ჰიდრომეტეოროლოგიის ინსტიტუტის შრომები, ტომი № 115, 2008
Transactions of the Georgian Institute of Hydrometeorology, vol. 115, 2008
Труды института гидрометеорологии Грузии, том № 115, 2008

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RADON DISTRIBUTION AND PREVALENCE OF LUNG CANCER IN SEVERAL AREAS OF WEST GEORGIA

Introduction

Radon distribution and its influence on human health is not well studied issue in Georgia, although some separate studies regarding some natural radioactive elements were performed. In USA, Europe and China was done important work in this field, new methodologies and approaches were worked out. According STCU project N 3992 "Assessment of radon-hazard potential, residential exposure, lung cancer and COPD in West Georgia" during 2007-2008 authors carried our field work in order to quantify the radon distribution, ascertain geological factors influencing indoor radon concentrations and find relation between radon content and health and in various geographical areas of West Georgia.

Method

When undertaking the gas survey of Rn the particular attention was paid to the multiple active zones of faults and areas of elevated geo-chemical background of uranium and quicksilver. Mobile group conducted the researches by Radon measurement PPA-01M-03 device. Rn content was measured in any type of water source (boreholes, wells and springs) and in the soil aeration zone in several regions ((Samtredia, Kutaisi, Vani, Tskaltubo, Khoni and Bagdadi). All observation sites were fixed by GPS measurements.

For Rn-222 gas measurements in the dwellings the alpha track detectors (ATDs) were used to provide integrated (mean) radon concentration. Alpha track detectors were installed for the period of 12 months in the apartments and basements. ATDs were placed on the each level of the dwellig with additional ATDs placed in the bedrooms and in any home work space.

To reveal possible association between radon distribution and prevalence of lung cancer in West Georgia, we have performed an ecologic epidemiological study. Data on prevalence of lung cancer in various regions were collected through the primary health care net (primary health care net is represented by policlinics and out-patients' clinics), National Cancer Center and department of statistic of National Center of Disease Control and Public Health.

The key method for fulfillment the project is Radon mapping based on application of geochemical methods. Connection of anomalies to geological and hydro-geological structures, also medical data is analyzed using GIS technology.

Data analysis

Results of analyses on radon concentration were marked on topographic and geological maps. After that the field data were digitized and transferred into GIS-system. On the basis of these data the map of Rn content in water and soil were compiled using GIS technique (Figs.1). Areas of anomalously high Rn exhalation both in water and in soil were revealed in Tskhaltubo, Kuttaisi, Vani, Bagdadi, Chokhatauri and Ozurgeti regions. In order to understand the nature of these anomalies it is necessary to analyze all factors that influence intensity of Rn degassing and lead to high risk of its accumulation. These factors are geological structures of the region, presence of tectonic faults, presence of radioactive elements in the rocks, hydrogeological and geomorphological structures of the region, soil characteristics etc (Fig.2).

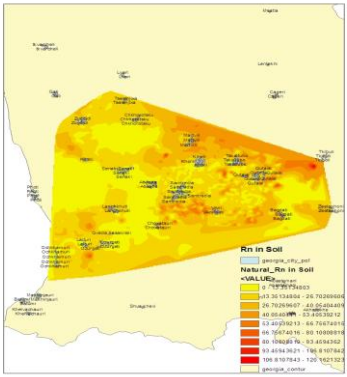

Fig. 1 Radon distribution in soil

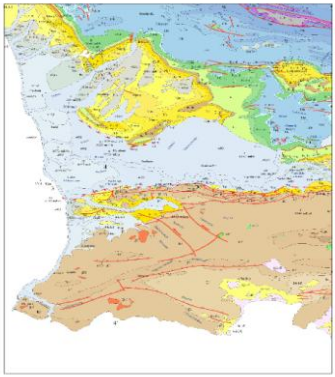

Fig. 2 Geological map

The Northern and Central parts of the tested area belongs from the geological point of view to the Kutaisi sub-zone of the Georgian plate and its Southern part – to the Adjara-Trialeti folded system. The North-East part of the first zone (villages Rioni and Gurna) is composed mostly by Jurassic volcanic rocks, which contain fissure groundwater of low mineralization (hydrocarbonate and calcium type). From the morphological point of view here we have glacial-erosion terrain that is characteristic for this mountainous area. In this area to the north of Kutaisi we found a band of elevated radon content in the soil (22-26 KBq/m^3), which should be related to the presence of dikes of the crystalline rocks and systems of faults, developed on this territory. At the same time the content of radon in the water is low, which can be explained by influence of near surface groundwater circulation in this zone.

To the South on the surface there are Lower Cretaceous rocks, which contain fissure and fissure-karstic type of pressurized ground water (regions of

Tskaltubo and Kutaisi); the characteristic example is the low-radioactive thermal waters of Tskaltubo resort. Here the springs have large debit (200-220 l/s). The recharge of the aquifer takes place in the northern elevated areas; then the aquifer plunge under the Quarternary layers and its discharge takes place at the contact area of Georgian plate and Adjara-Trialeti folded system, where a lot of transversal faults are found. This is also confirmed by the existence in this zone of low-radioactive thermal waters at the resorts Sulori, Amaghleba and Vani.

In the south and south-west part of test area, i.e. in the Adjara-Trialeti folded system (regions of Vani, Chokhatauri and Ozurgeti), in the volcanic and sediment rocks of Middle Eocen we observe karstic-fissure and fissure pressurized groundwaters of low radioactivity. The terrain here is of erosion-peneplain type.

Similar to Tskaltubo region here also are observed high values of Rn content in the soil (22-58 KBq/m^3); this can be explained by high gas permeability of rocks and geomorphology of the area. As to the Rn content in water, it is a bit less (16-22 Bq/l) than in Tskkaltubo region and cover much less area due to the fact that here mostly the shallow groundwater's are observed; these waters are characterized by shallow circulation system and they are not discharged on the surface (situation is alike to that in the North, where groundwater is in Volcanic rocks of Jurassic age). From the studied regions highest incidence rate (per 100.000 populations) of lung cancer is in several region (Tab. 1).

Table 1 Distribution of parameters

Region	Incidence rate of lung cancer	Rn in Soil	ATDs
Thkaltubo	20,4	39.53	219.7
Bagdati	13,9	30.68	
Vani	14,7	34.78	112
Zestafoni	19,9	35.82	
Terdjola	15,5	31.46	
Samtredia	26,6	23.07	3.5
Khoni	38,5	35.81	
Zugdidi	23,2	19.54	
Abasha	32,0	15.81	
Martvili	26,9	47.72	
Senaki	25,0	13.85	
Lanchkhuti	49,0	76	
Ozurgeti	29,7	61	
Chokhatauri	57,0	90	

In regions with high Rn distribution on the whole is highest incidence rate of lung cancer (Fig. 3).

In 2007 during field work in selected sites the alpha track detectors (ATDs) were installed; in 2008 part of them were dismantled and the tracks were investigated. The obtained results confirm the above conclusions. Increased long-time accumulation of Rn was observed in Tskhaltubo and Vani regions. Relatively less accumulation was in Samtredia region. In future the analysis of ATDs, installed in other regions will be continued.

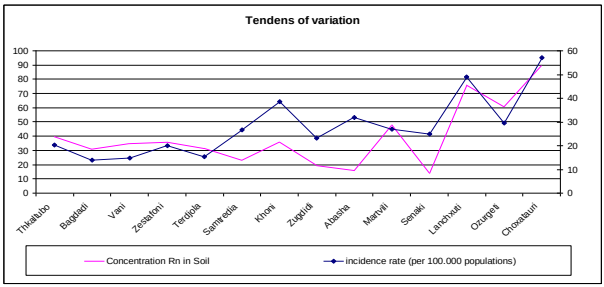

Fig. 3 Variation of parameters

Conclusions

Peculiarities of distribution of Rn on the territory of West Georgia was studied and anomalous areas were outlined. The elevated exhalation of Rn is the result of draining of Lower Cretaceous and Middle Eocen aquifers by rising springs and boreholes. This research once again confirms correlation between Rn exhalation and prevalence of lung cancer.

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ა. ამირანაშვილი, თ. ჭელიძე, კ. ღვინიანიძე, გ. მელიქაძე,
მ. თოდაძე, ი. ტრეკოვი, დ. წერეთელი

რადონის გავცელება და ფილტვის კიბო დასავლეთ საქართველოს ცალკეულ რაიონებში

რეზიუმე

ჩატარებულია რადონის განაწილების რაოდენობრივი შეფასება დასავლეთ საქართველოს ცალკეულ რაიონებში. მიღებული მონაცემები მოწმობს, რომ 100-ზე მეტი წყლის სინჯში აღინიშნება რადონის მაღალი შემცველობა. ამ უბნებთანაა დაკავშირებული ბინებში რადონის დაგროვების მაღალი მაჩვენებლები. ჩვენს მიერ ჩატარებული კვლევა კიდევ ერთხელ ადასტურებს კორელაციურ კავშირს რადონის კონცენტრაციასა და ფილტვის კიბოს გავრცელებას შორის.

А. Г. Амиранашвили, Т.Л. Челидзе, К.Г. Гвинианидзе, Г.И. Меликадзе, М.Ш. Тодадзе, И.Ю. Треков, Д.Г. Церетели

Распределение радона и рак легких в отдельных районах Западной Грузии

Резюме

Проведены количественные исследования распределения радона в отдельных районах Западной Грузии. Полученные данные свидетельствуют, что в более чем 100 пробах воды отмечается повышенное содержание радона. В тех же местах наблюдается повышенная концентрация радона в жилищах. Данное исследование еще раз подтверждает связь между концентрацией радона и распространением рака легкого.

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Radon Distribution and Prevalence of Lung Cancer in Several Areas of West Georgia

Abstract

Quantitative assessment of radon distribution in several regions of West Georgia has been carried out. According to field data in more than 100 water samples there is high content of radon. This research once again confirms correlation between Rn exhalation and prevalence of lung cancer.