GROUNDWATER OF GANIKH-AYRICHAY FOOTHILLS ON THE PROSPECTS OF USE

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Abstract

At last years, the demand for drinking and irrigation water increased sharply of our republic. The main water resources Kura and Araz rivers before get to our country, they were polluted with various chemical elements and compounds, organic substances, and the water level of the rivers decreased by 30%. The geological and hydrogeological conditions of the area have been thoroughly studied in order to select a sustainable water source in order to improve the drinking water supply of Baku and the Absheron Peninsula, as well as the city of Balakan. The object of study is the Ganikh-Ayrichay (Alazan) foothill plain, located on the southern slopes of the Main Caucasus Range, 210 km long and up to 30 km wide in Azerbaijan. Geophysical electrical exploration (GEZ) was conducted in the area with the ERA-MAX device and interpreted with the help of special computer programs. It was determined that the total mineralization rate (GMP) of plain ground and pressurized waters does not exceed 0.5-0.7g/l. These waters are mainly hydrocarbonate and mixed cations.

Keywords: Ganikh-Ayrichay foothill plain, water supply, aquifer, ground and pressurized waters, percent of mineralization

I. Introduction

Compared to neighboring republics, Azerbaijan's drinking water resources are unevenly distributed and limited in the South Caucasus. At the same time, 70% of the water resources formed outside of country. The main water resources Kura and Araz rivers before get to our country, they were polluted with various chemical elements and compounds, organic substances. Measures are being to take gradually replace the water of the Kura River, which is currently used in the water supply of Baku with quality groundwater resources.

Given the problems of protection and preservation of the environment, groundwater and surface water resources, forest massifs, especially the consequences of global climate change, it is impossible completely to solve them by individual states in this time. Consequently, all countries of the world or neighboring countries should resolve these issues globally. It is necessary to implement the conventions adopted by the UN [1-3].

Azerbaijan begins from the top of Tinov Rosso (3374 m), the border of the Main Caucasus Range in Azerbaijan, which represents most of the Greater Caucasus, providing the formation of the largest groundwater and surface water bodies. In many parts of the range, the height is more than 3,000 m, and in the central part it is more than 4,000 m. Absolute values of this range are gradually decreasing and expanding in the south-east of Bazarduzu-4466 m, Tufandag-4191m, Bazaryurd-4126 m, Babadag-3629m peaks. The length of the Ganikh-Ayrichay foothill plain in Azerbaijan is 210 km, and its width is up to 30 km.

The main rivers flowing from the southern slope of the Greater Caucasus Mountains flow perpendicular to the direction of elongation of Grade I tectonic rocks. Therefore, they intersect structures of different neotectonic regimes in the direction of their currents. Many of their tributaries extend perpendicular to the main river on tectonic faults.

Mountain rivers of the north-eastern slope of the Greater Caucasus (Samur, Gusarchay, Gudialchay, Garachay, Valvalachay, Shabranchay, Atachay) and rivers of the southern slope (Ganikhchay, Balakanchay, Ayrichay, Mukhakhchay, Katehchay, Kaychaychay, Talachay, Mazimchay) derives its sources from mountain ranges at an altitude of 2000-4000 m above sea level. These rivers form riverbeds and waterfalls in their streams, and when they reach the plains, they form strong ravines and divide into many tributaries, forming natural outflows (springs) of groundwater.

Orographically, the study area characterized by a very complex geological structure, as a typical mountainous area with sharply fragmented southern slopes of the Main Caucasus Range. The geological structure of the area includes complex complexes of various sediments formed in different paleogeographic and geodynamic conditions of the Meso-Cenozoic.

The history of geological development of the area played an important role in the formation of the Greater Caucasus rivers, their tributaries and groundwater complexes, in the formation of classical hydrogeological conditions as a whole, especially in the collection of sediments of the Fourth Period (QIV). The Ganikh-Ayrichay valley consists of the Fourth Period and the Pliocene large riverbed. The thickness of Upper Pliocene and Quaternary sediments is in the range of 1000 m. Mesozoic sediments were collected in the eastern part, and Mesozoic and Paleogene sediments in the west.

The relevance of the article is that the groundwater resources of the basin are estimated at 23-25 m^3/s, and the huge Ganikh-Ayrichay foothills begin in the north of Balakan region and in the south it includes the administrative districts of Zagatala, Gakh, Sheki, Oguz, Gabala, Goychay and Ismayilli regions area included. From 2010, high-quality drinking water for 5 m^3/s is supplied to Baku via the main water pipeline from the Oguz-Gabala section of this basin, and in the coming years, it is planned to build 2-3 new water pipelines from this field to Baku. Proceeding from this, taking into account of the Samur-Valvalachay and Ganikh-Ayrichay foothills on the north-eastern and southern slopes of the Greater Caucasus in the next 10 years, the protection, conservation and efficient use of both reservoirs is one of the most important issues.

The annual operational reserves of the republic's usable waters are concentrated in the Samur-Shabran, Ganikh-Ayrichay, Ganja-Gazakh, Mil-Garabagh, Jabrayil and Nakhchivan foothills. Only in the geological section of the Samur-Shabran and Ganikh-Ayrichay foothills is prevalent large river rocks, gravel and sandy rocks. The good development of the river network, the thickness and size of the aquifers and river cones, provided very important hydrogeological conditions for the Quaternary sediments at the intersection of these areas (Figure 1.).

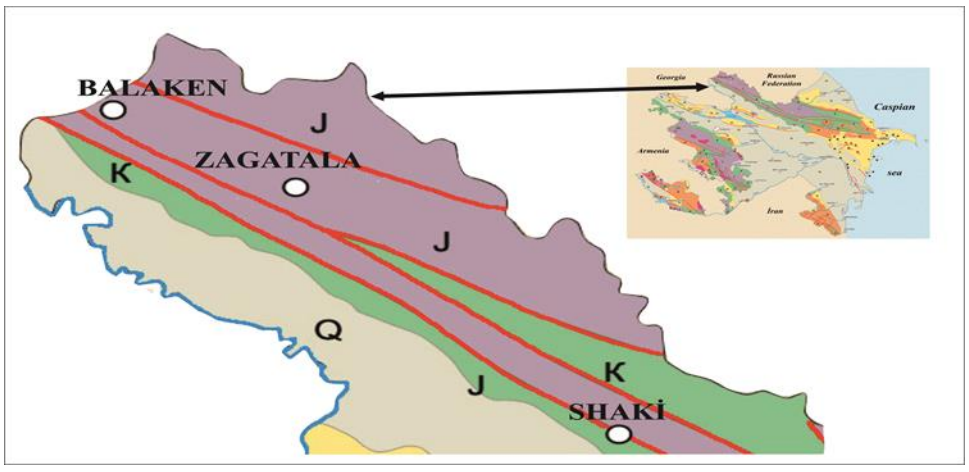

Figure 1: *Overview map of Azerbaijan*

Considering all this, the foothills of Samur-Shabran and Ganikh-Ayrichay have proven reserves of high categories (A, B, C1, C2) based on existing wells, and each of the two giant reservoirs should be used mainly for water supply to Baku and the Absheron Peninsula.

The foothill plain of Ganikh-Ayrichay, like the huge artesian basin in Azerbaijan, is characterized by the presence of large surface watercourses filled with coarse-grained alluvial and proluvial-diluvial deposits, and by the presence of intense atmospheric precipitation. The groundwater runoff from Quaternary sediments, which have a large thickness in this area, form due to the recharge of groundwater from the north of the Balakan-Zagatala zone, surface water and atmospheric precipitation, as well as water under pressure from the depth [4].

In accordance with the agreement signed between "Azersu" OJSC “Su kanal” Research and Design Institute and "Hydro Geo Environment Group" LLC in 2020, as a result of the work carried out on the selection of sustainable water sources to improve drinking water supply of Balakan city, Ganikh-Ayrichay confirms the great role of the plain in sustainable water supply.

During the research, hydrogeological conditions were assessed, comprehensive geophysical studies have once again confirmed the conditions of occurrence, depth and thickness of the aquifers. Monitoring of existing water intake wells, static and dynamic well levels, flow and determined the chemical composition of the water (Table 1) [5, 6].

Table 1: *Results of water samples analysis (2021)*

№	**Wells**	**E-1**	**E--2**	**W-3**	**W-7**	**W-11**	**W-12**	**W-24**	**W-25**
1	pH	7,24	7,27	6,98	7,3	7,01	6,76	7,46	7,36
2	Mineralization	387,6	557,7	204,5	201,7	193,8	200,9	658,3	377,6
3	Hydrocarbonate-HCO_3	231,8	396,5	85,4	85,4	79,3	85,4	427	231,8
4	Sulfates (SO_4^{2-})	22	8	59	58	60	59	8	15
5	Chlorides (Cl^-)	26,6	9,6	4,6	2,8	1,4	2,8	51,8	22,3
6	Calcium (Ca^{2+})	50,	76,2	36,1	36,1	36,1	36,1	76,2	56,1
7	Magnesium (Mg^{2+})	13,4	21,9	9,7	8,5	8,5	8,5	30,4	14,6
8	Na^++K^+	34	32	4,8	5,5	3,2	4,8	54,7	19,8
9	Nitrites (NO_2^-)	0,015	0,037	0,004	0,007	0,06	0,07	0,28	0,48
10	Nitrates (NO_3^-)	0,03	0,08	0,22	0,27	0,23	0,24	0,02	0,01
11	Ammonium (NH_4)	0,08	0,29	0,05	0,07	0,06	0,07	0,28	0,48
12	Iron (Fe^{3+})	0,2	0,19	0,59	0,28	0,3	0,44	0,18	0,09
13	Copper (Cu^{2+})	-	-	-	-	-	-	-	-
14	Aluminum (Al^{3+})	0,015	0	0,012	0,012	0	0	0,288	0
15	Zinc (Zn^{2+})	0,03	0,08	0,22	0,27	0,23	0,24	0,02	0,01

In the northern part of the Ganikh-Ayrichay foothill plain, in the territory of the village of Solban, Balakan region, geophysical studies by 6 points of the SEZ with 1 profile were carried out performed by DC vertical electrical sensing method (DCS) [7]. As a result of research conducted by this method, all the layers involved in the geological section of the area were interpreted by special computer programs to a depth of 230 m and final plans-profiles were compiled (Figure 2).

At the same time on the site drilled two exploration wells and along with the hydrogeological parameters of the area, the lithological features of the geological section, especially their thickness, were clarified. During the experimental-injection water in the exploration wells monitoring operations were carried out in existing wells and interactions were assessed. (Tables 2, 3).

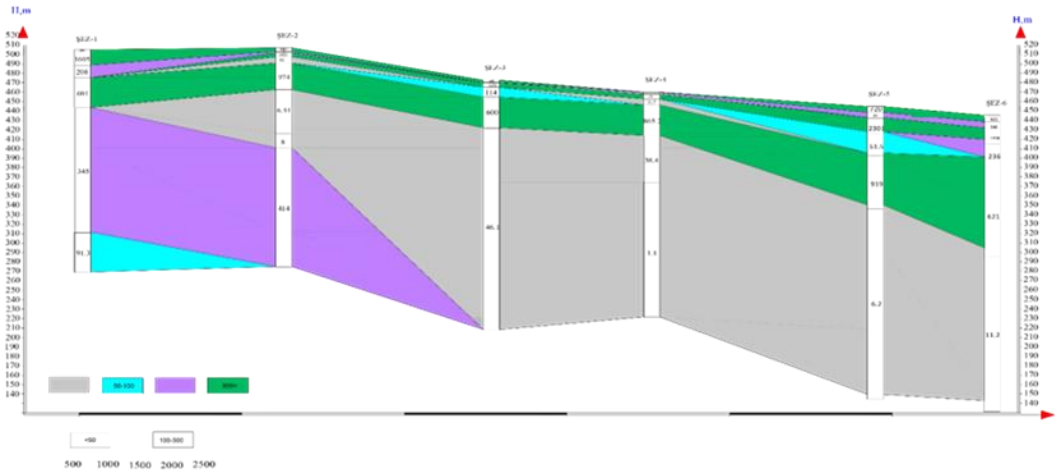

Figure 2: *Profile built on 6 GEZ points of Balakan region*

Table 2: *Lithological composition of exploration well No. 1 of Balakan region*

Balaken district		**Exploration well number K-1**		**Litological composition**	
Based on rock samples taken from every meter interval				X	619921.58
				Y	4620634,00
				Z	445
S/№	Name of rock example	How many meters	From meters	To meters	
1	Land	1	0	1	
2	Gravel	77	1	78	
3	Gravel filler clay	12	78	90	
4	Clay-gravel with clay filler	3	90	93	
5	Gravel filler clay	7	93	100	
6	Clay-gravel with clay filler	6	100	106	
7	Clay	8	106	114	
8	Clay-gravel with clay filler	4	114	118	

Table 3: ***Lithological composition of exploration well No. 2 of Balakan region***

Balaken district		**Exploration well number K-2**		**Litological composition**	
Based on rock samples taken from every meter interval				X	621480.25
				Y	4622477,35
				Z	522
S/№	Name of rock example	How many meters	From meters	To meters	
1	Land	1	0	1	
2	Gravel	41	1	42	
3	Gravel with sand filler	6	42	48	
4	Gravel	33	48	81	
5	Gravel filler clay	7	81	88	
6	Sand filler clay	14	88	102	
7	Gravel filler clay	8	102	110	

8	Sand filler clay	2	110	112
9	Gravel with sand filler	11	112	123
10	Black clay	18	123	141

Thus, the Ganikh-Ayrichay foothill plain was identified in previous years, in particular, the stability of the main geological-tectonic and hydrogeological indicators of the sediments of the IV period was confirmed. Centralized water supply to Baku and the Absheron Peninsula at the beginning of 2000 was calculated for a population of about 1.56 million people. At present, this figure is around 3.0 million. As a result of comprehensive measures taken at the state level over the past 10-15 years, the volume of drinking water supplied to Baku has increased from 570 million m3 to 700 million m3.

Taking into account the results of new hydrogeological surveys carried out within the boundaries of the Ganikh-Ayrichay reservoir, at the same time, in the water supply of Baku and the Absheron Peninsula, given the great and long-term importance of this reservoir it is necessary monitoring and expansion of the control and protection regime of the water intake.

II. Results

1. As a result of recent geophysical surveys (GEZ) in Solban village of Balakan region, a number of well sections and a profile of the area covering 6 wells have been established. The lithological composition, thickness, reservoir characteristics of layers to a depth of 230 m in the study area have been clarified and the chemical composition of groundwater has been studied. The hydrogeological parameters of the reservoir and the groundwater regime were specified from the drilled exploration wells.

2. Lack of fresh water resources in the country, global climate change and rising average temperatures observed in recent years, reduction of water in transboundary rivers and excessive pollution, on the other hand population growth, improving the standard of living, given the sharp increase in demand for irrigation water due to the development of agriculture, the action plan for water supply in Azerbaijan, it should be continued and expanded.

3. Analysis of the collected materials on water supply of Balakan region, Baku city and Absheron peninsula shows that the groundwater resources of Ganikh-Ayrichay water basin should be used comprehensively and efficiently. Along with the protection of the basin, it is considered important to begin construction of the III (Shollar) main water pipeline from the Samur-Gusarchay basin in the coming years. Groundwater resources of the Samur-Gusarchay basin with high categories (A, B, C1, C2) were approved in 1969 by the State Reserve Commission under the USSR Council of Ministers at 9 m^3/s. However, the construction of the III (Shollar) main water pipeline has not been completed yet.

4. In recent years, there has been a significant reduction in the water resources of transboundary rivers, and since 1970, the reserves of the Kura, Araz, and Ganikh rivers have decreased by more than 30%. According to various climate forecasts, taking into account the further reduction of water resources in the future, necessary steps should be taken and adaptation measures should be taken at the transboundary level, both within the country and in neighboring countries.

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