In: Radon
Editor: Audrey M. Stacks
ISBN: 978-1-63463-742-8

Chapter 7

RADON IN TAP WATER IN THE TERRITORY OF TBILISI CITY

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ABSTRACT

Content of radioactive gas radon – Rn-222 in tap water of municipal water-supply system in various territorial sites of Tbilisi city – capital of Georgia has been investigated. Within the framework of study there were analyzed the water resources used for supply of urban population by drinking water. It is shown, that now water supply is made from 11 sources of natural water which can be divided on two essentially various groups - sources in which underground waters (basically, from artesian wells) are used, and sources in which surface waters (river and from water reservoirs) are used. Water samples were selected in the residential buildings located in the main territorial sites of the city – in total 52 territorial entities have been allocated. Researches were carried out in the period January-December, 2013. Total amount of control points has made 118 points. Samples in nearby settlements (10 control points) were selected for comparison. In many control points sampling and the control of radon content was carried out monthly. Modern radon detector RAD7 was used for determination of radon content. It was established that radon content in water considerably changes depending on sampling time (that connects with possible changes of specific conditions of water transport to the consumer – distance from intermediate storage reservoirs, duration of stay in water mains, etc.) as well as on location of control point (that connects with primary prevalence in certain territories of water transport from surface sources – in this case activity of

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samples corresponded to group with very low radon content (<0.3 Bq/L) and low (0.3 - 1.0 Bq/L), or from underground sources – in this case activity of samples corresponded to group with typical radon content (1.0 - 3.0 Bq/L) and above typical (3.0 - 10.0 Bq/L)). Based on the received data (more than 700 results) there was issued radon map of tap water in the city territory. Comparison with literary data has been carried out, in particular it is noticed, that the received values do not exceed recommended reference levels and are not dangerous for the population.

Keywords: Radon, activity concentration, drinking (tap) water, Tbilisi

INTRODUCTION

Radon is one of three main gases which are a part of so-called “terrestrial breath” during which argon, helium and radon constantly escape from the Earth interior into atmosphere. Only radon is radioactive among these all gases [1].

Radon – inert gas without color and odor, 7.5 times heavier than air, it is well dissolves in water. Its half-time is rather small (3.8 days), and it constantly escapes in soil layers (and then into the atmosphere). Its short-lived decay products - Po-218, Pb-214, Bi-214, Po-214 and rather “long-lived” Pb-210 (half-time of 22.3 year) mainly contribute to natural radio-activity of various environmental structures, in particular, natural (including drinking) water.

Radon enters into water from surrounding soil, and also from granites, basalts, sands which adjoin with auriferous layers. Radon concentration in usually used water is small, but water from some deep wells and artesian wells can contain a lot of radon - from 100 pCi/L up to 1000000 pCi/L (3.7 - 37000 Bq/L) [2].

Dissolved in water radon operates doubly. On the one hand, together with water radon enters into digestive system, and on the other hand, people inhale radon allocated from water during its utilization.

Radon inhalation can cause lung cancer. Radon decays into radioactive elements which can subside in lungs during inhalation. Because they decay later too, these particles radiate energy impulses that can damage lung tissue and increase probability of development of lung cancer during all life. Drinking water containing radon also represents risk of development of cancer lumps of internal organs, first of all stomach cancer [3].

Thus, studying of radon content in various environmental structures (in the first place in drinking water and so-called “indoor” air in living accommodation) and determining the effect of various external factors on them is of great importance for health protection of public.

Researches of radon content level in drinking water are carried out within many decades. The beginning of systematic studying of radon radiation should be considered 70th years of 20 centuries when in the territory of Helsinki wells with very high radon concentration in water have been found out. Further, in view of growth of attention to the radon problem, especially radon dissolved in water, similar researches are carried out in many countries.

Results of numerous researches show, that radon content in water in the various countries changes in the big ranges. For example, radon concentration in tap water of Kulachi city, Pakistan, changed in the interval 0.333-0.903 Bq/L with average value 0.602 Bq/L [4]. Average value of radon concentration in tap water of Mashhad city, Iran, makes up 11.44

Bq/L [5], and size of changing of radon content in tap water of the capital of Iran – Teheran is 2.70 – 6.0 Bq/L with average value 3.70 Bq/L [6]. Interval of radon content in tap water of Lahore city, Pakistan, is 2.0 – 7.9 Bq/L with average value 4.5 Bq/L [7].

In the work [8] there were studied samples of tap water in various settlements of Bulgaria, and it was shown that radon concentration in them varied from 17±0.40 Bq/L up to 185.5±10.4 Bq/L. In the 1980s, a number of national studies of radon in public water supplies in the United States were carried out; for example, beginning in November 1980, Environmental Protection Agency of the USA (US EPA) systematically sampled the 48 contiguous states, focusing on water supplies that served more than 1,000 people, and as a result it was shown that radon concentration ranged from 0 to over 500 Bq/L, the average was 12.6 Bq/L/L [9].

In the present work it was studied radon content in drinking tap water (selected from municipal water-supply system) in various territorial sites of Tbilisi city – capital of Georgia.

TASKING

Modern water-supply system of Tbilisi has begun to be created actually in 1933. Main water resources of drinking water are located in 20 - 40 km to the north from the city (in so-called Kartli artesian basin), and are presented by 11 sources which can be divided into 2 groups:

- surface sources (Jinvali reservoir, Bodorna buffer pool, Bulachauri water pipe, Saguramo water pipe, Tbilisi reservoir, Samgori cleaning construction, Grmagele cleaning construction);
- underground sources (Choport-Misaktsieli water pipe, Natakhtari water pipe, New Natakhtari water pipe, Mukhrani artesian water pipe).

The whole of city territory is divided into 4 specific zones which water supply is provided, accordingly, by four zone watercourses. Zone watercourses, basically, are located parallel to another, on the left and right coast of the river Mtkvari (running practically in the city center). Water from zone watercourses arrives in zone reservoirs, pump stations and further in city water highways, whence arrives directly to the consumer. All highways represent uniform water-supply system that allows to supply in case of need water to the consumer from different zone systems.

In the present work there was a task in view of research of radon content in tap water on various territorial sites for the purpose of an establishment of its quantitative values, and also dependence on a territorial location of control points.

RESEARCH OBJECTS

Research objects were the samples of drinking tap water selected in various control points practically in the whole territory of the city. Based on the available information materials, 52 territorial entities (including 28 – on the right-bank part and 24 – on the left-bank part of the city) have been allocated in city. They have been identified on the basis of informal "historical" territorial sites (are connected in many cases with local settlements earlier existing in these territories which further at the expansion of city territory became its part). Names of these territories (see column *T*, Table 1) are widely used by the population for the identification of location of those or other objects (places of residing, location of public and office buildings, etc.).

Table 1. Distribution of territories (*T*) of Tbilisi (*C* - city; R - right bank, L - left bank) and nearby settlements (## 14 - 18) by the groups of activity (*GA*) of radon in tap water

#	*C*	*T*	*GA*			
			I	II	III	IV
1	Tbilisi, R	Patara Digomi (PD)				
2	"-"	Digomi housing unit (DHU)				
3	"-"	Agrarian University (AU), Didi Digomi (DD), Village Digomi (VD), Vashlijvari (Vj), Gotua (G), Vedzisi (Vz), Nutsubidze's Microdistricts (NM), Vaja-Pshavela's Quarters (VPQ), Kazbegi (Kz), Saburtalo str. (Sb), Bakhtrioni (B), Kostava (K), Bagebi (Bg), Vake (Vk), Vera (Vr), Mtatsminda (Mt), Sololaki (S), Ortachala (Ort)				
4	"-"	Kvemo Ponichala (KP)				
5	"-"	Zemo Ponichala (ZP), Village Ponichala (VP)				
6	"-"	Tskhneti (Tsk), Kojori (Kj), Tabakhmela (Tb), Tsavkisi (Ts), Okrokana (Ok)				
7	Tbilisi, L	Zahesi (Z)				
8	"-"	Avchala (Avch), Gldani (Gl)				
9	"-"	Mukhiani (M), Temka (T), Sanzona (Sz), Nadzaladevi (Nd)				
10	"-"	Zemo Chugureti (ZCh), Svanetisubani (Sv), Elia (E), Zemo Avlabari (ZA), Isani (I), Vazisubani (Vz), Varketili (Vrk), Dampalo (Dm), Orkhevi (Ork)				
11	"-"	Didube (D), Kvemo Chugureti (KCh)				
12	"-"	Avlabari (Avl), Navtlugi (Nv), Samgori (Sm), Alekseevka (A), Settlement Airport (SA)				
13	"-"	Lilo (L)				
14	Rustavi, Gardabani, Mtskheta	Rustavi, Village Mtisdziri, Mtskheta				
15	"-"	Mtskheta				
16	"-"	Nataxtari, Tserovani				
17	Dusheti	Tsitelsopeli				
18	"-"	Bulachauri				

The total amount of control points has made 118 points (in a number of control points water was selected monthly).

For comparison water samples was selected also in some nearby cities and settlements (in total 7) in which water selection was carried out in 10 control points.

METHODOLOGY

Sampling was carried out in special glass containers in capacity 250 mL. Containers were filled with water up to the top and densely closed by a cover. Then the selected water samples were transported to the laboratory for the analysis.

Electronic radon detector RAD7 was used for determination of radon content in water. In the device RAD7 it is used the method of detecting of alpha particles (created during decay process of radon and its products) based on the use of semi-conductor solid state detector. Protocol of measurement Wat-250 was used. Software Capture was used for processing of the received results.

Measurement error of the device does not exceed ±5 %. Dynamic range is 0.004 – 400 Bq/L. Detection limit of radon activity in water is estimated on the level of 0.03 - 0.04 Bq/L. For an estimation of real radiation background special repeated measurements of distilled water samples were carried out. The results received on two various devices have shown background activity in the range of 0.03 - 0.22 Bq/L (with arithmetic mean of 0.09 Bq/L).

For the investigated points taking into account reference level of 11 Bq/L recommended by US EPA [10] and the received results 5 groups of radon activity level in water have been established, in particular:

- 1st group (I) – control points in which value of radon concentration is very low - did not exceed 0.3 Bq/L (i.e., close to the background);
- 2nd group (II) – control points in which it is possible to consider that value of radon concentration is low - in the range of 0.3 - 1.0 Bq/L;
- 3rd group (III) – control points in which value of radon concentration can be designated conditionally as typical - in the range of 1.0 - 3.0 Bq/L;
- 4th group (IV) – control points in which it is possible to consider that value of radon concentration is above typical - in the range of 3.0 - 10.0 Bq/L;
- 5th group (V) – control points in which it is possible to consider that value of radon concentration is high - in the range of 10 - 30 Bq/L.

For the characteristic of time history (stability) of radon activity in control points depending on the period (month) of measurements the value of standard relative deviation of the received results was used which was calculated for specific control point by the received results in the course of year. For values of relative standard deviation no more than 50 % corresponding average value conditionally was accepted as stable (constant) value of activity concentration (and, accordingly, group of activity) for the given control point. If value of relative standard deviation exceeded this size, value of activity concentration (and, accordingly, group of activity) for the given control point was considered as the unstable.

RESULTS

For the whole period of observations it has been received more than 700 values of radon concentration in the water samples selected in various control points in the territories of Tbilisi and some settlements in its geographical area.

In the generalized view distribution of territories of Tbilisi (the order of location of territories, basically, was defined by their “geographical vicinity”) and nearby settlements by the groups of radon activity in drinking water for the period January - December, 2013 is given in Table 1.

Radon map of tap water in the territory of Tbilisi is given in Figure 1 (the shaded areas correspond to populated territories).

In Table 2 there are given average values of radon concentration and distribution of control points by groups of activity in Tbilisi and nearby settlements for the period January - December, 2013.

Figure 2 shows distribution of quantity (N) of territories of Tbilisi by the intervals of radon activity (R, Bq/L).

In Table 3 there are given monthly average, minimal and maximal values of radon activity, their generalized values, and also relative standard deviation (RSD) in various control points in territorial entities of Tbilisi and nearby settlements (in the range ≤0.3 ÷ 1.0 Bq/L with primary water supply from surface (*srf*) sources and 1.0 ÷ 10.0 Bq/L with primary water supply from underground sources (*und*)).

Note. Given distribution of territories by the types of water supply was carried out based on the analysis of radon activity values in drinking water on corresponding territorial entities (see section Analysis).

Figure 3 shows monthly dependence of averaged activity of radon in the territories of Tbilisi with primary water supply from surface (*srf*) and underground (*und*) sources for the period January - December, 2013.

Apparently from the received results, it is possible to note following features;

- average activity of radon in water in the territories of Tbilisi changes in sufficiently wide range – from background values and close to them (0.03 - 0.3 Bq/L) up to 2.2 Bq/L and more (maximal value of 6.54 Bq/L, territory Zahesi);
- in nearby settlements the size of changing of average radon-in-water activity is a little another – from 0.33 Bq/L (in settlement Bulachauri) up to 8.93 Bq/L and more (maximal value of 13.1 Bq/L in Rustavi);
- the whole territory of Tbilisi sufficiently conditionally can be divided into 2 big groups - territories, where radon activity is low (0.3 - 1.0 Bq/L) or very low (<0.3 Bq/L) with average value of 0.45 Bq/L (minimal value of 0.03 Bq/L, maximal value of 3.2 Bq/L), and territories, where radon activity is typical (1.0 - 3.0 Bq/L) or above typical (3.0 - 10.0 Bq/L) with average value of 1.82 Bq/L (minimal value of 0.1 Bq/L, maximal value of 6.54 Bq/L); it is necessary to notice, that the greatest relative density (47.5 %) is made by control points with typical values of activity; thus in nearby settlements the condition also differs a little - the greatest relative density (70 %) is made by points with activity above the typical;
- in seasonal dependence it is possible to note some tendency to decrease of activity concentration in summer months;
- stability of activity in various control points also varies in sufficiently wide limits, thus its average value (from 40% to 56%) in the first group is a little bit more in comparison with the second group (from 10% to 57%); it is possible to note that

value of stability in individual control points depending on the period changed from 16 up to 150 % in the first group and from 7 to 87% in the second group.

Table 2. Average values (A_{av}) of radon concentration in tap water, distribution of quantity of control points (N_p) by the group of activity (*GA*), and their ratios ($R_N = N_p/N_t$ %; N_t – total quantity of control points) in the territory (*T*) of Tbilisi (*Tb*) and nearby settlements (*Tb-A*)

#	*T*	*GA*	A_{av}, Bq/L	N_p	R_N, %
1	*Tb*	I	0.1	37	31.4
2	"-"	II	0.6	22	18.6
3	"-"	III	1.8	56	47.5
4	"-"	IV	3.9	3	2.5
5	*Tb-A*	II	0.3	1	10.0
6	"-"	III	2.9	2	20.0
7	"-"	IV	4.2	7	70.0

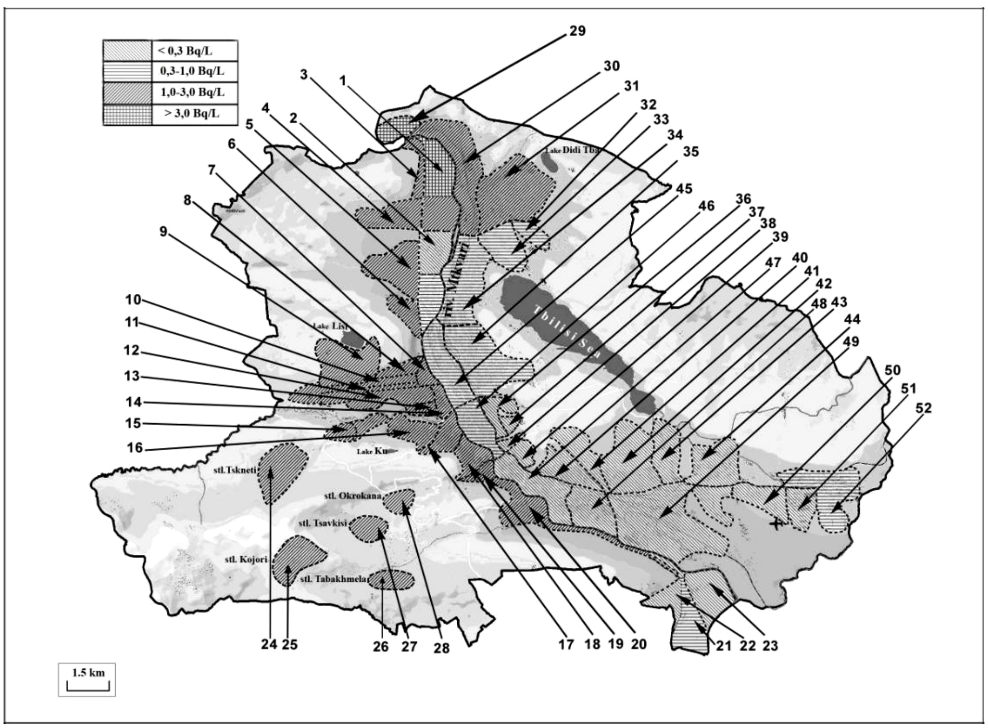

Figure 1. Radon map of tap water of Tbilisi city (schematic location of city territories (*T*)).

#	*T*	#	*T*	#	*T*	#	*T*	#	*T*	#	*T*	#	*T*	#	*T*	#	*T*
1	PD	7	G	13	B	19	S	25	Kj	31	Gl	37	Sv	43	Dm	49	Sm
2	DHU	8	Vz	14	K	20	Ort	26	Tb	32	M	38	E	44	Ork	50	A
3	AU	9	NM	15	Bg	21	KP	27	Ts	33	T	39	ZA	45	D	51	SA
4	DD	10	VPQ	16	Vk	22	ZP	28	Ok	34	Sz	40	I	46	KCh	52	L
5	VD	11	Kz	17	Vr	23	VP	29	Z	35	Nd	41	Vz	47	Avl		
6	Vj	12	Sb	18	Mt	24	Tsk	30	Avch	36	ZCh	42	Vrk	48	Nv		

Table 3. Monthly average activity of radon (*A*) in tap water, their averaged (A_{av}), minimal (A_{mn}) and maximal (A_{mx}) values, relative standard deviation (*RSD*), and also their generalized values (Prm - *aver, min, max*) in the territories of Tbilisi (*Tb*) and nearby settlements (*Tb-A*) with primary water supply from surface (*srf*) and underground (*und*) sources (S)

#	C	S	AR Bq/L	Prm	A, Bq/L												A_{av}	$A_{mn,}$	$A_{mx,}$	RSD,
					Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Bq/L	Bq/L	Bq/L	%
1	*Tb*	*srf*	*≤0.3 ÷ 1*	aver	0.44	0.62	0.48	0.50	0.57	0.49	0.16	0.19	0.77	0.54	0.30	0.30	0.45	0.16	0.77	40
2				min	0.03	0.06	0.06	0.03	0.03	0.04	0.03	0.03	0.04	0.1	0.04	0.08	0.05	0.03	0.12	56
3				max	1.26	2.36	1.63	3.20	2.20	2.00	0.84	0.81	2.69	1.87	1.20	1.57	1.80	0.81	3.20	41
4		*und*	*1 ÷ 10*	aver	1.95	2.06	1.76	2.20	2.01	1.70	1.65	1.62	1.72	1.64	1.80	1.73	1.82	1.62	2.20	10
5				min	0.54	0.75	0.28	0.10	0.37	0.20	0.39	0.56	0.21	0.26	0.11	0.36	0.34	0.10	0.75	57
6				max	4.45	3.86	4.63	6.13	6.54	6.09	5.17	3.33	4.34	4.74	4.92	5.77	5.00	3.33	6.54	20
7	*Tb-A*	*srf*	*≤0.3 ÷ 1*	aver				0.62	0.46	0.05	0.31	0.18	0.31	0.21	0.47	0.35	0.33	0.05	0.62	53
8		*und*	*1 ÷ 10*	aver	6.01	4.77	4.86	2.03	4.05	4.71	5.52	4.32	5.74	3.59	8.93	6.22	5.06	2.03	8.93	33
9				min	4.44	1.36	3.37	0.67	0.91	3.05	3.06	3.47	4.49	2.88	6.14	4.75	3.22	0.67	6.14	51
10				max	9.14	13.1	7.06	3.47	7.82	7.25	8.62	5.28	8.13	4.51	11.7	8.98	7.92	3.47	13.1	35

Note. AR – activity range.

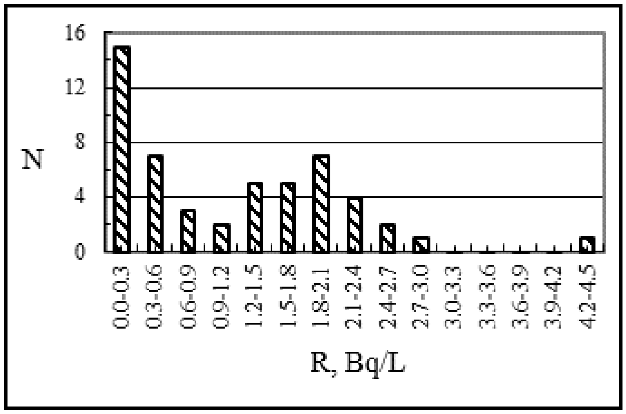

Figure 2. Distribution of quantity (N) of territorial entities of Tbilisi by the intervals of radon activity (R, Bq/L).

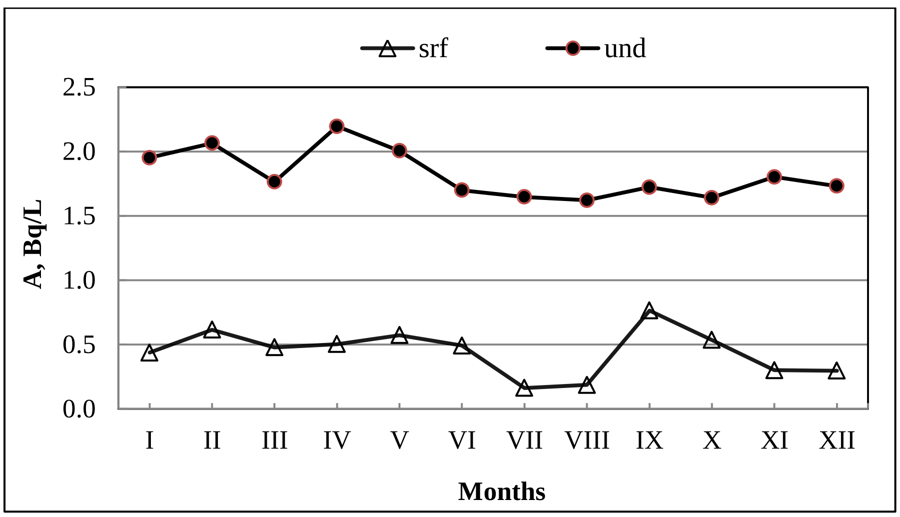

Figure 3. Monthly dependence of averaged activity of radon (A, Bq/L) in tap water in various control points in the territories of Tbilisi with primary water supply from surface (*srf*) and underground (*und*) sources.

ANALYSIS

Apparently from the received data, in Tbilisi the big size of changing of radon activity in drinking (tap) water is observed – the basic data array is within the limits from 0.1 and less up to 6.5 Bq/L. Size of changing in nearby settlements is a little another - from 0.33 up to 13.1 Bq/L.

It is necessary to consider that observable big size of changing of radon activity in drinking water in the territory of Tbilisi is connected, first of all, with a considerable quantity and a variety of characteristics of natural sources of water resources. As it was marked above, water supply of Tbilisi is provided with natural sources of two types - surface (basically, river water) and underground (basically, artesian waters). It is possible to consider, that the first type of waters differs by the small values of radon activity, and the second - higher. It proves to be true the results received for settlements, being in immediate proximity from target systems of maintenance of quality of drinking water. So, for example, in settlement Bulachauri (being in immediate proximity from a surface source of drinking water Bulachauri water pipe) value of activity in water system laid in the range from 0.05 up to 0.6 Bq/L (with average value of 0.33 Bq/L), and in settlement Natakhtari (being in immediate proximity from an artesian source of drinking water Natakhtari water pipe) value of activity in water system laid in the range from 1.1 up to 6.3 Bq/L (with average value 4.0 Bq/L). It is possible to consider these values, in certain degree, as “reference” at the estimation of type of natural source providing water supply of corresponding territory (or control point). For example, in the territory Zahesi (# 29, Figure 1) which among the all city territories is most close located to Natakhtari water pipe (and approximately on the same distance, as well as settlement Natakhtari), values of activity in water system also were the highest in comparison with other territories - from 1.6 up to 6.54 Bq/L (with average value 4.7 Bq/L, group IV), thus activity was sufficiently stable (RSD within 30-39 %). It gives the reason to consider, that this territory (and also some other territories in which there are observed typical and above typical values of radon activity in drinking water - more than 1.0 Bq/L) is provided by water from underground sources (for example, Natakhtari water pipe). Such feature of water-supply system the city explains presence of two maxima on the histograms of distribution of territories depending on the radon activity in drinking water (Figure 2).

In is necessary to note that values of radon activity in tap water in the territories which are sufficiently far from sources (for example, ## 36 - 52, Figure 1), correspond to low or very low groups (i.e., less than 1.0 Bq/L). These territories are located on the left bank of the river Mtkvari and, basically, are areas of new buildings. For their supply with drinking water resources of artesian sources were not adequate (which have been mastered in an initial stage of creation of modern water-supply system of Tbilisi and, basically, provided historically “older” territories located on the right bank) and additional water resources on the basis of surface sources began to be created.

It is interesting to notice, that territory of Digomi housing unit (# 2) is located on the right bank, but also characterized by low values of activity. It, apparently, is connected with that, in this territory one of the first areas of new buildings is located, and it is possible, use of surface sources has begun with it for supply with drinking water. Thus in the northern part of the territory #1 (directly adjoining to the territory # 29) values of radon activity in water also correspond to the group IV, and in its southern part (which directly adjoining to the territory # 2) basically water with smaller values of activity (group III) prevails. In the territory # 2 values of activity continue to decrease (group II, and further group I). On the other hand nearby (also on the right bank) there are located territories (# 3, 4 etc.) which also were areas of new buildings, however radon activity in these territories is considerably more (more than 1.0 Bq/L). Apparently, these areas (and also northern part of the territory # 1 and territory # 29) laid close to the first zone watercourse by which water run from Natakhtari water pipe, and for their supply water was taken from this highway.

It is necessary to note that on the left bank likewise there are located historically “old” territories (for example, # 47, Avlabari), but they are characterized by low values of radon activity. Apparently, they have been translated in due course by the supply from surface sources of water. Considering, that now the water supply system is united in a uniform network of water highways, in separate local sources can remain (probably, periodically) water delivery from underground sources. So for example, in one of control points in this territory average value of activity has made 1.7 Bq/L that is connected with such case. Such cases take place also in other territories (on the left bank), also being “old” areas, in particular Didube, Kvemo Chugureti (## 45, 46). The raised quantity of “unstable” points (i.e., points in which value of activity varies in sufficiently big range during period of year) are observed in these districts. Apparently, in these cases depending on the period (month) of observation prevails one type of water, or another.

It is necessary to notice, that, of course, fluctuations of radon activity can take place also because of various features of control points of sampling, for example, distances from the basic water lines, selection time, etc.

The observable tendency to decrease of radon activity in summer months, basically, apparently, is connected with increase in temperature of water in accumulator reservoirs therefore speed of decontamination of radon from water can increase.

Proceeding from the received results by the values of radon concentration in drinking water, the majority of the investigated control points (territories) in Tbilisi was in the groups with low (0.3 - 1.0 Bq/L) or typical (1.0 - 3.0 Bq/L) values which are noticeably below recommended reference levels. This circumstance, in certain degree, allows considering the general condition with radon activity not so dangerous. It is necessary to notice nevertheless, that insignificant quantity of control points (up to 4%) is in the group with rather high values of activity (3.0 - 10.0 Bq/L). It is possible also to notice, that the results received for nearby settlements are considerably above, than within Tbilisi. The majority of the investigated control points was in the groups with typical (1.0 - 3.0 Bq/L) or above typical values of activity (3.0 - 10.0 Bq/L), and in one case (Rustavi) activity of 13.1 Bq/L corresponding to the group with high values (10 - 30 Bq/L) has been registered. It is possible to consider, that this circumstance is connected by that water supply in these settlements (except settlement Bulachauri) is provided by natural sources of the second type. Thus it is necessary to notice, that in Rustavi water supply is provided by own sufficiently close located underground source, that, apparently, causes higher values of radon activity in tap water [11].

Comparison of the received results with some literary data is carried out in Table 4.

Table 4. Average, minimal and maximal values of radon concentration (A) in tap water in various regions of the world

#	Region, country	A, Bq/L			Ref.
		average	minimal	maximal	
1	Kulachi, Pakistan		0.602	1.218	[4]
2	Mashhad, Iran	16.238			[5]
3	Tehran, Iran	3.7			[6]
4	Lahore, Pakistan		2.0	7.9	[7]
5	Various regions of Bulgaria (Haskovo, Smolian, Kustendil, Blagoevgrad, Sofia)		1.17±0.40	185.5±10.4	[8]
6	Various states of USA	12.6	0	>500	[9]
7	Tbilisi, Georgia				Present work
	srf	0.45	0.03	3.2	
	und	1.82	0.1	6.54	

Apparently from the data, the received results by the average values of radon activity are close to the values received in works [4, 6].

Received results testify about topicality of researches of radiation background of natural waters (drinking, surface, etc.) and necessity of their further studying.

ACKNOWLEDGMENTS

This publication was supported by the project # 5644 “Radon background in drinking and surface waters in areal of capital of Georgia – Tbilisi” of Science and Technology Center in Ukraine and Shota Rustaveli National Science Foundation.

CONCLUSION

1. It was carried out analysis of water-supply system of Tbilisi and it was noted its some features; there were discussed methodological approaches on objects of research and processing of results.
2. Within January-December, 2013 there were carried out more than 700 measurements of radon activity in tap water samples selected in 118 control points (52 territories) in Tbilisi and 10 control points in nearby settlements.
3. It was established, that radon activity in water in the territories of Tbilisi changes in sufficiently wide range – from background values and close to them (0.03 - 0.3 Bq/L) up to 2.2 Bq/L and more (maximal value of 6.54 Bq/L); in nearby settlements size of changing of radon activity in water is a little another - from 0.33 Bq/L up to 8.93 Bq/L (maximal value of 13.1 Bq/L).
4. It was shown, that the whole territory of Tbilisi sufficiently conditionally can be divided into 2 big groups - territories, where radon activity is low (0.3 - 1.0 Bq/L) or very low (<0.3 Bq/L) with average value of 0.45 Bq/L and territories, where radon activity is typical (1.0 - 3.0 Bq/L) or above typical (3.0 - 10.0 Bq/L) with average value of 1.82 Bq/L; the greatest relative density (47.5 %) is made by control points with typical values of activity; thus in nearby settlements the condition also differs a little - the greatest relative density (70 %) is made by points with activity above the typical.
5. It was carried out analysis in which it was shown, that the received results, basically, are connected with features of water resources of drinking water, in particular with existence of qualitatively differing sources – surface and underground; comparison with literary data has been carried out.
6. Based on the received results radon map of the territory of Tbilisi has been created.

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