

Abstract

The dissertation of Daniyar Borashuly Chensizbayev on the topic: "Formation of lithium-bearing industrial groundwater of the Shu-Sarysu depression based on the example of the Kolkuduk site", presented for the degree of Doctor of Philosophy (PhD) in the educational program: 8D05202 – "Hydrogeology and Engineering Geology".

Relevance of the Study. The study of the formation of lithium-bearing industrial groundwater in the Shu-Sarysu depression, using the Kolkuduk site as an example, makes a significant contribution to the field of hydrogeology as it allows a deeper understanding of the processes of formation and migration of lithium-bearing waters within a specific geographical zone. In groundwater, the concentration of mineral substances can reach such high levels that their extraction for industrial purposes can be both profitable and efficient. In the context of the interaction between water and rock, brines containing chlorides play a crucial role. Given the intensive use of groundwater for industrial purposes and the growing demand for resources, understanding the mechanisms of formation and distribution of lithium-bearing groundwater is becoming particularly important. The study of the formation of lithium-bearing industrial groundwater at the Kolkuduk site not only helps to identify the specifics of hydrogeological processes in the area but also to determine the key factors influencing the formation and quality of groundwater. Industrial groundwater and brines saturating the geological profile of the Shu-Sarysu depression are characterized by a high content of various microcomponents such as bromine, lithium, strontium, rubidium, iodine, potassium, and others. These waters represent an important object of industrial interest as hydromineral raw materials.

The relevance of this work is determined by the following aspects:

Scientific Research Aspect: The study of the formation and dynamics of lithium-bearing industrial groundwater requires a comprehensive approach and the application of modern hydrogeological and geochemical methods. Solving scientific and technical problems related to the assessment of lithium concentration, its extraction, and purification is an important part of this work.

Practical Application: The results of the study may serve as a basis for the development of new technologies and methods for lithium extraction. Applying the obtained data in practice will improve the methods for developing deposits and enhance the efficiency of using water resources for lithium production.

Strategic Importance of Lithium: Lithium is a critically important element for the production of batteries used in electric vehicles, mobile devices, and energy storage systems. This is particularly relevant in the context of the global shift toward more environmentally friendly technologies.

The significance and relevance of the study of the formation of industrial groundwater in the Shu-Sarysu depression is explained by their important contribution and potential for the development of the country's mineral resources sector.

The purpose of this dissertation is a comprehensive study of the formation of lithium-bearing industrial groundwater in the Shu-Sarys depression using the example of the Kolkuduk site in order to develop effective methods for their use for lithium extraction.

The object of scientific research is industrial groundwater in the territory of Shu-Sarysu province, in particular the promising Kolkuduk site.

To achieve this goal, the following tasks were solved:

1. Geological and hydrogeological study of the region (analysis of the geological structure, hydrogeological features of the Shu-Sarysu depression).
2. Assessment of the factors influencing the formation of lithium-bearing groundwater. Study of the chemical composition of groundwater.
3. Study of the concentration and distribution of lithium in groundwater, determination of lithium content at different depths and locations. Identification of the most promising zones for lithium extraction.
4. Analysis of existing lithium extraction technologies. Development and optimization of lithium extraction methods.

The scientific novelty of this dissertation lies in the in-depth and comprehensive study of the processes involved in the formation of lithium-bearing industrial groundwater in the Shu-Sarysu depression, with a focus on the Kolkuduk site. For the first time, the dissertation provides a detailed analysis of the geological, hydrogeological, and hydrochemical conditions of the region, which allowed the identification of previously unexplored patterns in the formation of lithium-bearing waters in the studied area. The obtained data on the stratigraphic composition, tectonic structures, and their influence on the distribution of aquifers, as well as on the geochemical processes contributing to lithium accumulation, significantly expand the scientific understanding of the mechanisms of lithium concentration in groundwater.

The main provisions submitted for defense:

1. Based on the results of studying the geological features of the Kolkuduk site in the Shu-Sarysui depression, a high ability to form lithium-bearing industrial groundwater has been revealed.
2. The concentration of lithium in the groundwater of the Kolkuduk site ranges from 60 mg/l to 130 mg/l and depends on the hydrogeological conditions and geological structure.
3. The performed hydrogeological zoning of the Shu-Sarys depression, based on the analysis of the geological structure and hydrogeological characteristics, allows us to determine the genesis and identify key areas where the industrial use of groundwater with a high content of minerals, including lithium, is most effective.

The practical significance of this research lies in the development and determination of effective methods for lithium extraction from lithium-bearing groundwater in the Shu-Sarysu depression. The results obtained will allow for the improvement of lithium extraction technological processes, leading to reduced production costs and increased efficiency. This, in turn, will contribute to the expansion of lithium production, which is in high demand in high-tech industries such as electronics, battery manufacturing, and renewable energy. The development

of effective lithium extraction methods from the region's groundwater will ensure more rational use of natural resources and contribute to the economic development of the region.

In addition, this research expands existing knowledge in the fields of geology and hydrogeology, as well as lithium extraction technologies, creating a foundation for further scientific and technological developments. The data obtained can serve as a basis for subsequent studies and innovations, contributing to the development of new solutions and technologies in the field of mineral extraction and natural resource management.

The author's personal contribution consists in setting goals and objectives; in carrying out ground route work; processing materials, analyzing the prospective development of industrial brines; carrying out work in the laboratory of chemical and analytical research; formulating conclusions and main provisions of the dissertation. Processing and generalization of research results and their further publication.

The work on the dissertation was carried out at the U.M. Akhmedsafin Institute of Hydrogeology and Geoecology within the framework of the BR10262555 program "Thermal energy, mineral resources and therapeutic potential of thermomineral and industrial groundwater of Kazakhstan. Assessment of the state and trends of changes in hydrogeochemical parameters of groundwater under the influence of natural and climatic changes and anthropogenic loads" commissioned by the Committee of Geology of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan.

The author participated as an executor in the implementation of the grant project "Assessment of the prospects for the development of associated reservoir brines of oil and gas deposits in Kazakhstan as hydromineral raw materials".

Approbation of the work. 6 articles have been published on the topic of the dissertation, including: 3 articles in republican specialized publications recommended by the Committee for Control in the Field of Education and Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan; 1 article in an international journal indexed in the Scopus database (Bulletin of the Tomsk Polytechnic University, Geo Assets Engineering, ISSN 2413-1830); 2 articles have been published in the proceedings of international conferences.

The structure and scope of the dissertation. The dissertation consists of an introduction, 5 chapters and a conclusion. The volume of the work is 140 pages of text, 31 figures, 10 tables, and a list of 188 references.

PhD. student



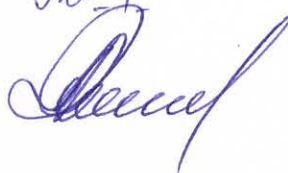
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