Technical science and innovation

Volume 2019 | Issue 4 Article 3

12-12-2019

FACTORS DETERMINING THE CHANGE OF HELIUM CONCENTRATION IN UNDERGROUND WATERS OF UZBEKISTAN AND THE ACCORDING TERRITORIES

M.M. Zakirov
Tashkent State Technical University

I.A. Agzamova
Tashkent State Technical University

N. Mavlyanova
Chairperson of the State Examination Commission in Geology faculty of Lomonosov Moscow State University

Recommended Citation

Zakirov, M.M.; Agzamova, I.A.; and Mavlyanova, N. (2019) "FACTORS DETERMINING THE CHANGE OF HELIUM CONCENTRATION IN UNDERGROUND WATERS OF UZBEKISTAN AND THE ACCORDING TERRITORIES," *Technical science and innovation*: Vol. 2019: Iss. 4, Article 3.
DOI: https://doi.org/10.51346/tstu-01.19.4.-77-0040
Available at: https://btstu.researchcommons.org/journal/vol2019/iss4/3

UDK 550.343.6.42.550(575)

FACTORS DETERMINING THE CHANGE OF HELIUM CONCENTRATION IN UNDERGROUND WATERS OF UZBEKISTAN AND THE ACCORDING TERRITORIES

M.M. Zakirov[1], **I.A. Agzamova**[1], **N. Mavlyanova**[2]

[1]*Tashkent State Technical University*
[2]*Chairperson of the State Examination Commission in Geology faculty of Lomonosov Moscow State University*

Abstract

The article presents the results of the analysis of long-term regime observations of change in the concentrations of groundwater of Uzbekistan and adjacent territories. Based on these observations, the main factors affecting the changes of the quantitative content of helium. The results of the evaluation of the characteristics of the changes and distribution of helium in groundwater. The change of helium concentration in groundwater significantly influence the deformation and hydro-geodynamic and tectonic conditions. Described and quantified four factors with different concentrations of helium. They allow to correctly assess the variation of helium associated with seismic events.

Key words: *groundwater, hydrogeoseismology, precursors, earthquakes, helium, concentration, migration, regime observations, gas-chemical parameters.*

The noble gas - helium of the Earth has a different origin. One part of it was brought by protoplanetary matter, from which the planets of the solar system were formed, and the Earth, in particular, is the primary gas. Their isotopic composition was formed during nucleosynthesis millions and billions of years before the formation of the solar system. The origin of the other part of the noble gases is associated with the decay of natural radioactive elements - this radiogenic isotopes. They are formed both directly during the decay of radioactive and secondary nuclear reactions induced by their radiation during the entire time the Earth exists as a planet.

The influence of nuclear processes on the prevalence of noble gas on Earth is exceptionally great. The entire amount of terrestrial helium is associated with the radioactivity of potassium, uranium and thorium. This is due to the very low content of primary noble gases in the Earth’s material - the lowest among its constituent chemical elements. Such a shortage of noble gases in the material of the solar system arose at the earliest stages of its development.

An equally important property of helium is chemical inertness, due to which their geochemical features are studied by simple physical methods. In addition to the fact that noble gas - helium makes it possible to study nuclear processes on the Earth and measure the isotopic age of rocks, it serves as a sensitive indicator of the redistribution of radioactive elements in the process of differentiation of the Earth. Consequently, noble helium can be used to study how no elements allow one to study the process of degassing the Earth, starting from the earliest stages of its existence.

The sixties of the last century at the origins of the study of the spatial distribution of helium were such scientists as V.P. Yakutseni, I.N. Yanitsky and V.I. Bashorin. The results of these studies were a separate section of geological surveys - helium surveys that determine hydrocarbon deposits, tectonic fault zones and during monitoring observations of nuclear power plants and hydraulic structures. The pulsating nature of helium migration, associated with tectonic activation, contributed to the study of helium concentration by regime observations in

Central Asia [1,2]. It is one of the topical and priority areas of research on the problem of earthquake prediction. In the field of earthquake forecasting, helium is one of the informative hydrogeo - seismological precursors of earthquakes, and the study of the main factors affecting the change in helium concentration in groundwater in Uzbekistan is an urgent problem.

A great contribution to the development of the methodology of such studies was made by scientists of Uzbekistan [2-7].

Determination of the concentration of helium concentration includes: well testing; laboratory and field measurements of the helium content in free gas; water and comparing the data with geological and tectonic conditions. Our studies to determine the relative concentration of helium concentration in water points were carried out by the gas chromatographic method and the absolute value of helium was determined using the INGEM-1 device (magnetically discharge helium indicator).

Considering variations in the concentration of helium in groundwater, we did not find changes due to earth tides, diurnal and longer periodic changes.

Comparing and analyzing the values of the concentration of helium, its uneven distribution was revealed, both in area and in a vertical section of the study area. This is mainly due to the tectonic situation and hydrogeological conditions of the study area [3-4].

According to available materials, the helium concentration varies widely from 0.06-1.6 vol.% Or 0.00002-0.35 ml / l both in the groundwater supply areas and in submerged parts of the territory.

Based on the foregoing, in each considered water point with its geological, lithological and tectonic conditions, four different factors were determined that determine the concentration of helium in groundwater (Table 1). These are the factors:

A - the proximity of sources of α-radiation (granites and massifs of intrusions) and the presence of stable Paleozoic rocks. This factor includes water points in the Havotag region, high-mountain springs Arashan bulak, Sassykul and the spring Kirk-kiz.

The underground waters of the Havotag wells are located in the southern part of the Pristashkent artesian basin. At depths of 1800-2100m, fissure-karst pressure and thermal waters (46-520C) were discovered in Paleozoic sediments. Helium concentration in the range 1.1-1.6 vol.%, 0.016-0.022 ml / l. Alpine clan. Arashanbulak, Sassykul and the clan. Kirk Keys is represented by Paleozoic sediments, with water temperatures from 12 to 160C. The helium concentration is 0.02-0.047 vol.% Or 0.002-0.0.003 ml / l. A similar value of the helium concentration in the above water points is associated, firstly, with natural radioactive decay, i.e. the more α-radiation in the rocks, the more helium is generated; secondly, when evaluating the enrichment of groundwater with helium, not only the radioactivity of water-bearing rocks, but also underlying sediments is taken into account. In lithology, these conditions are most characteristic of ancient carbonate-granite, volcanic-granodiorite and intrusive rocks, in connection with which it becomes clear that the main background volumes of helium concentration are associated with ancient deposits.

B - the process of cracking of water-bearing rocks and the migration of gases from deeper layers according to existing discontinuous violations, i.e. on tectonic faults. Well points are assigned to this factor. Fazylov, Ulugbek, Gazli and Dzhengeldy with a depth of groundwater 220-300m and 1600-2300m. The host rocks are sand, sandstones with interbeds of clay. Sandstones on calcareous cement, lenses of sandy limestone with interbeds of clay, igneous rocks. Similarly to situations, a helium concentration of 0.018 - 0.1 vol.%, Less often 1.8 vol.% Or 0.0084-0.025 ml / l, rarely 0.35 ml / l, and a temperature in the range of 22-420C are characteristic.

As is known, the mechanism of manifestation of the background values of helium depends on the water-bearing rocks themselves, on their deformation or fracture, as well as on the presence of buried tectonic faults. Under such conditions, it is assumed that helium migration is determined mainly by transport and diffusion processes.

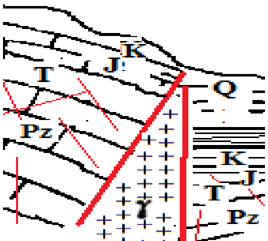
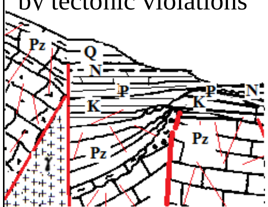
V - the process of accumulation of helium in stagnant zones. A distinctive feature of this factor is that the test aquifer itself is at a depth of at least 1300 m, where optimal conditions for helium accumulation are created in a limited part of the sedimentary cover. These are areas covered by clays and clay-marl deposits. Here, water-bearing rocks occur in the form of anticlinal "traps". Below are the pre-Paleozoic and Paleozoic deposits, contributing to the accumulation of helium. Similar conditions are most common in water points: Yangiyul, Zangi-ota, Galaba, IOBK (Institute of Vegetable-Gourds), A. Yassaviy and Tekstil located in the flat part of the study area. These water points have a helium concentration in the range 0.06-0.32 vol.% Or 0.002-0.006 ml / l, water temperature 44-650C.[14,15]

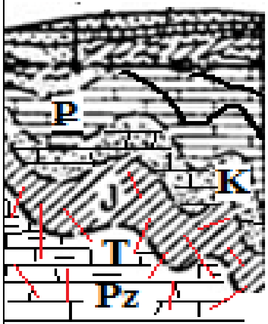
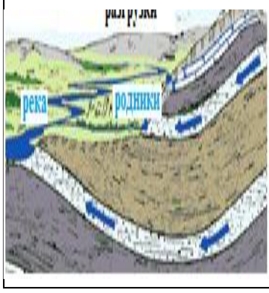
G - zones of active water exchange, characterized by low values of helium concentration. Significant influence on the accumulation and distribution of helium is exerted by the features of geomorphological and hydrogeological conditions for the location of water points. These include water wells. Chimgansay and springs Chinar, Khojikent, Teskaribulak, Humsan and clan. Nurata. Here there are optimal conditions for the dissipation of helium into the atmosphere.[7-10]

In other words, filtration paths are placed along which the movement of helium dissolved in groundwater occurs. In the zone of intense.

Table. 1.

The influence of the main factors on the concentration of helium in the underground waters of Uzbekistan and adjacent territories.

Geological and lithological and tectonic factors	Water points observations	HO- row urning mbrell a	Water Capacity early breeds the horizon	Depth meter	^{0}T	Content He	
						ob.%	ml / l
1	2		4			7	8
Proximity of sources α-radiation and the presence of Paleozoic rocks. 	well 8 Havotag	z	Fissured Karst water in carbo- od-granite and carbonate-volcano-stomata-gronodi orite and int zivny deposits	1800 2100	52	1.1	0,016
	well. 6 Havotag			1800 2000	46,5	1.6	0,022
	Rod Arashan bulak			0,0	21	0.047	0.0025
	group genus. Kirk Keys			0,0	16	0.02	0.002
	род.Сас-сы-куль			100	12	0.03	0.003
Development of fissure water rocks and migration not from deeper layers by tectonic violations 	well. Fozilov	1	Sands, Sandstones with interbeds of clay. Sandstones to lime-forged cement, sandy lime lenses nyak in demand clays and igneous rocks	2241 2294	24	0.12	0.01
	well. Fozilov -1	2		1942 2082	24	0.018	0.0084
	well. Ulugbek	2		1600 1800	22	1.8	0.35
	well. Djengeldi	z		220 250	23	0.04	0.02
	Well.Gazli	2		250 300	42	0.047	0.025

Congestion processes Not in stagnant areas.		Well.Yassaviy	2	Mergels, sandstones, siltstones, limestone, conglomerates, different grained gravel, sandstones with alcareous cement, lenses of sandy limestones with interlayers yami clay	1300 2240	65	0.13	0.0047
		Well.Yangiyul	2		1480 1570	63	0.28	0.0021
		Well.Zangi-ota			1860 2100	69	0.13	0.0051
		Well.Pobeda			1640 1860	47	0.097	0.022
		Well.Tekstil			2200 2400	44	0.32	0.0029
		Well.IOBK			2100 2240	54	0.099	0.0023
		Well.Lunacharskiy			1700 1830	62	0.06	0.006
Zone where active water exchange takes place		well.39 Chimgansay	1-4	Poor gravel pebble deposits	45	7	0.05	.00008
		Well. 38 Chimgansay			47	7		.00002
		Spring. Cinar	z	Fissured conglomerates sandstones limestones and dolomites	0,0	10		.00003
		Spring. Xodjikent			0,0	12		.00004
		Spring. Teskaribulakк			0,0	14	0.15	.00004
		Spring.д. Xumsan -1			0,0	12	0.14	.00002
		Spring.Xumsan-2			0,0	6	0.12	.00002
		Spring.Nur-ota			0,0	16		.00004

water exchange, there is no accumulation of helium concentration, but there is a migration of helium through structural tectonic disturbances. In this connection, the helium concentrations in the underground waters of the studied water points are significantly low and amount to 0.00002-0.00008 ml / l and 0.05-0.15 vol.%.[11-13]

If we trace the change in the helium content (Fig. 1), then, on the whole, at first glance, there is a fuzzy, but smooth decrease in horizontal stretching from the feeding areas to the side of formation subsidence.

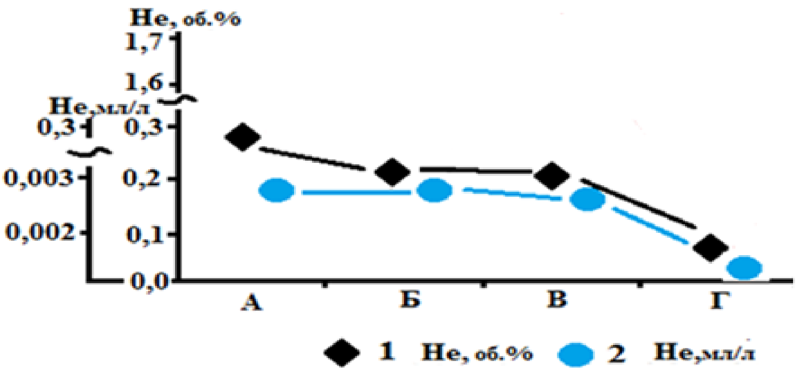


Fig. 1. Graph of helium concentration versus hydrogeological and tectonic factors. 1 - helium in vol /%, 2 - helium ml / l.

In general, the helium content in terms of the integrity of hydrogeological and tectonic conditions in non-disturbed structures is high, i.e. has maximum value in the zones of difficult and most difficult water exchange. The minimum value is in the zone of active water exchange.[15-17]

In conclusion, we can note:

- in the present work, for the first time, an attempt was made to group hydrogeological and tectonic conditions for the isolation of four factors with different values of helium concentration and a gradual increase in the helium concentration in horizontal strike was revealed, from the feeding areas to the side of formation subsidence;

- the identified factors will correctly assess the helium variations associated with seismic events. These important issues for hydrogeoseismology will be the subject of our further research.

Reference

1. Zakirov M.M. Some features of the formation and distribution of helium in the underground waters of the Pristashkent artesian basin. // Geology and mineral resources. Tashkent, No. 3.2017, S.42-44.
2. Zakirov M.M., Yusupov Sh.S., Ziyavuddinov R.S. Features of changes in the concentration of helium in groundwater (for example, the South Tien Shan and the Pamirs). .//Geology and mineral resources. Tashkent, No. 4,2018, S.44-47
3. Ziyavuddinov R.S. Features of the manifestation of helium in the underground waters of seismically active regions of Uzbekistan // Abstract of Cand. Diss. Tashkent, 2015.22s.
4. Ibragimova T.L., Ibragimov R.S. Methodological aspects of studying the relationship of variations in the gas-chemical composition of groundwater with seismicity // Problems of Seismology in Uzbekistan No. 11, 2017, P.36-45.
5. Zakirov M.M. Some factors affecting the helium content in the groundwater of the South Tien Shan and the Pamirs. / Sat: “Analysis, forecasting and management of natural risks taking into account global climate change”. M., “GEORISK-2018”, Volume 1,2018. S.182-188.
6. Matveev E.S., Tolstikhin I.N., Yakutseni V.P. Isotopic helium criterion for the origin of gases and the identification of zones of neotectogenesis (for example, the Caucasus). "Geochemistry". 1978. No. 3. S. 220-227
7. Kropotkin P.N., Valyaev B.I. Land degassing and geotectonics // Abstracts dokl. IV Symposium "Degassing the Earth and Geotectonics". M: "Science." MOIP. 1976. S.3-11.
8. Sadykov F.S., Yusupov Sh.S., Zakirov M.M. Features of the concentration of helium dissolved in groundwater, as a harbinger of the preparation of the upcoming earthquake // International Scientific and Practical Conference "GEORISK-2015" M: 2015. October 12-14. S.354-359.
9. Yusupov Sh.S. The mechanism of formation of isotopic precursors (for example, the carbon isotopic composition in the carbonate system CO2, HCO-3 (H2CO3) groundwater) // Abstracts of the fifth Kazakh-Chinese International Symposium "Modern geodynamics and seismic risk of Central Asia." Almaty 2013.S. 224-225.
10. Zakirov M.M. and Ziyauddinov R.S. Features of change of helium concentrion in underground water (on the example of the southern Tien-Shan and Pamirs)./ CIBTech Journals,Jaipur,India, - Volume 9. - №1. – 2019. - pp.29 - 33
11. Umurzakov R.K. and Zakirov M.M. Conditons at formation of molecular hydrogen in groundwaters of seismoactive regions of Uzbekistan. / CIBTech Journals, Jaipur, India. - Volume 9. - №1. - 2019. - pp.71 - 75
12. Sultanhodzhaev A.N., Latipov S.U., Khasanova L.A. and others. "Hydrogeoseismological precursors of earthquakes." Tashkent: 1983. 135 p.
13. Ground-Water tracers – a short review / S.N. Devis, G.K. Thompson, V. Bentley, G. Stiles - Ground-water.- 1980.- vol.18.- №1.- pp.I4 - 25.
14. Hezzeg A.L. Early diagtntsis of organic matter in lakt sediments a stable carbon

isotope study of pore waters. / Chemical Geology. Isotope GeoSci. – 1988.- 72/8.- №3.- p.199 – 201

15. Finkelstein D.N. Inert gases. M: "Science." 2009. S. 195.