ABSTRACT
for the degree of Doctor of Philosophy (PhD) in the specialty
"6D075500-Hydrogeology and engineering geology"
by Miras Yesenuly Sanatbekov
on the topic: "Geodynamic and hydrogeological criteria for assessing the hydrocarbon potential of the Balkhash and Alakol depressions"

General characteristics of the work.

Administratively, the Balkhash basin is located on the territory of the Almaty region of the Republic of Kazakhstan. Large rivers such as Ile, Leps, Karatal and Aksu flow through its territory, as well as small lakes on the floodplains of rivers. Permanent settlements are located in the south and south-east of the basin, the largest of which are Bakanas village, Akkol village, Bakbakty village and Matai station.

Geologically, the Alakol promising oil and gas basin, closely related to the Alakol intermountain basin, is limited by folded structures. The Tarbagatai upland is located in the north, the Dzungarian Alatau in the southwest, and the Berlik and Maily mountain ranges in the southeast.

The Balkhash-Alakol depression, located in Kazakhstan, is one of the poorly studied basins and is now assessed as a zone with low potential for the discovery of hydrocarbon resources. In the context of intensive changes in the energy sector and the importance of ensuring its sustainability, the study of this region is becoming one of the priorities in the scientific field. At the moment, there is a low probability of detecting significant hydrocarbon reserves in the basin.

The main purpose of this scientific study is a comprehensive analysis of the factors affecting the hydrocarbon potential of the Balkhash-Alakol depression. To achieve this goal, a study of geodynamic features of the area, including structural characteristics of underground horizons, as well as an analysis of hydrogeological parameters and reservoir properties was carried out. Thanks to the use of modern methods and technologies and the use of experience gained from studying similar regions, a new approach to lowland hydrocarbon resources can be formed.

Based on the analysis of geodynamic and hydrogeological factors, the territories where the accumulation of hydrocarbons is possible have been identified. The practical significance of the results obtained lies in the possibility of their application in the planning and conduct of exploration and exploration work, which opens up new opportunities in the study and development of the hydrocarbon potential of the region.

Assessment of the current state of the solved scientific or scientific-technical problem.

The geological and tectonic features of the region determine the unique conditions for the formation of sedimentary complexes and the occurrence of hydrocarbons, which leads to significant interest in its oil and gas potential. The main problems associated with the study of the oil and gas potential of the Balkhash - Alakol basin include insufficient knowledge of modern geological sections, a limited amount of relevant seismic data, as well as the need for a detailed analysis of the lithological and structural features of sedimentary complexes.

The Balkhash-Alakol basin contains powerful sedimentary strata composed of volcanogenic sedimentary rocks of Paleozoic age and terrigenous sediments of Meso-Cenozoic age, which creates difficult conditions for the forecast of oil and gas reservoirs. The study of the geological and geophysical characteristics of the sedimentary complexes of the basin requires modern approaches and methods to identify promising areas of hydrocarbon accumulation. To solve the above-described problems, it becomes relevant to apply an integrated approach, including the following methods and approaches: the use of methods of gravity exploration, aeromagnetic survey and high-resolution seismic exploration to clarify geological structures, lithological characteristics of the section and assess the prospects of oil and gas potential.

Seismic studies in recent years have made it possible to obtain more accurate data on the occurrence of sedimentary rocks and to establish new promising sites within the basin. The construction of detailed seismic and geological models of the basin sections based on the latest data makes it possible to predict the conditions of occurrence of hydrocarbons and identify potential reservoirs. Such models are based on the interpretation of seismic data, including profile and 3D studies, and serve as the basis for subsequent oil and gas exploration. Hydrogeochemical analyses make it possible to determine the composition and behavior of reservoir waters, which can serve as an indicator of oil and gas systems and help in the localization of promising sites.

The study of the hydrogeochemical conditions of the Balkhash-Alakol basin makes a significant contribution to understanding the processes of hydrocarbon migration. The analysis of the lithological composition of sedimentary rocks is aimed at identifying their reservoir properties, which is an important stage for substantiating the oil and gas potential. The assessment of porosity, permeability and resistance of rocks to the effects of reservoir fluids makes it possible to more accurately determine the properties of the reservoir and its ability to accumulate and retain hydrocarbons.

Thus, the study of the Balkhash-Alakol basin is aimed at solving urgent scientific and technical problems associated with insufficient knowledge of its geological structures and sedimentary complexes. This work is aimed at developing and applying integrated methods to assess the oil and gas potential of the basin, which may be of significant importance for further planning of exploration and discovery of new fields in the region.

Justification of the need for this research work.
The need for scientific research in the basin is due to a number of factors that determine its prospects for the search for hydrocarbons and at the same time reflect the lack of knowledge of the region. The Balkhash-Alakol basin is a large negative structure with powerful sedimentary strata and unique tectonic features, which creates favorable conditions for the formation and accumulation of hydrocarbons. However, despite its significant potential, the current state of research within the basin remains limited. In recent decades, oil and gas exploration has practically not been carried out here, and data on its structure and the lithological composition of sedimentary complexes need to be updated and detailed.

Special attention to the need for research in the Balkhash basin is explained by the lack of detailed geological and geophysical data, including modern seismic and geological models of sections that allow predicting the presence and distribution of hydrocarbon reservoirs. Moreover, the lack of modern hydrogeochemical data that could serve as indicators of hydrocarbon systems makes it difficult to accurately understand the conditions of migration and localization of hydrocarbons. These aspects are especially relevant for the development of an effective methodology for identifying promising sites in the conditions of the complex lithological structure of the sedimentary cover characteristic of the Balkhash basin.

Taking into account these factors, this research work is aimed at a comprehensive study of the Balkhash and Alakol basin in order to obtain new data on its tectonic structure, lithological composition and hydrogeochemical features. The results of these studies will allow us to assess the prospects of the basin for oil and gas potential and will provide a basis for further planning of exploration activities in the region. Thus, the work has important scientific and practical significance aimed at expanding knowledge about the structure and capabilities of the Balkhash and Alakol basin as an oil and gas bearing facility.

Information about the planned scientific and technical level of development.

The planned scientific and technical level of research includes the use of modern methods of studying the Balkhash-Alakol basin, which will help to more accurately determine its oil and gas potential.

The use of high-precision seismic exploration (including profile and 3D surveys) will allow you to create a detailed model of the basin structure and identify the areas most promising for hydrocarbon accumulations.

Hydrogeochemical analysis of groundwater composition will help to better understand the conditions under which oil and gas can migrate and accumulate.

Lithological studies will allow us to study the properties of rocks, including their ability to retain hydrocarbons.

The whole range of methods and data will ensure a high level of development, which will be useful for effective planning of further exploration activities in the region.

The relevance of the topic.

Large initial forecast and prospective hydrocarbon resources are concentrated on the territory of South-Eastern Kazakhstan. But their main share falls on the Zaisan oil and gas lowland. In addition, the territories of Balkhash-Alakol are characterized by uneven exploration. And at the moment it is estimated as a low-potential area for the discovery of hydrocarbon resources. In the context of dynamic changes in the energy industry and the increasing importance of ensuring the sustainability of the energy sector, research in this region is becoming a priority in the scientific field.

Therefore, forecasting and prospecting for oil and gas in vast poorly explored territories using advanced hydrogeological methods in combination with traditional geological, geochemical and geophysical methods remain an urgent task of the work. For their implementation, a large amount of factual material on geology has been accumulated on the territory of Balkhash-Alakol, part of which falls on hydrogeological information. These are information about high-flow aquifers in wells,

data on more than 100 mineralized sources, which, unloading in the valleys of rivers and lakes, carry information about the hydrogeochemical conditions of the section and the productivity of territories that have not yet been studied by deep drilling.

The novelty of the topic.

1. The tectonic and lithological conditions affecting the formation of hydrocarbon accumulations in the Balkhash-Alakol basin have been determined, and the presence and distribution of oil and gas parent rocks, reservoirs and tires have been established. This was done through a detailed analysis, including the study of the geological structure and structure of the basin, the construction of profiles and the definition of the main zones of oil and gas formation.

2. For the first time, a comprehensive assessment of the prospects of various areas of the Balkhash - Alakol basin for hydrocarbon prospecting was carried out. The directions of future prospecting and exploration are justified and the most suitable sites for their implementation are identified.

3. For the first time, a comprehensive assessment of the hydrogeological conditions affecting the migration and accumulation of hydrocarbons was carried out. The interrelationships between groundwater and hydrocarbon systems have been established.

The connection of this work with other scientific research works.

The author participated in the implementation of the program-targeted financing project No.AR05133073 "Geodynamic evolution and assessment of oil and gas potential in the intermountain basins of Eastern and Southeastern Kazakhstan (Alakol, Balkhash and Ili)" for 2018-2020.

The purpose of the study is to study in detail and conduct a comprehensive analysis of the factors affecting the hydrocarbon potential of the Alakol depression.

The object of the study is the Alakol and Balkhash depressions.

Research objectives:

1. Collection and analysis of geological data on the Balkhash-Alakol depression. To study the facies distribution of precipitation, as well as the conditions and stages of their accumulation, in order to determine the key geological factors affecting the oil and gas potential of the region.

2. Study of the geodynamic history of the region. To analyze tectonic events and their influence on sedimentary processes, which will help to understand the role of geodynamics in the formation of hydrocarbon systems.

3. Investigation of hydrogeological conditions. To assess the factors influencing the migration and accumulation of hydrocarbons, including the interaction between reservoir waters and oil and gas parent rocks.

4. Assessment of the hydrocarbon potential. To calculate the volume of hydrocarbons and provide recommendations for further study, including the selection of promising sites for exploration.

Provisions to be defended:

1. The tectonic and lithological conditions for the formation of hydrocarbon deposits in the Balkhash basin have been established and the forecasts of the oil and gas potential of the region have been clarified.

2. A comprehensive analysis of the geodynamic history and its influence on sedimentary processes has been carried out, as well as to explain the mechanisms of formation of hydrocarbon systems.

3. To determine the hydrogeological conditions affecting the migration and accumulation of hydrocarbons, and optimize exploration work.

4. The calculation of the hydrocarbon potential of the Balkhash basin confirms its prospects for further study and development.

The practical significance of the work.

This dissertation is of great importance for the oil and gas industry of Kazakhstan. The results of the study will help to improve the methods of hydrocarbon prospecting, as recommendations for conducting prospecting and exploration in the Balkhash-Alakol basin will make them more efficient and economically feasible. The obtained data on geological and hydrogeological conditions will also help in planning scientific research. The research will enrich scientific knowledge and become the basis for future work in the field of geology and ecology. In addition, the assessment of conditions will help to avoid contamination of groundwater during exploration, which is important for environmental protection.

Structure and scope of the dissertation.

The dissertation is presented on 133 pages of computer-typed text and consists of an introduction, 4 sections, and a conclusion, as well as 50 figures and 2 tables. The dissertation includes a list of 103 sources utilised.