Summary

of the dissertation on competition scientific degree Doctor of Philosophy (Ph.D.)
on specialty 6D070600 - «Geology and exploration of mineral deposits»

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Mineral waters of Alakol basin
Conditions of formation and prospects of development

General description of the work. The dissertation work examines the issue of the formation of mineral waters in the Alakol basin. Presented mainly with nitrogen terms mineral waters of this group are widely used for balneological purposes both in Kazakhstan and in a number of other countries (Bulgaria, Austria, Hungary, France, and others.).

According to their physical and chemical properties, these waters can be successfully applied (without special technical devices) for the heating purpose. So, at the location of a number of resorts in areas with a harsh climate, is very important for their development and improvement.

However, at the present time, a serious limitation for increasing the capacity of a number of balneological health resorts, exploiting nitrogen terms are small quantities of operational resources of these deposits. The last obstacle in most cases, the comprehensive usage of the term described for balneological purposes and for industrial heating purposes.

In this work were considered natural, geological, hydrogeological conditions Alakol basin. Moreover, both previously known and newest data on the chemical, gaseous, isotope compositions of the mineral waters of the Alakol depression were analyzed with the usage of the example of the Aynabulak and Barlyk-Arasan deposits.

The objects of investigation are the thermomineral waters of the Alakol basin.

Relevance of the work. Nitrogenous terms represent one of the largest groups of mineral waters. They are widely used for balneological purposes both in Kazakhstan and in several other countries (Bulgaria, Austria, Hungary, France, etc.).

In Central Asia, there are more than 10 resorts. They are based on the exploitation of deposits of the nitrogen term.

These waters, in terms of their physico-chemical properties, can be ineffectively used (without special technical devices) for heat exchange purposes. So, at the location of the a number of resorts in areas with a harsh climate is very important for their development and improvement.

However, at the present time, a serious limitation for increasing the capacity of a number of balneological health resorts, exploiting nitrogen terms are small quantities of operational resources of these deposits.So, it hinders, in most cases, the comprehensive usage of the described terms both for balneological and heating purposes.

For economic and social development of the sovereign Republic of Kazakhstan, it is necessary to develop all branches of its national economy, including health care. In these issues, much attention is paid to activities aimed at strengthening public health, where a special place in the system of envisaged measures occupies the development of medical treatment and prevention and also sanatorium institutions that consume different types of mineral waters. One of the regions of the Republic of Kazakhstan with more favorable natural conditions and rich mineral water resources for the development of sanatorium construction is the Alakol basin.

The modern operation of Alakol basin with well-endowed mineral waters is still far from the potential possibilities of the underground hydrosphere. The limited usage of rich hydromineral resources is largely due to the insufficient study of the regularities of the location and formation of mineral waters in various hydrogeological structures of the Alakol basin. Most of the hydrogeological and hydrogeochemical information, especially in the field of hydromineral issues was received until the middle of the 1970s. In subsequent years, a survey and a geochemical study of mineral springs and hydromineral areas were practically not carried out. Consolidated report on mineral waters of the modern period until present time were based on an outdated, limited by volume material, far from fully reflecting the complex hydrogeological and hydrogeochemical conditions, that are characteristic for different geological structures in the region. As a result, Aynabulak mineral spring, the therapeutic mud of the Alakol basin, some varieties of mineral waters without "specific" components and properties were poorly studied. There are also scattered materials about the influence of Barlyk-Arasan mineral waters on the human body. The formation of underground mineral waters in the region has also not been enough studied. At the same time remain a discussion of a number of fundamental issues.

As a result of the current situation to this day there is no summarizing work reflecting at the modern level of knowledge the regularities of the location and formation of various geochemical and genetic types of mineral waters in the hydrogeological structures of the region. It is obvious that the solution of these and other tasks associated with the problem of searching, rational usage and protection of hydromineral resources is possible only on a well-developed scientific basis.

In recent years, the unique factual material obtained on the territory of the Alakol Depression, after summarizing, makes it possible to reveal regularities in the distribution and formation of mineral waters. This is especially important for the eastern part of

Kazakhstan, where the Alakol basin has a large potential of natural heal therapeutic resources. The most important part of Alakol basin is underground mineral water.

The relevance of the study of mineral water formation conditions has not only practical (provision of hydromineral base of the sanatorium Barlyk-Arasan, protection of mineral waters from pollution and exhaustion), but also a scientific interest. The investigation of the chemical and isotope composition of the mineral waters of the Alakol depression opens a new look at the formation of groundwater in a large and poorly studied region in the hydrogeochemical region.

Therefore, the subject of the dissertation work - The mineral waters of the Alakol basin is very relevant from theoretical and practical positions.

Research background. In the 19th century and the first half of the 20th century the Alakol basin was repeatedly visited and investigated by geologists, hydrogeologists, geographers, topographers and hydrobiologists. Among them, it should be noted studies of A. Shrenk (1840-1845), A.V. Golubeva (1867), V.V. Sapozhnikova (1904-1907), V.A. Obrucheva (1905-1906, 1909), B.K. Terletskogo (1931-1940), Z.A. Svarichevskaya (1933) and at al.

Issues of hydrogeological conditions of the Alakol intermontane basin are covered in the works S.M. Mukhamedzhanov (1965), T.T. Isabayev (1968 г.), R.D. Kudrin (1965), Zh.S. Sydykov (1972) and et al.

It has been devoted many published works to the description of geology, located in the system of folded structures of the Tien Shan, the Alakol sedimentary basin (A.K. Buvalkin (1960), A.K. Bouvalkin and V.I. Vlasov (1961), A.K. Bouvalkin and A.K. Zhaimin (1958), A.H. Ivanov (1962), V.A. Obruchev (1958), A.K. Bouvalkin and L.I. Kotova (1991), L.K. Didenko-Kislitsin (1999) and others).

The completed investigations allowed for the first time to cover in a comprehensive manner the main features of the hydrological regime and the water balance of groundwaters.

Analysis of studies on the Alakol basin, along with a variety of ideas, opinions and research methods showed different degrees of its study on the specific climatic factors. This complicates the study of environmental sustainability in the region. At present, the qualitative and quantitative aspects of water resources that are changing under the influence of modern natural-anthropogenic factors and processes in the Alakol basin are aimed at assessing. These aspects determine the stability of the aqua system with its intensive economic development and contribute to the development of a management strategy for the rational usage of the region's natural resources.

In view of the above the goal and main tasks of the present work are formulated.

Aim of the work. The main goal of the research was to clarify the geochemical features, the regularities of the location and formation of mineral waters in the Alakol basin and the identification of the prospects for their comprehensive usage.

To achieve this goal, it was necessary to solve the following tasks:

- identification of regularities of the location of mineral waters;
- study of the role of structural and tectonic factors in the formation of mineral waters;
- compiling the classification of mineral waters and identifying their analogues among the used domestic and foreign types;
- study of the chemical and isotopic composition of mineral waters;
- evaluation of forecasted resources mineral waters;

The object of investigation is the underground mineral waters of the Alakol basin.

The subjects of study are the chemical composition and resources of groundwater, balneological wells, thermal waters, the processes of formation of underground mineral therapeutic waters.

Materials and methods of research. The dissertation is based on the results of the author's personal research in the period of field work, as well as a large amount of factual material, including published and stock papers.

To evaluate the genesis of ion-salt, micro-component and gas compositions of mineral waters, character of the relationship between fresh, ground, pressure and mineral waters was used methods of studying tectonic and endogenic fissuring of rocks, hydrochemical and other methods.

Scientific novelty of the dissertation. On the basis of detailed studies of the formation of thermomineral waters in the Alakol basin, the role of structural-tectonic factors in the formation of explored deposits of thermomineralic groundwaters has been established. In addition, their outputs were justified on the day surface predominantly to areas of tectonic disturbances. Moreover, the influence of geological-lithological factors and the depth of circulation of mineral waters on their chemical and gas compositions were determined. The genesis of nitrogenous terms based on isotope studies was also revealed. As a result, the heat-energy potential of the thermomineral waters of the Alakol basin was evaluated and recommendations for the comprehensive development of thermomineral waters were given.

Protected positions. The following basic principles are substantiated and protected in the work:

1. The mineral waters of the Alakol basin are unique under the geological-structural and hydro-geological conditions of formation, composition and genesis of groundwater. Comprehensive development of these mineral waters is socially and economically significant.

2. The data of isotopic studies clearly show that the nitrogen hydrotherms of the Alakol basin is the result of the interaction of ancient infiltration waters with enclosing rocks and the large-scale redistribution of chemical elements between the aqueous solution and the secondary mineral formations formed under these conditions.

3. The currently used mineral water of the Barlyk-Arasan deposit corresponds to natural resources determined by natural factors. Excess of water abstraction over the value of natural resources will inevitably lead to the extinction of this unique deposit.

The growth of reserves of nitric-siliceous terms for sanatorium-resort treatment is possible only due to the involvement of other deposits of the region.

Practical significance of the work. Known regularities are detailed and new regularities of distribution and formation of mineral waters are revealed. This allows on a scientific basis to solve more effectively the problems of their search and exploration (taking into account specific balneological types and reserves of mineral water deposits), as well as their protection from pollution and exhaustion.

Investigation methods. Methodical methods and approaches, especially in the study of the composition of water, are a fundamental part of the research. Therefore, special attention was paid to the choice of water analysis methods. In the course of the work, an extensive database of chemical analyzes of water was collected over a long period of time. It also includes analysis of recent years, carried out on modern analytical equipment.

At the first stage, the collection, analysis and processing of factual material (data from field studies and reports from various organizations) was conducted. The materials of previous scientific research on the objects under consideration were also analyzed.

Samples for the analysis of cations and anions were filtered in place of sampling through a membrane filter with size 0.45 μm. Such a procedure is now universally recognized and it allows separating the dissolved fraction of the suspension. This is especially important in the analysis of trace elements and rare earth elements. Unfiltered water samples for analysis of oxygen and hydrogen isotopes ($\delta 18O$, $\delta 2H$) in them were placed in a glass container and covered with a dense lid to avoid exchange with air of the atmosphere. Analysis of the isotopic composition of water samples was carried out in the Resource Center "Geomodel" of the Science Park of the Saint Petersburg University on a laser infrared spectrometer Picarro L-2120i. Chemical analyzes of water were carried out in the analytical center of the Institute of Hydrogeology and Geoecology named after U.M. Ahmedsafin.

Publications. According to the results of the research in the republican publications and the CIS countries, 7 articles have been published. They contain the main content of the dissertation.

Structure and scope of the dissertation. The dissertation consists of an introduction, 7 sections, conclusion and list of references from 87 titles, set out on 115 pages. In the work there are 14 tables and 24 figures.

List of published works on the subject of the dissertation

1. E.Sh. Zhexembayev. The mineral spring of the Alakol basin. Proceedings of NAS RK, series of geology and engineering sciences, Almaty, №2 (2016), P. 92-96.

2. E.Zh. Murtazin, E.Sh. Zhexembayev. Thermomineral springs of the Alakol basin. Bulletin of KazNITIU, Earth Sciences, Almaty, No. 2 (2016), P. 38-42.

3. E.Sh. Zhexembayev. Barlykarasan thermomineral springs of the Alakol Depression. International Satpayev Readings - 2016, KazNRTU named after. K.I. Satpayev, Almaty, Volume No. 1 (2016), P. 374-378.

4. E.Sh. Zhexembayev, R.I. Plotnikova. Thermomineral waters of the Balkhash-Alakol region (South-Eastern Kazakhstan). Journal "Domestic Geology", Moscow, Nedra Publishing House, No.2 (2017), P. 68-75.

5. E.Sh. Zhexembayev, Zh.T. Mukaev, Y.N. Kassenov. Aynabulak thermo-mineral spring of Alakol basin. Materials of the International Scientific and Practical Conference "Modernization of Natural Science Education in Conditions of Updated Content" KazNPU, Almaty, 2-3 March, 2017, P. 447-450.

6. E.Sh. Zhexembayev, E.Zh. Murtazin, I.V. Tokarev, A.T. Khabiyev. Hydrogeochemical features of nitrogen therms of Alakol basin (East Kazakhstan). Известия НАН РК, серия геологии и технических наук, No. 3 (2017), P. 185-197.

7. E.Sh. Zhexembayev, I.V. Tokarev. Isotopes of oxygen and hydrogen in the thermal waters of the Alakol basin (East Kazakhstan). VII Russian Youth Scientific and Practical School "New in knowledge of ore formation processes". Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Russian Academy of Sciences, 2017.