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Research Article

CONDITIONS AT FORMATION OF MOLECULAR HYDROGEN IN GROUNDWATERS OF SEISMOACTIVE REGIONS OF UZBEKISTAN

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ABSTRACT
The results of long-term observations of the gas composition under various seismotectonic and hydrogeological conditions of Uzbekistan (based on the content of molecular hydrogen) are analyzed. Dependences of the average long-term values of molecular hydrogen (H_2) on the lithological composition and temperature of groundwater was studied and compared.

Keywords: *Molecular Hydrogen, Temperature, Groundwaters, Lithological Composition*

INTRODUCTION
Hydrogen, due to its activity in aqueous solutions, plays an important role in physicochemical processes. It is formed as a result of various radiation-chemical processes, as well as processes of thermocatalytic decomposition of water under high-temperature conditions at great depths. Migration of deep hydrogen is called a degassing rod (Kropotkin and Valyaev, 1976); possessing the highest rate of ascent, hydrogen interacts with the mineral components of the lithosphere, determines the processes of metamorphism and metasomatism (the transfer of matter by diffusion of components in the pore solution).
One of the ways of hydrogen formation, in addition to continuously occurring processes leading to the oxidation of hydrogen in the earth's crust at high temperature, is the interaction of water with iron or its compounds (Sultanhodjaev *et al.*, 1978):

$2FeO + H_2O = Fe_2O_3 + H_2$
$3FeO + H_2O = Fe_3O_4 + H_2$
$FeS + FeSiO_3 + 3H_2O = Fe_2SiO_4 + SO_4 + 3H_2$
$3FeSiO_4 + H_2O = 3FeSiO_3 + Fe_3O_4 + H_2$

Due to its chemical activity, hydrogen in the earth's crust, as well as in the hydrosphere, is most often in a bound state and is a part of rocks, minerals, organic compounds and water. Releasing from the compounds, hydrogen enters into new reactions or migrates to the surface of the Earth, leaving the atmosphere and further into space.
Hydrogen is of great importance for geochemical transformation of rocks, the formation of hydrocarbon deposits, ore deposits of polyvalent elements (uranium, molybdenum, selenium, rhenium, etc.). Received in recent years, observations of variations in the concentration of molecular hydrogen in various geostructural zones of the Earth indicate the prospects of this type of research for solving the problems of geodynamics and hydrogeology.
Issues of formation of the gas composition of groundwater have been and remain relevant, and the solution of the most important geological, geochemical and hydrogeological problems is associated with them. And it is not by chance that the interest in studying the nature and mechanism of abnormal manifestations and content of groundwater gas composition during the seismic activation period is growing, information on the features of its distribution and distribution in the studied groundwaters is needed. These data are also necessary for the correct formulation of research on the search for precursors of earthquakes.

Aim of the work

The aim of the work is to identify the specific features of the formation of molecular hydrogen in groundwater with different lithological composition and temperature of water-bearing rocks in seismically active regions of Uzbekistan.

MATERIALS AND METHODS

The results of long-term observations of the gas composition (molecular hydrogen) in groundwater of various seismotectonic and hydrogeological conditions of Uzbekistan were analyzed;

Some features of the change in the groundwater of molecular hydrogen from the lithological composition of rocks and the temperature of groundwater; (on the example of the Pretashkent and Fergana artesian basins at the stations of Andijan, Namangan and in the underground waters of the Surkhandarya region (the complex predictive station (CPS) of Shurchi) (Umurzakov, 2016) were studied.

Changes in the gas-chemical composition and hydrogeodynamic parameters of groundwater through deep boreholes were studied.

RESULTS AND DISCUSSION

In the table, data reflecting the dependence of the magnitude of molecular hydrogen on the temperature of groundwater are summarized.

Table 1: The change in the content of molecular hydrogen from the temperature of groundwater

Name of water points	Age of water bearing rocks	Water temperature in T^0 C	Variations of the water temperature from and to, in T^0 C	Average values of H2 content, vol.%	The fluctuations in the content of H2, vol.% From and to
		Pretashkent artesian basin			
Keles		52		0.0005	
IMG		65		0.0052	
Shreder		40		0.0016	
Botanika		47	40 - 65	0.0009	0.0005 –
Buyuk Ipak Yuli	K_2	62		0.0007	0.0052
CWS		62		0.0012	
Pobeda		47		0.0012	
Chernyaevka		40		0.0078	
Tashkent		57		0.0081	0.0078 –
mineral waters			24 - 57		0.0146
Fazilova		55		0.0135	
A. Yasavy		24		0,0146	
		Surkhandarya artesian basin			
Shurchi well 5		26		0.011	
Shurchi well 7	. Q	22	21 - 26	0.017	0.011 – 0.018
Shurchi well 8		21		0.018	
		Fergana artesian basin			
Chartak 1		39,5		0.12	
Chartak 2		44		0.016	
Chartak 4		38	38 - 44	0.04	0.016 – 0.12
Chartak 6	N_1	41,5		0.054	

Chartak well		42		0.019	
Namangan.					
Andijan 1		23		0.16	
South		32	23 - 32	0.09	0.09 – 0.16
Alamushuk					
Khojaabad 745		45		0.07	
Jalalabad,1		42	42 -45	0.05	0.02 – 0.07
Jalalabad,3	I	43		0.02	

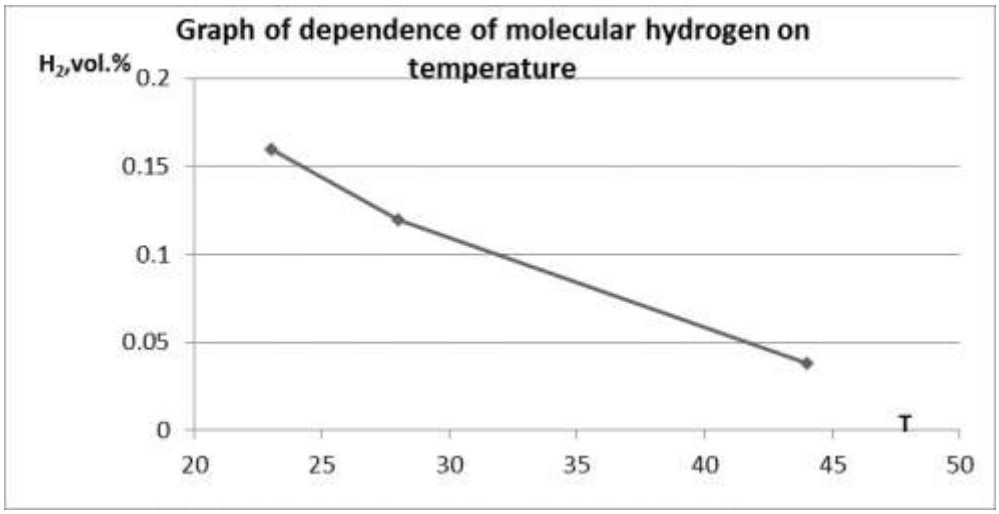

Figure 1. Graph of dependence of molecular hydrogen on temperature.

It can be seen from the figure and table that in the groundwater the changes in the temperature indexes of the water are accompanied by noticeable changes in the concentration of molecular hydrogen. In groundwater at a temperature of 40-65 °, the H_2 concentration is low 0.0005-0.0052% by volume, and at a temperature of 23-32 ° the values increase to 0.09-0.16% by volume, indicating a decrease in the solubility of the molecular hydrogen with increasing temperature.

Figure 2 and Table 2 show the dependence of the long-term average values of molecular hydrogen H2 on the lithological composition of the rocks.

Table 2: The change in the content of molecular hydrogen from the lithological composition of water-bearing rocks

Name of water points	**Age of water bearing rocks**	**Lithological composition of water-bearing rocks**	**Average values of H2 content, vol.%**	**Fluctuations in the content of H2, vol.%, From and to**
Pretashkent artesian basin				
Keles			0.0005	
IMG			0.0052	
Shreder			0.0016	
Botanika		Sandstones,	0.0009	
Buyuk Ipak Yuli	K_2	siltstones	0.0007	
CWS			0.0012	0.0005 –0.0146

Pobeda			0.0012	
Chernyaevka			0.0078	
Tashkent mineral waters			0.0081	
Fazilova			0.0135	
A. Yasavy			0.0146	
Surkhandarya artesian basin				
Shurchi 5			0.011	
Shurchi 7	Q	Gravel and pebbles	0.017	0.011- 0.018
Shurchi 8			0.018	
Fergana artesian basin				
Chartak 1			0.12	
Chartak 2			0.06	
Chartak 4		Sandstones,	0.04	
Chartak 6		conglomerates	0.054	
Chartak well Namangan.	N1		0.019	0.02-0.16
Andijan 1			0.16	
South Alamushuk			0.06	
Khojaabad 745			0.07	
Jalalabad,1	I	Gravels,	0.05	
Jalalabad,3		conglomerates	0.02	

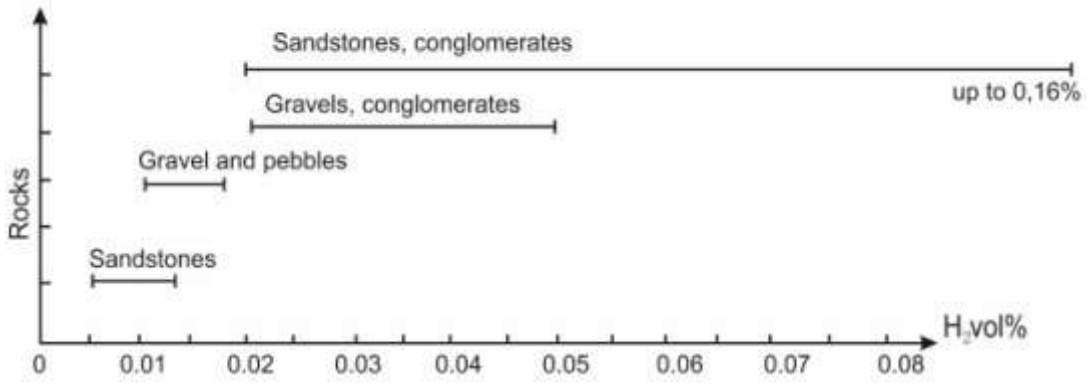

Figure 2: Dependence of molecular hydrogen in groundwater on the lithologic composition of water-bearing rocks.

It can be seen from the figure that: 1) relatively high values of molecular hydrogen (0.02 to 0.16% by volume) are characteristic for sandstones and conglomerates, as well as for gravelites and conglomerates (0.02 to 0.055 vol.%); 2) low values of H_2 (0.0005 to 0.0135% vol.) Are confined to sandstones and siltstones (0.0146 vol.%), Gravel-pebble deposits (0.011 to 0.018 vol.%).

CONCLUSION

Relatively high values of molecular hydrogen (up to 0.16% vol.) in groundwater are confined to sandstones and conglomerates;

A rather low content (0.0005-0.018 vol.%) of molecular H2, down to its absence is characteristic of sandstones and gravel-pebble rocks;
Temperature changes affect the change in the concentration of molecular hydrogen in groundwater. At a high temperature, the H2 concentration is low, and at low temperatures its concentration increases, which indicates an inverse relationship between the solubility of molecular hydrogen and temperature.

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