interesting (G.A. Mavlianov et al., 1983).