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STUDY OF HYDRODYNAMIC AND HYDROCHEMICAL REGIME OF SUBSOIL WATERS IN THE DEBRIS CONE TARTARCHAY

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ИЗУЧЕНИЕ ГИДРОДИНАМИЧЕСКОГО И ГИДРОХИМИЧЕСКОГО РЕЖИМА ГРУНТОВЫХ ВОД КОНУСА ВЫНОСА ТЕРТЕРЧАЯ

ГУСЕЙНОВА ГЮНАЙ НИЗАМИ ГЫЗЫ

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The legitimacies of the subsoil waters regime formation in the debris cone area of the Tartarchay have been studied in the article. A direction, dynamics and reasons occurring in hydrodynamical and hydrochemical regime of subsoil waters have been investigated in long-term period, the factors playing a leading role in the regime formation have been determined.

Groundwater with suitable sweet (mineralization rate up to 1.0 g/l) and low mineralization (1–3 g/l) has been spread unevenly in mountainous and Foothill regions of the country, starting from Paleozoic age rocks and up to modern age sediments. Regional exploitation reserves of underground waters of Foothill and lowland regions were estimated by the national geological exploration Service, and hydrogeological researches were carried out on some regions (Karabakh – Mil, Ganja – Gazakh) in order to re-evaluate underground water resources in recent years.

According to the calculations carried out in different years for the Republic in general, the regional exploitation reserves of groundwater – 23764.28 thousand m^3/day (or 9 billion a year). m^3). Approved by the reserves Commission – 12079,4 thousand m^3/day, including for mountainous regions – 126,4 thousand m^3/day. The total mineralization of groundwater in the amount of 1592.1 thousand m3/day is 1–3 g/l, which can be used for irrigation and technical purposes.

Key words: *debris cone, subsoil waters, mineralization degree, hydroizogypsum, drainage, irrigation.*

В статье изучены закономерности формирования режима грунтовых вод в районе конуса выноса реки Тертерчай. Исследованы направление, динамика и причины изменения гидродинамического и гидрохимического режима грунтовых вод в многолетнем периоде, определены факторы, играющие ведущую роль в формировании режима.

Подземные воды с подходящей пресностью (минерализация до 1,0 г/л) и малой минерализацией (1–3 г/л) распространены в горных и предгорных районах страны неравномерно, начиная от пород палеозойского возраста и до современных отложений. Региональные эксплуатационные запасы подземных вод предгорных и равнинных районов были подсчитаны Национальной службой геологоразведки, а в некоторых районах (Карабах-Мил, Гянджа-Газах) с целью переоценки ресурсов подземных вод в последние годы были проведены гидрогеологические исследования. .

По проведенным в разные годы расчетам в целом по республике региональные эксплуатационные запасы подземных вод составляют 23764,28 тыс. м^3/сут (или 9 млрд м^3 в год). Утвержденные комиссией запасы – 12079,4 тыс. м^3/сут, в том числе для горных районов – 126,4 тыс. м^3/сут. Общая минерализация подземных вод в количестве 1592,1 тыс. м^3/сут составляет 1–3 г/л, которые могут быть использованы для орошения и технических целей.

Ключевые слова*: конус выноса, грунтовые воды, степень минерализации, гидроизогипс, дренаж, орошение.*

Problem statement. As it is known, study of the subsoil waters regime is a structural part of the general complex of hydrogeological researches performed for the purpose of use perspective assessment, including exploitation resource calculation.

But the exploitation resource considers a quantity of the subsoil waters obtained with technico-economically rational water-raising in a reguired number and quality in a constant regime for the exploitation period. So, the hydrogeological researches must be directed to grounding of the subsoil waters, including the subsoil waters regime study.

Object and method of the research. The distinctive places have been selected in the debris cone area of the Tartarchay, the purpose is to study the subsoil water regime, their modern reserve, condition of the qualitative formation. The complex research methods have been used: the researches have been performed on initial cameral, field and laboratorial investigations and total cameral research stages. The information about a research object published in the fund, archives materials and reference sources has been systematized, then the field and laboratorial research materials have been analyzed in the first stage of the research.

Analysis and discussion. The debris cone of the Tartarchay which surrounds a great area of the Garabagh plain is situated in the north-east part of the Little Caucasus. This region borders on the Kur river from north-east, on İnjachay from north-west, on Khachinchay from south-east, on maternal rocks of the Little Caucasus from south-west and approximately borders on horizontal possessing 450 m height. The debris cone of the Tartarchay is considered an accumulative plain which is inclined from south to north because it is situated on the north-east slope of the Little Caucasus.

The relief height is from 450 m (in the south) to 1.0 m, but the surface inclination changes from 0,02 to 0,004 m. The surface of the research zone is strongly broken by the river valleys and many ravines and dry river valleys.

Splintering of the relief strongly gets reduced in the north-eastern direction and the plain surface becomes smoothed everywhere (from wave-like to the even surface).

The Tartarchay debris cone region is characterized by the weak hot semidesert and the field climate type having dry winter. The medium long-term temperature of the air is 14–14,5 °S in the Kur and 10–14 °S in the southern part. The coldest months are January and February (medium long-term temperature 0–3 °S), but the warmest months are July-August (medium long-term temperature 25–28 °S). The change amplitude of the temperature is from 7–9 °S (January) to 12–14 °S (August) [1].

The atmospheric precipitations are a main nutrition source of the subsoil waters and mainly fall down to the land surface like liquid. A quantity of the atmospheric precipitations is 200–400 mm during a year. Its 100–200 involve the plant vegetation period, but 100–150 mm-non vegetation period.

An average monthly relative moisture of the air is 39–82 %. Its minimum value is observed in June – Avgust (39–67 %), but a maximum value is observed in the spring and autumn (63–82 %) [3].

The evaporation from the open water surface changes (according to the long-term information) from 800 mm (in the south-west) to 14 mm (in the north-east). A quantity of evaporation from water surface is 3–4 times more than the atmospheric precipitations number. The additional water sources (subsoil and surface waters) are used for the irrigation purposes [4].

The biggest water canal is considered the Kur in the region. This river forms a region border in the north, it runs from north-west to south-east. The river bed inclination is 0.00015, but the flow rate is 1–2.1 m/sec in this area. An average yearly expense of the Kur is 397 m^3/sec. The main nutrition sources are snow (52 %), rain (18 %) and subsoil waters (30 %) [8]. An average yearly turbidity is 100–150 g/m^3.

The second largest river of the region is the Tartarchay.

Its average yearly expense is 21.9 m^3/sec in the Madagez station. The nutrition sources are snow (22 %), rain (47 %) and subsoil waters (31 %).

The Injachay runs from the north-west border. Its length is 83 km, but water collector area is 205 km^2. An average yearly expense is 1.12 m^3/sec near the Talish canal. The nutrition sources are snow (19 %), rain (52 %) and subsoil waters (29 %) [3]. Total hardness of the debris cone rivers is 3–6 mg.ekv/l (weak hard waters). The water of these rivers is used with the irrigation purpose [2].

A chemical composition of the Tartarchay, Khachinchay and Injachay waters changes along their flow. So, a chemical compositioin of waters is hydrocalcareous-calcic-magnesium at the foothill zone, but it is hydrocalcareous-sulphate-sodium, sodium-calcic, hydrocalcareous-sulphate in their low flow. The mineraliration rate of waters accordingly changes (a from 0.24 g/l to 2.27 g/l) in the direction of the rivers flow. A slight change is observed along the flow in the Kur river.

The most part of the river waters in debris cone is spent on penetration from river-bed in the alluvial-prolluvial plain. They wedge on the land surface and create “garasu” (black water) flows in the Kur zone. The water stroages have been built for using of these rivers waters in their upper flows with the purpose of irrigation. These water storages partly compensate a need of the region for the irrigative waters in the summer months, (at the foothill and central part). The subsoil waters spreaded in the central part of the region are used for the purpose of the irrigation and water provision of the settlements.

The precipitations of the Mesozoic (juri, chalk), paleogenic, neogenic and the fourth period take part in geological structure of the zone. The subsoil waters concern the modern, fourth period precipitations and they spread on the whole zone. The subsoil waters formation happens at the foothill part where the rocks of the zone has a high water-permeability.

But the subsoil waters formation continues towards bottom over the flow. If the formation sources of the subsoil waters which exceed at the top of the debris cone are considered infiltration from the rivers, atmospheric precipitations, condensation waters, including trickling from maternal rocks of the upland zone then the infiltration exceeds from irrigation waters over the flow at the bottom.

Unloading of subsoil waters occurs by the plants tranpiratoin and physical evaporation, flowing aside and to the Kur from interriver area, including by the artificial methods-drainage system and water exploitation with water-conductors [5, 6, 8].

The bed depth and mineralization of the ground waters in the Injachay-Khachinchay aouthor to get an exact information about formation, nutrition and unloading condition of subsoil waters at present.

A bed depth of subsoil waters is very different, and it change by 0–20 m, its gradual decrease is observed along the flow in the direction of north and north-east. The bed depth of subsoil waters gets decreased from 5–10 m to 2–3 m from the top part of the debris cone till the Kur river, then it rises again till 3-5 m near the Kur. But it is observed less than 1m in the small area towards east in a central part of the zone (6 km^2) [2].

According to the hydroizogypsum map the subsoil water flow is directed from west and south-west to east-from foothill to the Kur river. An absolute mark of the subsoil water level changes 300 m from right bank of the Tartarchay canal till 10 m along the Kur river.

An analysis of the regime-observation data indicate that an increase is observed in an average value of the bed depth in subsoil water of the zone (1951–1983), and this is connected with increase of the irrigative waters volume and largeness of the irrigated areas.

In connection with the collector-drainage system activity, the areas which are surrounded by the subsoil waters at 1–2 m of depth get reduced 1.5–2 times at the expense of the subsoil waters in the most depth in 2013 in comparison with 1983.

We should note that the areas which are surrounded by the subsoil waters possessing 1–2 m depth in connection with the intensive activity of drainage get decreased at the expense of subsoil waters in the most depth (2–3, 3–5, 5–10 m) in 2013 in comparison with the previous years. While the subsoil waters at 1–2 m of depth occupied 760 km area in 1983, this area reduced till 44 % and was 335 km in 2013. The subsoil waters at 2–3 m depth increased their area 15.3 %, but the area occupied by the subsoil waters at 5–10 m depth didn't change in 2013. (Table 1).

Table 1. **Perennial of the bed depth of the subsoil waters in the debris cone of the Tartarchay**

Bed depth of subsoil waters, m	The areas which are surrounded by the subsoil waters possessing different bed depth: km^2 in fraction numerator, in denominator-from total area with the coefficient.			
	H.Y.Israfilov,1951	H.Y.Israfilov,1962	R.Y.Mammadov,1983	G.N.Huseynova,2013
<1	173 / 9,3	209 / 11,2	3 / 0,4	6 / 0,3
1-2	321 / 17,3	560 / 30,2	760 / 40,9	335 / 18
2-3	307 / 16,5	443 / 23,8	365 / 19,6	549 / 29,5
3-5	508 / 27,3	180 / 9,7	125 / 6,7	409 / 22
5-10	173 / 9,3	110 / 5,9	602 / 32,4	561 / 30,2
>20	20 / 1,1	–	–	–
Average weight value, m	5,7	4,8	3,8	4,1

The researches indicate that the waters taken from the upper Garabagh canal with the purpose of irrigation (for the purpose of agricultural plants irrigation and saline soils washing) are drinkable (0.5–0.6g/l), but chemical composition is sulphate-hydrocalcareous-calcic-sodium, changes in pH=7.6–8.0 interval. During the irrigation a mineralization rate of the waters trickling from the aeration zone rises.

The analysis of the long-term (1951–1983) regime-observation data indicates that a mineralization rate of the subsoil waters gradually reduced under an influence of the long-term irrigation performed in a drainage backround. So, an average weight value of the mineralization rate of the subsoil waters reduced from 22.1 g/l to 2.3 g/l in 1983, but any change wasn't observed in 2013 (Table 2). But the areas which are surrounded by them have been differently changed for mineralization degree.

Table 2. **Dynamics of the Tartarchay debris cone area in a long-term section of the subsoil waters mineralization**

Subsoil waters mineralization, g/l	The areas which are surrounded by the subsoil waters possessing different mineralization: km^2 in fraction numerator, in denominator-from total area with the coefficient.			
	H.Y.Israfilov, 1951	H.Y.Israfilov, 1962	R.Y.Mammadov, 1983	G.N.Huseynova, 2013
<1	420 / 22,6	504 / 27,1	1027 / 55,3	465 / 25,0
1-3	453 / 24,4	343 / 18,5	591 / 31,7	1116 / 60,0
3-5	130 / 7,0	148 / 7,9	67 / 3,6	111,6 / 8,0
5-10	145 / 7,8	122 / 6,6	70 / 3,8	148,8 / 8,0
10-25	135 / 7,2	135 / 7,3	105 / 5,6	14,9 / 0,8
25-50	219 / 11,8	250 / 13,4	–	3,7 / 0,2
>50	358 / 19,2	358 / 19,2	–	–
Average weight value, g/l	21,6	22,1	2,3	2,4

If in 1983 groundwater with mineralization rate of up to 1 g/l covered 55,3 % of the total area, in 2013 the area surrounded by groundwater with similar mineralization has already increased 25,0 g/l for 55–60 %. On the other hand in the areas covered by groundwater with mineralization of 1–3 g/l, increased from 31,7 % to 60,0 %, but in the areas with 3–5 g/l and 5-10 g/l it rose from 3,6 % to 8,0 % the reductions are observed in the places where it is more than 10–25 g/l.

Conclusion

It was determined as a result of the researches that the leading role in a formation of the subsoil waters regime was transformed from natural factors into technogen factors in a long-term section of the Tartarchay debris cone (1951–2013). It was known that a serious change occurred in hydrodynamical and hydrochemical regime of the subsoil waters in a long-term section (1951-2013). So, an average weight mark of the subsoil waters level increased from 5.7 m to 3.8 m in 1951 till 1983, mineralization rate reduced from 21.6 g/l to 2.3 g/l. An average weight value of the subsoil waters rose from 3.8 m to 4.1 m, mineralization rate increased from 2.3 g/l to 2.4 g/l as a result of the subsoil waters extraction by the water-conductors from 1983 to 2013.

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