Journal of the Georgian Geophysical Society,
Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.19B, 2016, pp. 101-110

The Preliminary Results of the Chemical-radiological Investigations of the Soils on the Territory of the Makhata Mountain

Sophiko B. Matiashvili

M. Nodia Institute of Geophysics at Iv. Javakhishvili Tbilisi State University,1 M Alexsidze Str 0160, Tbilisi, Georgia, sophiko_79@mail.ru

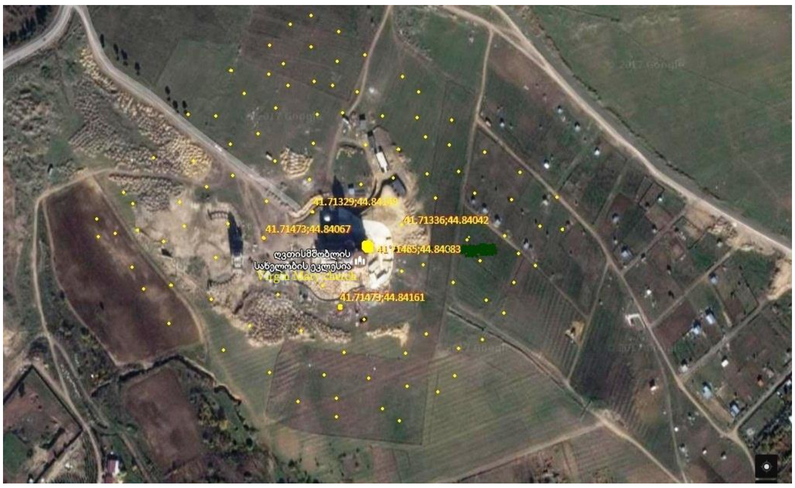
ABSTRACT

A detailed environmental study of any section of the city of Tbilisi on the subject of environmental hazards is a particularly urgent issue. From this point of view, the area of Mount Mahat is special, because Here for several years now operates the Church of Virgin Mary of Iberia Cathedral. 2012-13 years. A radioecological and agrochemical study was conducted on that site in the territory of Mount Makhata, where the Church of the Iberian Mother of God will be located. Laboratory studies of soil samples taken from this area were carried out at the research center of the Ministry of Agriculture. According to the initial data of environmental monitoring, it can be considered that the investigated territory is either a polluted medium level or a little polluted. Here the criterion is the content of a specific pollutant element, which should be less than the maximum permissible concentration of radionuclide in excess of the former Soviet standards. The background of agrochemical contamination on the investigated site is also not alarming. However, in spite of the fact that the radiation monitoring did not reveal significant contamination with radiation spots or point sources, periodic ecological monitoring of the investigated territory should continue to be continued in the future.

***Key words*: Radiation monitoring, agrochemical monitoring, heavy metals, Makhata mount**

Preface

The Makhata Mountain is located on the left bank of the river Mtkvari, to the north of the central part of Tbilisi city, between the eastern edge of the city and the Tbilisi Sea (reservoir), at ≈600 m above sea level (Pic. 1). Nowadays the territory is a part of the ex-terrace of the mountain. The Makhata Mountain is built of upper Eocene clay and sand covered with the Quaternary alluvial sediments. It is characterized with flat top, slanting eastern and southern slopes and steep western and northern slopes.



Pic. 1
Virgin Mary church and surrounding Makhata mountain of area.

In 2012 on the Makhata Mountain the building process of the Church of Virgin Mary of Iberia was launched. The foundation was blessed by Catholicos-Patriarch of All Georgia Ilia II. The Makhata territory is of special significance regarding both its historical past and current meaning. It is natural that like other residential areas the site must be ecologically safe for the population. In this regard in 2012-2013 radio-ecological and agro-chemical investigations were carried out on the mountain area for the Church of Virgin Mary of Iberia. The soil samples taken from the territory were studied at Scientific-Research Center of Agriculture.

Actuality, novelty and formulation of the task

As a rule, detailed investigation of any area of Tbilisi regarding ecological safety is an especially important issue. In this view point the Makhata territory is of great significance as far as the Cathedral has been functioning for several years at this place. As the Cathedral was being built the relevant infrastructures were developed simultaneously: roads, buildings for rite, different auxiliary facilities and communications were built. Thus, the Makhata area, which is already densely urbanized, nowadays includes religious buildings of the Sameba Cathedral and the Church of Virgin Mary of Iberia, which are public places for a large quantity of people. Taking into consideration that during the Soviet period several important military facilities were located on the territory it is natural that ecological safety of such places is of the most significant issues.

Extremely high pollution of environment caused due to unsystematic industrialization was a problem characteristic of the last century. Its dramatic results were deteriorated by the Soviet military facilities. Nowadays many military objects have been replaced with civil ones. Therefore, ecological investigation (especially radiation monitoring) of these places is quite necessary in certain cases. It is considered that among civil factors for environment pollution the most significant reasons are industry and agriculture [1-6]. One more factor is natural erosion of soil. This factor is especially strong at the places of probable deep contamination of rocks, e.g. near mines and quarries. Saturation of the soil with chemicals plays the most minor role in the contamination of such places. Different artificial radioactive sources also often take part in environment pollution, e.g. before the 70-s of the 20th century massive environmental radioactive contamination was caused due to nuclear weapons tests in the atmosphere, also dissipation of radionuclides and spillage of radioactive water out into the environment from some nuclear electric power station. Besides the direct effects on ecosystem, natural and artificial radionuclides have indirectly environmental effects (acceleration of the formation of secondary aerosols, influence on the clouds microphysics, atmospheric precipitation, etc.) [7-9].

In this regard disastrous ecological results of several nucleus accidents are well known for public, for example, the Chernobyl Disaster was followed by especially widespread contamination caused by radionuclides, whereas during the Fukushima Disaster great quantity of radioactive water was spread into the environment [10,11]. Besides, as we have mentioned above, the environment is significantly contaminated by mining and transport fumes, as a result of which great quantity of radionuclides and heavy metals appear in the soil.

Besides the above mentioned civil pollution sources, the territory of Georgia was significantly contaminated by the former Soviet military facilities. Unfortunately, the most of them were located in urban areas in the centre of Tbilisi as well as in its vicinity, for example, several significant facilities (munition-factory *Arsenal*, headquarters of air forces, arsenal) were located on the Makhata Mountain. As it appeared after the collapse of the Soviet Union there had been no radiation control kept on many of the military facilities. Namely, contamination of environment and buildings by radionuclides and point radioactive sources was observed at many places of Georgia. Very often the radioactive contamination was followed by pollution with heavy metals, e.g. on the Makhata Mountain at the site of the former Soviet facilities the soil was contaminated by radiation. As a rule, it was caused by point radioactive sources, the significant quantity of which in the past was kept at military facilities (munition-factory *Arsenal*, headquarters of air forces, arsenal) located on the territory of the Makhata Mountain. These facilities were investigated within the framework of a special international programme (NATO grant G564 – **Complex monitoring of military bases in Georgia** 2002-2004). According to the specification of the programme this preliminary (2002) investigation included observations of only the areas of former and active military facilities and their surrounding territories. Thus, we may state that detailed radioecological monitoring of the civil (urban) part of the Makhata Mountain has not taken place if not taken into account the not quite detailed air monitoring of Tbilisi during the last years of the Communist period. Perfect ecological monitoring has neither been fulfilled during the building process of the cathedral. In this period the building area underwent significant technologic pressure. Huge masses of soil were cut off and flattened. At this time contaminating elements must have been distributed on the surface from the local foci (in the case of their existence). Consequently, we may suppose that since the Soviet period the building area has probably been contaminated with radionuclides regarding its nearness to the munition-factory. Thus, we once again state actuality of our task, the goal of which, first of all, is to verify radioecological safety of the territory and surroundings of the Cathedral and the Tsminda Ioane Church (Church of Saint John).

It is obvious that such task must include radiation monitoring in front of the Makhata Mountain slope, which is adjacent to a very densely populated area and also quite a large territory to the north of the cathedral (so called Arsenal settlement) to the Tbilisi Sea. Like at any other places, in this area any kind of radioactive influence on humans and the environment from any kind of radiation source should be excluded. The level of contamination of the soil with heavy metals (radioactive elements) should be also determined, which is much more labour-intensive task compared to surface radiation monitoring. Exactly this is the goal of the 2012-2018 special research programme, the part of which is our research. This programme includes preliminary ecological monitoring at the areas of probable radioactive pollution. Such investigations are essential for obtaining data on the background states in case of revealing probable serious contamination of the soil in the Makhata area and its adjacent territory. Otherwise, it would be impossible to determine the measures of improvement of the soil conditions in case it is required. As a rule, new background states must correspond to the permissible concentration of contaminating elements, though nowadays there is some ambiguity regarding this issue [12,13]. It is clear that requirements of ecological safety must be properly fulfilled for agricultural lands and urban areas. In this regard it is obvious that we consider the Makhata territory as one of the special zones of Tbilisi. In 2012-2013 the soil parameters on the building territory and the area adjacent to the Church of the Virgin Mary of Iberia were measured for three times. At certain points selected, according to due rules, together with soil composition the natural radiation background in the atmosphere was determined on the whole territory of Makhata including the yard of the Sameba Cathedral. The natural radiation background varied within the permissible levels: /0-20/ microSv. This result was expected as far as unlike West Georgia the natural radiation background in East Georgia has mainly been within the permissible limits during the whole period of instrumental measurements even after the Chernobyl Disaster. However, it is known that even before the Chernobyl Disaster artificial radionuclides had penetrated into the territory of Georgia as a result of nuclear weapons tests taking place before 1963 in the Earth's atmosphere. We suppose that exactly this is the reason for probable difference in radionuclide concentration in various types of soils adjacent to one another that is accepted according to radiation-hygiene and sanitary standards.

In this viewpoint the most interesting is radionuclide Cs^{137}, which appeared in a big amount in the radioactive cloud after the Chernobyl Disaster. At the same time the Institute of Physics and Technology of Sokhumi on its own initiation carried out radiation monitoring of the Abkhazian coastline [1,13]. The monitoring results showed that the Cs^{137} concentration was especially high. Generally, according to the evaluation system of that time, radioactivity measured at different places varied within interval (2-5 curie/km^2), which must have been considered alarming. In 1991 the contamination level was verified at some places. It showed decrease in radioactivity, which must have been a result of decrease only in radionuclides, namely, in the Cesium concentration. Naturally, this effect is connected with atmospheric precipitations, which are especially frequent in West Georgia, namely in Abkhazia, compared to those of East Georgia. Despite the relatively weak diffusion effect nowadays in East Georgia the level of contamination by Cesium may not be higher than contamination by other elements, e.g. Potassium and Phosphorus. We consider the Cesium contamination level, which was recorded thirty years ago in East Georgia, namely in Tbilisi [10,14,15] as a basis for such claiming. That time Tbilisi city appeared in a Cesium contamination zone by isoline 0.1 curie/km^2. Volumetric radioactivity as 22 Bq/kg approximately corresponded to such surface radioactivity. Taking into account the diffusion effect and the time period, which has passed after the measurement, the volumetric radioactivity measured earlier must have been halved. This means that the role of Cesium, compared to other radioactive elements, in the contamination of territory of the Makhata Mountain must be relatively lower nowadays.

Thus, as a result of the analysis of the soil samples obtained on the Makhata territory (not less than 100 samples obtained during each field work) we determined the level of contamination with radioactive and chemical elements. The samples were removed without a grid, while the sample points were selected randomly and the distance between neighbouring points was 10-12 m. The agrochemical analysis was made by approved standard methodology. Approximately 1000 points were checked during each field work of the radiation monitoring process. For the radiation investigations military field radiation dosemeter РП was used. The monitoring process did not reveal any artificial point radiation source.

In table 1, which corresponds to the territory of Tsminda Ioane Church, the results of the agrochemical analysis are shown. This site is characterized with dark grey soil, [16] which is homogenous here on a quite large area; N1 denotes datum of the soil sample obtained from the foundation. The sample is a mixed soil. This means that the obtained datum is average. The data, which correspond to the samples taken from the angles of the 50m side square shape territory around the church foundation (digging depth – 0-60 cm, interval – 20 cm; N1-N5) are also average.

Table 1

Main agrochemical data of the soil composition. Iveeri's Monastery Complex Church

Depth in cm	Humus-%	Nitrogen		Phosphorus		Potassium	$PH(H_2O)$	$CaCO_3$%
		General %	Hydro g/kg per g soil	Total %	absorbed g/kg in soil	General %		
Average 0-60	3.2	0.19	7.2	3.2	7.3	1.29	6.3	None
0-20	4.9	0.27	9.9	5.2	11.4	1.38	6.3	None
20-40	3.0	0.18	6.9	3.1	7.2	1.31	6.2	
40-60	1.3	0.14	3.8	1.4	3.4	1.20	6.4	
0-20	5.0	0.21	11.4	5.2	11.2	1.52	7.3	2.8
20-40	2.6	0.12	6.2	3.1	5.3	1.44	7.3	2.
40-60	1.3	0.08	4.8	1.7	3.2	1.38	7.5	6.9
0-20	5.2	0.26	15.8	5.2	12.1	1.51	7.7	18.8
20-40	1.8	0.18	7.9	3.1	8.9	1.45	7.9	21.6
40-60	1.2	0.13	6.3	1.9	5.1	1.39	8.0	38.3
0-20	4.9	0.19	14.2	5.3	12.7	1.45	7.4	9.9
20-40	3.1	0.11	7.4	3.3	7.9	1.38	7.5	11.3
40-60	1.1	0.07	3.2	1.2	4.6	1.35	7.7	14.7

Besides chemical analysis, by means of the samples taken from the points constituting Table 1 we carried out radiological analysis (table 2) and analysis of heavy metal concentration in the soil (table 3).

Table 2

Iveeris Monastery Complex					
Radionuclide(Bq/kg); (Averaged 0-60 cm)	№1 44.84083; 41.71465	№2 44.84149; 41.71329	№3 44.84042; 41.71336	№4 44.84161; 41.71473	№5 44.84067; 41.71473
^{40}K	493	481	404	465	264
^{226}Ra	12	5	9	15	5
^{208}Tl	5.9	9.2	13	11	9.5
^{224}Ra	208	369	191	280	275

Table 3

Heavy metals - Iveeris Monastery Complex mg/kg						
1	Fe	590.135	582.21	307.27	438.96	479.70
2	Mn	13.31	937	826	1040	1034
3	Ni	10.7	12.7	0.1	12.7	9.0
4	Cu	82.9	72.7	64.1	77.2	74.2
5	Pb	102	123	129	146	125
6	Zn	244	202	154	286	199
7	Co	7.7	5.8	-	0.7	3.05

As seen from the above tables, the laboratory analysis, besides the church foundations and its adjacent dark grey soil, shows sufficient material for general agrochemical characterizing of all the types of soils on the Makhata Mountain. Indeed, Table 4 indicates that the Makhata territory contains dark grey, forest brown and field type soils and mixed soils between them, though here mainly dark grey soils of different thicknesses are met. They have developed on eroded products of sandstone, porphyry and andesite. Besides, the soils here have different profile thickness in accordance with the relief sloping.

Table 4

№	Soil types.	Depth cm	Humus %	Nitrogen		Phosphorus		Potassium		PHH_2O	$CaCO_3$%
				General % 100 g soil	Hydro mg per 100 g soil	Total % 100 g soil	Absorbed mg in 100 g soil	General % 100 g soil	Exchanged mg in 100 g soil		
1	Dark grey	0-20 20-40 40-60	5.2 3.1 1.4	2.7 1.8 1.4	10.3 7.2 4.1	0.52 0.31 0.14	11.4 7.2 3.4	1.38 1.31 1.20	38.2 34.0 28.7	6.3 6.2 6.4	None
2	Dark grey	0-20 20-40 40-60	2.7 2.1 1.7	2.2 1.8 1.5	12.1 6.0 3.7	0.52 0.31 0.15	8.9 5.3 3.0	1.41 1.30 1.21	39.9 36.2 30.0	6.0 6.2 6.5	None
3	Forest brown soil	0-20 20-40 40-60	3.7 2.4 1.3	2.1 1.2 0.8	11.4 6.2 4.8	0.52 0.31 0.17	12.2 5.3 3.3	1.52 1.44 1.38	32.4 28.7 21.4	7.3 7.3 7.5	2.8 2.5 6.9
4	Humus-carbonate soil	0-20 20-40 40-60	3.5 1.7 1.1	2.6 1.8 1.3	15.2 7.8 6.2	5.2 3.1 1.9	13.2 9.4 5.5	1.54 1.51 1.49	42.1 38.5 34.0	7.7 7.9 8.0	18.8 21.6 38.3
5	Meadow alluvial soil	0-20 20-40 40-60	2.6 1.2 0.8	1.9 1.1 0.7	14.2 7.4 3.2	5.2 3.1 1.10	12.7 7.9 4.6	1.25 1.18 1.15	27.7 22.5 20.1	7.4 7.5 7.7	9.9 11.3 14.7

6	Black soil	0-20	3.2	2.5	14.2	5.2	17.6	1.86	36.5	7.1	2.8
		20-40	1.9	2.1	9.9	3.1	12.0	1.74	33.0	7.4	2.4
		40-60	1.2	1.8	7.2	1.11	8.4	1.49	28.4	7.4	18.3

Thus, on the basis of the preliminary study we may consider that at the monitoring sites the level of the agrochemical contamination in the soils of Makhata territory is not significant. It is obvious that such conclusion is correct only in case of fulfilling soil purity criteria, according to which the concentration level of a concrete contaminating element must be less than the maximum concentration limit established for this element. However, it is known that determination of a maximum concentration limit for some elements is a world-wide problem, which makes it very difficult to assess ecological hazards. In order to prove this, e.g., we can present some former Soviet standards, which, due to absence of new standards in Georgia, are considered permissible even nowadays [17]:

Lead: approximate safe level for this element in clay carbonated soils is 65 mg/kg. Consequently, according to Table 4 in some soil samples obtained by us the level of contamination by lead (1.92-1.59 times) exceeds the approximate safe level.

Nickel: Unlike lead, the level of contamination by this element in our samples appeared much lower than the Soviet approximate safe level 40 mg/kg. Namely, in this case the contamination level is (4-500 times) less than the approximate safe level.

Copper: The level of contamination by this element is near the approximate safe level – 66 mg/kg (1.25-0.97 times).

Regarding that our goal is general assessment of the level of contamination in the Makhata territory soils we suppose that Table 5 is quite useful. It shows concentration of chemical elements in soils at randomly selected sites. Table 6 is compiled in the same way. It shows concentration of radioactive elements and heavy metals in some of those 100 samples, the analysis of which was done. It is obvious that the absolute values of the data in this table is insignificantly changed compared to the data in the tables 2 and 3 (Δ(max) ≈40-50 %).

Table 5

Coordinates	Points dispersed in any direction, Bq/kg								
	K^{40}	Ra^{226}	Tl^{208}	Ra^{224}	Cs^{137}	Bi^{211}	Pb^{214}	Pb^{212}	Th^{228}
Lat 44,84083 Long 41,71465	493				27				
Lat 44,84149 Long 41,71329	441				12	57			–
Lat 44,84042 Long 41,71336	292	12		221	5		13		–
Lat 44,84067 Long 41,71473	395		9.2	369					–
Lat 44,84161 Long 41,71473	404	12		191	9.2	19			–
Lat 44,83991 Long 41,71546	465		13		15	16		21	–
Lat 44,8398 Long 41,7144	432	15		280			15		–
Lat 44,83755 Long 41,71601	466			275	8.7		19	32	–

Lat 44,85752 Long 41,71612	377	15	5.9	155		19	21		–
Lat 44,85746 Long 41,75460	364	17	9.5	271		10	16		–
Lat 44,86601 Long 41,76560	542		11	313			23		–
Lat 44,86612 Long 41,75532	497	23		267		18	33	18	–

Table 6 is a simple illustration of the fact connected with the differences of national ecological-sanitary standards in different countries [17]. Namely, there are no universally permissible limits for soil contamination by radioactive elements. Therefore, we have received certain degree of freedom regarding exceedance in permissible concentration (EPC). This parameter practically determines the value of exceeding the maximum permissible concentration (MPC) of some element in soil in order to consider it life-threatening. Therefore, it is considered that for assessment of ecological hazards and evaluation of life-threatening concentration we may use the following formula: $A=EPC \cdot MPC$, where MPC is a measured concentration. As a rule, it is obvious that for a concrete contaminating element the theoretical value must be compared to the results of the laboratory analysis. Besides, by analogy with heavy metals for various radioactive elements the EPC must be different. It is also noteworthy that, compared to radioactive elements, reliability of assessment of contamination by heavy metals is higher as far as for metals practically all EPC-s are known. This parameter varies according the class a heavy metal belongs to: 1. very hazardous; 2. moderately hazardous; 3. less hazardous. According to this classification in various countries different standards of EPC are established. Table 6 is an illustration of such standards and enables comparing EPC standards in Netherlands [17] and the EPC standards in the former Soviet Union. The comparative analysis shows that, e.g., in Netherlands the concentration of lead in sand, sandstone and some soils may 55-times exceed MPC, the established value of which for this country was 6.0 mg/kg. Consequently, in Netherlands the moderately hazardous for life concentration is considered 330 mg/kg, whereas in the former Soviet Union the maximum permissible concentration was MPC=32-130 mg/kg for all kinds of soil. Same parameters in Netherlands, e.g., for copper is MPC 3 mg/kg and approximate safe level is 10.5 mg/kg (EPC= 3.5). According to the standards of the former Soviet Union the corresponding values are MPC =3 mg/kg and approximate safe level is 66 mg/kg (EPC=22). These two samples show the measures of differences in the standards of various countries. Therefore, taking into consideration the reality in the country it is quite difficult task for Georgia to elaborate national standards.

Table 6

Heavy Metals	MPC, mg/kg	EPC, mg/kg	EPC for Georgia, mg/kg
Ni	4	2.6	4
Cu	3	3.5	6
Co	5	24	5
Zn	23	16	23
Pb	6.0	55	65

Conclusion. According to the data of the preliminary ecological monitoring on the contamination by agroecological and radioactive elements of some part of the Makhata Mountain territory we may generally consider that the territory is moderately or less contaminated [18]. This statement is based on the laboratory analysis of the soil samples randomly taken mainly from the foundation of the Church of Virgin Mary of Iberia and its adjacent territory. If we extrapolate from the obtained data, we may suppose that the agrochemical pollution level in the soils of the Makhata Mountain territory is not serious. Despite the radiation monitoring has not revealed contamination of the site by radiation spots or point sources the territory should be monitored periodically in future as well, as far as several significant military facilities were located in this area in the Soviet period.

The author thanked Professor Zaur Chankseliani for guidance and Professor Zurab Kereselidze for useful advice.

References

[1] Eisenberg M. Radioactivity of the environment. Translated from English under editorship of P.P. Lyarskii M., Atomizdat, 1967, (in Russian).
[2] Chankseliani Z., Zardalishvili O. Ecological Principles of Agro-chemistry. (a book). Tbilisi, 1992, 107 p. (in Georgian).
[3] Budagashvili T., Karchava J., Gunia G., Intskirveli L., Kuchava T., Gurgenidze M., Amiranashvili A., Chikhladze T. Inventory of Greenhouse Gas Emissions and Sinks. Georgia's Initial National Communication on Under the United Nations Framework Convection on Climate Change, Project GEO/96/G31, Tb., 1999, 137 p.
[4] Amiranashvili A.G., Amiranashvili V.A., Gzirishvili T.G., Kharchilava J.F., Tavartkiladze K.A. Modern Climate Change in Georgia. Radiatively Active Small Atmospheric Admixtures. Institute of Geophysics, Monograph. Trans. of M. Nodia Institute of Geophysics of Georgian Acad. of Sc., ISSN 1512-1135, v. LIX, Tb., 2005, 128 p.
[5] Tavartkiladze K., Begalishvili N., Kharchilava J., Mumladze D., Amiranashvili A., Vachnadze J., Shengelia I., Amiranashvili V. Contemporary climate change in Georgia. Regime of some climate parameters and their variability. Monograph, ISBN 99928-885-4-7, Tb., 2006, 177 p., (in Georgian).
[6] Amiranashvili A., Bliadze T., Chikhladze V. Photochemical smog in Tbilisi. Monograph, Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, v. 63, Tb., 2012, 160 p., (in Georgian).
[7] Amiranashvili A.G., Gzirishvili T.G., Chumburidze Z.A. On the role of artificial ice forming reagents and radioactive intermixtures in the variation of convective clouds thunderstorm and hail activity. Proc. 12th Int. Conf. on Clouds and Pricipitation, Zurich, Switzerland, August 19-23, v. 1, 1996, 267-270.
[8] Amiranashvili A.G. Increasing Public Awareness of Different Types of Geophysical Catastrophes, Possibilities of Their Initiation as a Result of Terrorist Activity, Methods of Protection and Fight With Their Negative Consequences. Engaging the Public to Fight Consequences of Terrorism and Disasters. NATO Science for Peace and Security Series E: Human and Societal Dynamics, v. 120. IOS Press, Amsterdam•Berlin•Tokyo•Washington, DC, ISSN 1874-6276, 2015, pp.155-164. http://www.nato.int/science; http://www. springer.com; http://www.iospress.nl
[9] Amiranashvili A., Chargazia Kh. Intra-Annual and Seasonal Variations of Sub-Micron Aerosols Concentration and their Connection with Radon Content in Surface Boundary Layer of Tbilisi City. Bulletin of the Georgian National Academy of Sciences, vol. 10, N 2, 2016, p. 72-78.
[10] Fesenko S.V., Aleksakhin R.M., Sanzharova N.I., Lisyanskii K.V. Analysis of strategy for the application of protective measures in agriculture after the accident in the Chernobyl Nuclear Power Plant. Radiation biology. Radio-ecology. Vol. 38, 5, 1988, (in Russian).
[11] Berman X. The basics of radiology (Fukushima accident). "Education", Tbilisi, 2015, pp 17-19.
[12] Intervention Criteria in a Nuclear or Radiation Emergency. International atomic Energy. Vienna, 1994, pp. 78-87.
[13] Gelashvili K. Radiation safety norms. "Education", Tbilisi, 2000; p. 221.

[14] Tsitskishvili M.S., Gachechiladze G.A,. Katamadze N.M, Intskirveli L.N., Kurtanidze S.R. Impact of the Cernobyl disaster on the radio on the ecological situation in the ecowavay. Radionuclide echo of Cernobyl in Georgia. Radiation studies VI, “Education”, Tbilisi, 1991, pp. 132-150, (in Georgian).
[15] Mosulishvili D., Shonia N., Katamadze N., Ginturi E., Some data of radionuclide monitoring in Georgia after the Chernobyl disaster. Radiation studies VI, “Education”, Tbilisi, 1991, pp. 221-240, (in Georgian).
[16] Talaxadze G. Georgian basic soil norms. “Education”, Tbilisi, 1964, pp. 217.
[17] Standarts for the content of heavy metals and metalloids in soil. Soil science, №3, 2012, pp.368-375.
[18] Gelashvili K. Radiation Hygine. “Education”, Tbilisi, 1976, pp. 222.

მახათას მთის ტერიტორიაზე ნიადაგების ქიმიურ რადიოლოგიური გამოკვლევის პირველადი შედეგები

ს. მათიაშვილი

რეზიუმე

თბილისის ნებისმიერი უბნის დეტალური გამოკვლევა ეკოლოგიურ უსაფრთხოების მიზნით განსაკუთრებით აქტუალურ საკითხად ითვლება.ამ თვალსაზრისით მახათას უბანი მაინც განსაკუთრებულია,რადგან ამ არეში უკვე რამდენიმე წელიწადია მოქმედებს საკათედრო ტაძარი.კერძოდ, 2012-2013 წლებში მოხდა მახათას მთის იმ უბნის რადიოეკოლოგიური და აგროქიმიური გამოკვლევა, სადაც განთავსდა ივერიის ღვთისმშობლის ეკლესია.ამ ტერიტორიიდან აღებული ნიადაგის ნიმუშების ლაბორატორიული კვლევა ჩატარდა სსიპ სოფლის მეურნეობის აგრარული რადიოლოგიისა და ეკოლოგიის სამეცნიერო- კვლევით ცენტრში. მახათას მთის ტერიტორიის აგროეკოლოგიური და რადიაქტიური ელემენტებით დაბინძურების პირველადი ეკოლოგიური მონიტორინგის მონაცემების მიხედვით გამოკვლეული ტერიტორია შესაძლებელია ზოგადად მივიჩნიოთ, როგორც საშუალო დონეზე ან უფრო ნაკლებად დაბინძურებულად. კრიტერიუმად მიღებული იყო, რომ კონკრეტული დამაბინძურებელი ელემენტების შემცველობა არ აჭარბებდა კონცენტრაციის ზღვრულად დასაშვები გადაჭარბების ყოფილ საბჭოთა ნორმას.ამიტომ გარკვეული სიზუსტით შეიძლება განვაცხადოთ, რომ მახათას ტერიტორიის ნიადაგებში აგროქიმიური დაბინძურების ფონი საგანგაშო არ არის. თუმცა მიუხედავად იმისა, რომ რადიაციულმა მონიტორინგმა არ გამოავლინა ამ ადგილის დაბინძურება რადიაციული ლაქებით ან წერტილოვანი წყაროებით, პერიოდული ეკოლოგიური მონიტორინგი ამ ტერიტორიაზე მომავალშიც უნდა გაგრძელდეს.

Первичные результаты химико-радиологических исследований почв на территории горы Махата

С. Б. Матиашвили

Резюме

Детальное экологическое исследование любого участка города Тбилиси на предмет экологической опасности является особенно актуальным вопросом. С данной точки зрения район горы Махата является особенным, т.к. на этом участке уже несколько лет действует кафедральный собор Самеба. В 2012-13 гг. было проведено радиоэкологическое и агрохимическое исследования того участка территории горы Махата, на котором будет располагаться церковь Иверской Богоматери. Лабораторные исследования образцов почвы, взятых с данной территории, были проведены в научно –исследовательском центре Министерства сельского хозяйства. Согласно первичным данным экологического мониторинга, можно считать, что исследованная территория является либо загрязненной среднего уровня, либо мало загрязненной. Тут критерием используется содержание конкретного загрязняющего элемента, которое должно быть меньше предельного превышения допустимой концентрации радионуклида по бывшим советским нормам. Фон агрохимического загрязнения на исследованном участке также не является тревожным. Однако, несмотря на то, что радиационный мониторинг не выявил значительного загрязнения радиационными пятнами или точечными источниками, периодический экологический мониторинг исследованной территории должен быть продолжен и в будущем.