

## **ANNOTATION**

Dissertation work on the topic:

**«Specificity of the geodynamic and structural development of sedimentary basins in South Kazakhstan and the criteria for their oil and gas content on the basis of an integrated geological and geophysical analysis»,**

submitted for the degree of Doctor of Philosophy (PhD) in the specialty  
**"6D070600 - Geology and exploration of mineral deposits"**

**TULEMISSOVA ZHAMAL SERIKOVNA**

### **Evaluation of the current state of the solved scientific or scientific and technological problem (objectives)**

The oil and gas content of Kazakhstan was considered mainly by the western regions of Kazakhstan (Caspian Sea, Mangyshlak, Ustyurt). The oil and gas potential of these regions was studied in sedimentary complexes of the Paleozoic and Mesozoic-Cenozoic sedimentary cover.

In this work, on the basis of generalization and analysis of extensive geological and geophysical material, the prospects of oil and gas content of a number of sedimentary basins of South Kazakhstan are considered.

For the first time, the issues of oil and gas content of the depressions of South Kazakhstan, as early as 1925, were noted by A.D. Arkhangel'sky [1], who was later energetically supported by N.G. Kassin [2], K.I. Satpayev [3, 5], N.S. Shatsky [4], noting this in a number of publications. During the Second World War, the issues of prospecting for hydrocarbon raw materials acquired particular importance, and in this regard, a prospecting and exploration expedition was organized to assess the sedimentary basins of South Kazakhstan for the search for oil and gas. Much attention was paid to the Ili basin, the prospects for oil and gas potential were associated with the Mesozoic-Cenozoic sedimentary cover. Scientific controversy on this issue ended with the drilling of the first key well in East Kazakhstan and the conduct of regional geophysical work (1954). In the period 1954-1958, 8 more deep exploration wells were drilled here. In subsequent years, prospecting and exploration work was carried out in the Shu-Sarysu and Syrdarya depressions. In the following decades, regional, detailed, seismic exploration work was carried out, a number of parametric, exploratory and exploratory wells were drilled, which made it possible to draw a number of practical conclusions about the prospects for the oil and gas potential of the sedimentary basins of South Kazakhstan. Practical results were obtained in the Shu-Sarysu depression, in which two fields of nitrogen-helium gas were discovered and direct signs of oil and gas were established in the form of droplet oil inclusions in cracks in limestones of the Lower Carboniferous [6-11].

In the early 70s in the Moyinkum trough of the Shu-Sarysu depression (the Airakty structure), industrial fountains of hydrocarbon gas were obtained. In 1972, a powerful flow of hydrocarbon gas was obtained from the Upper Devonian sediments at the Pridorozhnoye structure.

Subsequently, geological production and research organizations carried out a program for the comprehensive study of oil and gas bearing sedimentary basins in Kazakhstan [12, 13]. A tremendous amount of work has been done to collect, systematize and describe the geological structure and parameters of oil and gas fields in Kazakhstan. On the basis of these developments, in 2000, the "Map of the forecast of the oil and gas potential of Kazakhstan" [14] and the "Map of the location of oil and gas perspective structures of Kazakhstan" [15] were prepared and published.

The results of these studies were published in a series of capital reference books [16, 17], monographs [8] and numerous production and thematic reports [18, 19 and many others]. The results of modern concepts of oil and gas geological zoning, geological, geophysical and geochemical data, the specifics of the structure and formation of oil and gas fields, as well as prospective assessments of the main oil and gas complexes are given in [8].

A group of leading oilmen of Kazakhstan in 2003 (Akchulakov U., Zholtaev G., Zhylkaidarov S., Paragulgov Kh.Kh. and others) assessed the predicted hydrocarbon resources of the Republic of Kazakhstan [18].

The results of the "Comprehensive study of sedimentary basins of the Republic of Kazakhstan" on the reassessment of the prospects of its territory and the resource base for oil and gas, were summarized based on the results of regional and areal seismic and geological and geophysical works, prospecting and exploration drilling, the integration of various types of research in all 15 basins, in the period 1990-2013 in a special work [19].

In this regard, the issue of assessing the oil and gas potential of the sedimentary basins of South Kazakhstan remains on the agenda, which in turn initiates the continuation of systematic geological and geophysical work in this region.

### **Basis and initial data for the development of the theme**

During carrying out work on this topic, numerous stock and literary sources were used, as well as materials of long-term field and cameral studies of leading geologists and geophysicists who have been involved in different years with the oil and gas content of sedimentary basins in South Kazakhstan. In addition, materials and data of scientific leaders, co-leaders of the dissertation were involved, such as cartographic (various geological, structural, lithological-paleogeographic, tectonic, maps, diagrams, sections), the results of analytical work on the study of the material composition of oil and gas complexes, data on the analysis of layer-by-layer sections and cores of wells.

The results of the latest published geological-geophysical and geochemical studies on the topic of this work are fully used.

The basis for the development of the topic of the dissertation work is the justification for carrying out geological and geophysical work to identify perspective oil and gas complexes of sedimentary basins in South Kazakhstan.

### **Justification of the necessity for research**

This work is a logical continuation of earlier studies aimed at studying the prospects for oil and gas content of sedimentary basins in South Kazakhstan. This

requires the following range of studies:

1. Compilation of correlation geological and historical sections of the Shu-Sarysu, Ili and Balkhash sedimentary basins.
2. Allocation and substantiation of the capacities of oil and gas and prospective oil and gas complexes.
3. Paleogeodynamic and lithological-paleogeographic reconstruction of the areas of the considered sedimentary basins to assess their oil and gas potential.
4. Study of the material composition and quantitative determination of organic matter in them.
5. The need to develop a geological and geophysical model of the deep structure of oil and gas regions in the region

**The validity and reliability of scientific provisions, conclusions and recommendations is confirmed by:**

- modern geological, geophysical, structural, lithological and stratigraphic data;
- study of selected in the process of field work stone material on the reference lithological and stratigraphic sections of oil and gas and perspective oil and gas complexes with subsequent laboratory study, methods of mineralogical, petrographic, thermal, X-ray structural, track and radiological analyzes;
- scientifically grounded methods of interpretation of structural and seismic data for the development of a model of the deep structure of sedimentary basins in South Kazakhstan;
- construction and detailing of lithological and stratigraphic reconstructions of the formation of sedimentary basins;
- assessing the hydrocarbon potential of the considered sedimentary basins.

**Information about the planned scientific and technical level of development**

As a result of the work carried out, the oil and gas potential of the sedimentary basins of South Kazakhstan will be assessed and the predicted resources of the main oil and gas and perspective complexes will be determined. To solve the set tasks, a set of lithological and paleogeographic maps and sections, the most important historical and geological events will be compiled. It is assumed that these maps will make it possible to assess the areal changes that occurred in sedimentary basins during their formation. Areal variations and thicknesses of perspective oil and gas complexes will be taken into account when determining the areas of sedimentation and distribution of organic matter of oil source complexes in them, which will ultimately make it possible to assess the predicted hydrocarbon reserves of the region. Based on the samples taken from the reference sections, thermal, X-ray diffractometric and track analyzes of oil source complexes will be carried out and the content of organic substances in them will be determined. All these obtained parameters were the basis for assessing the predicted hydrocarbon resources.

**About patent research and conclusions from them**

The analysis of patent research shows that at the moment geophysical work is predominant, aimed at solving specific problems related to the diagnosis of oil and gas bearing deposits using seismic exploration and magnetometry methods.

#### **Information on metrological support of the thesis**

Achievement of high quality of research results and study of the material composition of structural-material complexes is ensured by metrological and auxiliary technical services in accordance with the approved standards.

#### **Relevance of the topic**

Determined by the needs of the modern world economy in hydrocarbon raw materials. The data available to date on the geological and geophysical characteristics of the oil and gas bearing areas of South Kazakhstan (Shu-Sarysu, Ili, Balkhash) need serious correction and supplemented by the results of the latest geological, lithological and stratigraphic, analytical, geodynamic, geophysical, drilling and geochemical studies the purpose of identifying criteria for oil and gas content.

The theory of tectonics of lithospheric plates with its developed physical and theoretical basis serves as a sufficiently reliable basis for the development and substantiation of models for the formation of oil and gas basins. In this regard, we can confidently talk about a certain specialization and specific mechanisms of formation of hydrocarbon accumulations in various geodynamic settings, the industrial development of which is of economic interest. Based on a comprehensive interpretation of geological, geophysical and geochemical data, it is planned to develop geodynamic models reflecting the formation, development and structure of oil and gas and perspective sedimentary basins located in South Kazakhstan (Shu-Sarysu, Balkhash and Ili basins), as well as assessing the prospects their oil and gas content.

#### **The novelty of the topic**

This work will be a certain contribution to the study of geology, deep structure and assessment of the hydrocarbon potential of the territory of South Kazakhstan, which is directly related to the expansion of the prospects of the mineral resource base of the Republic, taking into account the modern requirements of market relations. In this study, modern achievements in the field of geodynamics, deep geophysics, the study of the material composition of oil and gas complexes in order to assess the prospects of South Kazakhstan are used and implemented. New developments are proposed for the magnetic prospecting method for the detection and diagnosis of hydrocarbon deposits. Geological parameters (lithological-stratigraphic, lithological-paleogeographic, structural, geophysical, etc.) for calculating the predicted hydrocarbon resources of the sedimentary basins of South Kazakhstan have been established and substantiated.

#### **The relationship of this work with other research works**

The author took part in the implementation of the following scientific projects:

1. "Targeted development of university science focused on innovative results", topic 5: "Development of an effective technology of modern geological, geophysical and petrophysical analysis for prospecting, exploration and production

in sedimentary (stratigraphic) oil and gas traps in sedimentary basins of Kazakhstan", period 2011 -2014;

2. Program 120 "Grant financing of scientific research" on the topic: No. 0112RK00470 "Assessment of the oil and gas potential of the sedimentary basins of South Kazakhstan", period 2012-2014;

3. Grant financing of scientific research, Information and telecommunication technologies. 1.1 Creation and development of space systems and technologies. "Development and implementation of a national software package for solving technological problems of the oil and gas industry in Kazakhstan" Develop innovative technologies for processing and analyzing space imagery data for predicting oil and gas content and conducting prospecting and appraisal works in sedimentary basins of Kazakhstan, period 2015-2017;

1. Target program: No. BR05236800 "Solution of strategic and applied problems in the oil and gas industry of Kazakhstan" under section 1. Formation of geodynamic models of oil and gas basins in Kazakhstan in order to identify large oil and gas perspective zones based on the analysis of data from modern geological and geophysical studies, period 2018-2020.

**The purpose of the study** is geological and geophysical analysis of the structure of sedimentary basins in South Kazakhstan with an assessment of the prospects for hydrocarbon potential. For individual sections of the work, the objectives of the study:

1. study of structural features, lithological-stratigraphic correlation and material composition of structural-material complexes of the cover of sedimentary basins and their oil and gas content;

2. thermal, X-ray diffraction and track study of rock samples and sediments of the Upper Paleozoic and Mesozoic-Cenozoic;

3. study of the deep structure of the cover and basement of the sedimentary basins of South Kazakhstan using geophysical data;

4. drawing up a deep geological and geophysical profile "Turkestan";

5. Creation of a geological and geophysical model of the deep structure of oil and gas bearing regions of the region with the identification of factors of localization of hydrocarbon deposits.

**Research object:** sedimentary basins of South Kazakhstan (Shu-Sarysu, Pribalkhash, Ili) with a predictive assessment of their prospects for prospecting and exploration of hydrocarbon deposits.

**The main objectives of the study:**

1) elucidation of the specifics of the structure, stratigraphic correlation and material composition of the UCS cover of sedimentary basins;

2) study of the Paleozoic tectonics and lithological-paleogeographic conditions of the formation of sedimentary basins in South Kazakhstan. Sedimentary basin cover map;

3) study of the Mesozoic-Cenozoic tectonics and lithological-paleogeographic conditions of the formation of sedimentary basins in South Kazakhstan;

4) geodynamic analysis and conditions for the formation of sedimentary basins;

5) study of the deep structure of the cover and basement of the sedimentary basins of South Kazakhstan using geophysical data. Interpretation of the deep geological and geophysical according to the geological and geophysical profile "Turkestan";

6) identification and substantiation of factors and criteria for oil and gas content of sedimentary basins.

### **Scientific positions and results presented for defense:**

1) substantiation of the identified structural and material units of the cover and basement and, on the basis of this, clarification of the volumes and thickness of perspective oil and gas and complexes, as well as the study of the material composition of oil and gas complexes using modern analytical methods;

2) construction of a model of the deep structure of sedimentary basins based on a comprehensive analysis of geological and geophysical data and reconstruction of the geodynamic conditions for the development of the region;

3) assessment of the predicted hydrocarbon resources of raw materials in sedimentary basins.

### **Scientific and practical value**

The proposed topic is scientific and applied in its meaning. In this regard, the research generalization is a contribution to the study of the geology and forecast of hydrocarbons in Kazakhstan, which is of great scientific and practical importance for further research on the prospects for expanding the country's mineral resource base, taking into account the new requirements of market relations.

**The implementation of the work** is described in numerous publications of the author, illustrating various aspects of geology, lithological-paleogeographic, paleogeodynamic and analytical studies aimed at substantiating the prospects for the hydrocarbon potential of sedimentary basins in South Kazakhstan.

### **Approbation**

The main provisions of the dissertation work were reported and discussed at international conferences:

1) VII International Symposium "Problems of geodynamics and geocology of inland orogens" - June 19-24, 2017 Bishkek - "On the role of modern high-precision geophysical methods in the search for hydrocarbon deposits" and "Geodynamic conditions for the formation of the main oil and gas basins of Kazakhstan in the Paleozoic";

2) The Fourth International Scientific Conference "Correlation of Altaids and Uralides: Deep Structure of the Lithosphere, Stratigraphy, Magmatism, Metamorphism, Geodynamics and Metallogeny" - April 02-06, 2018, Novosibirsk - "Data from the study of the material composition of a promising oil source complex Cenozoic cover of the Ili basin" and "Comparative characteristics of the stratigraphic section of the cover of the Shu-Sarysu basin and its specialization in the search for hydrocarbons";

3) International Jubilee Scientific Conference dedicated to the 40th anniversary of the National Assembly of the Russian Academy of Sciences. - 2018, Bishkek - "Study of the material composition of the rocks of the coal-Permian section of the southwestern part of the Shu-Sarysu oil and gas basin";

4) All-Russian conference with international participation "Petrology of magmatic and metamorphic complexes" - November 27-30, 2018, Tomsk - "Data from the study of the content of organic matter in sediments of the Carboniferous-Permian age in the southwestern part of the Shu-Sarysu basin" and "Geodynamic conditions for the formation of sedimentary basins in South Kazakhstan (Shu-Sarysu, Pribalkhash, Ili)";

5) International conference of young scientists and students "Modern techniques and technologies in scientific research" - April 24-26, 2019, Bishkek - "The material composition and distribution of organic matter in the cover of sedimentary basins of South Kazakhstan";

6) International Scientific and Practical Conference "State and Prospects for the Exploitation of Mature Fields" - May 16-17, 2019, Aktau - "Assessment of the predicted hydrocarbon potential resources of the Shu-Sarysu, Ili, Balkhash sedimentary basins of South Kazakhstan".

### **Publications**

On the topic of the dissertation, 19 scientific papers have been published, including 4 in scientific publications recommended by the Committee for Control in Education and Science, 4 in an international scientific journal included in the information base of the Scopus company, 11 in materials of international conferences.

The main provisions of the dissertation are published in the following works:

1) Tulemissova Zh.S. Comparative characteristics and conditions for the formation of sedimentation traps of hydrocarbons in the West Siberian, Caspian and Shu-Sarysu basins // - Izvestiya NAS RK. Geological and technical series - Almaty, 2017. - No. 2 (422). - S.56-61.

2) Tulemissova Zh.S., Tripolsky V.P., Korobkin V.V. About the role of modern high-precision geophysical methods in the search for hydrocarbon deposits // Problems of geodynamics and geocology of inland orogens: abstracts of reports. VII International Symposium. - Bishkek, 2017. -- pp. 154-160.

3) Tulemissova Zh.S., Korobkin V.V. Geodynamic conditions of the formation of the main oil and gas basins of Kazakhstan in the Paleozoic // Problems of geodynamics and geocology of inland orogens: abstracts of reports. VII International Symposium. - Bishkek, 2017. -- pp. 76-80.

4) Tulemissova Zh.S., Korobkin V.V. Features of the geodynamic evolution of the main oil and gas basins of Kazakhstan in the Paleozoic // - Bulletin of KBTU. Oil and gas series. engineering. – Almaty, 2017. –№4 (43). – C.52-61.

5) Tulemissova Zh.S., Korobkin V.V., Samatov I.B. Data of the study of the material composition of the perspective oil source complex of the Mesozoic-Cenozoic cover of the Ili basin // CORRELATION OF THE ALTAIDES AND URALIDES deep structure of lithosphere, stratigraphy, magmatism, metamorphism, geodynamics and metallogeny. Materials of the 4rd International scientific conference. –Novosibirsk, 2018. - PP. 156-159.

6) Tulemissova Zh.S., Korobkin V.V. Comparative characteristics of the stratigraphic section of the Shu-Sarysu basin cover and its specialization in hydrocarbon prospecting // CORRELATION OF THE ALTAIDES AND

URALIDES deep structure of lithosphere, stratigraphy, magmatism, metamorphism, geodynamics and metallogeny. Materials of the 4rd International scientific conference. –Novosibirsk, 2018. - PP. 153-156.

7) Korobkin V.V., Samatov I.B., Tulemissova Zh.S. Data from the study of the mineral composition and dispersed organic matter in the rocks of the Carboniferous-Permian section of the southwestern part of the Shu-Sarysu basin // Geology and conservation of mineral resources. KazGEO. - 2018. –No. 2 (67). - S. 16-30.

8) Korobkin V.V., Tulemissova Zh.S. Specificity of the geological structure and geodynamic conditions of the formation of the Shu-Sarysu sedimentary basin in the Late Paleozoic // "The impact of external fields on the seismic regime and monitoring of their manifestations" dedicated. To the 40th anniversary of the National Assembly of the Russian Academy of Sciences: abstracts of reports. int. anniversary. scientific. conf. - Bishkek, 2018. -- S. 190-193.

9) Tulemissova Zh.S., Korobkin V.V. Deep structure and geodynamic conditions for the formation of sedimentary basins in Southern Kazakhstan (Shu-Sarysu, Pribalkhash, Ili) // Geology and conservation of mineral resources. KazGEO. - 2018. - No. 3 (68). - S. 24-34.

10) Korobkin V.V., Samatov I.B., Tulemissova Zh.S. Study of the material composition of the rocks of the Carboniferous-Permian section of the southwestern part of the Shu-Sarysu oil and gas basin // "The impact of external fields on the seismic regime and monitoring of their manifestations" dedicated. To the 40th anniversary of the National Assembly of the Russian Academy of Sciences: abstracts of reports. int. anniversary. scientific. conf. - Bishkek, 2018. -- S. 194-197.

11) Korobkin V.V., Samatov I.B., Tulemissova Zh.S. Data from studying the content of organic matter in sediments of the Carboniferous-Permian age in the southwestern part of the Shu-Sarysu basin // Mater. X All-Russia. Petrographic Conf. with international participation "Petrology of magmatic and metamorphic complexes". - Tomsk: Publishing house of the Tomsk Center for Science and Technology. Issue 10, 2018. -- P. 447-457.

12) Korobkin V.V., Tulemissova Zh.S. Geodynamic conditions for the formation of sedimentary basins in southern Kazakhstan (Shu-Sarysu, Balkhash, Ili) // Mater. X All-Russia. Petrographic Conf. with international participation "Petrology of magmatic and metamorphic complexes". - Tomsk: Publishing house of the Tomsk Center for Science and Technology. Issue 10, 2018. - C.457-467.

13) Tulemissova Zh.S., Buslov M.M. The material composition and nature of the distribution of organic matter in the covers of sedimentary basins // Mater. XI Intern. conf. young scientists and students "Modern techniques and technologies in scientific research." - Bishkek, NS RAS, 2019. -- P. 392-399.

14) Tulemissova Zh. S., Buslov M. M. Geodynamic conditions of formation of sedimentary basins of South Kazakhstan (Shu-Sarysu, Pre-balkhash, Ili) - IOP Conference Series: Earth and Environmental Science. - 2019. V.319. Iss.1. - Article number 012021.



15) Tulemissova Zh. S., Buslov M.M., Bekmukhametova Z.A. Data of studying the content of organic matter in deposits of the stone-perm separation of the southwestern part of the Shu-Sarysu basin. - IOP Conference Series: Earth and Environmental Science. - 2019. V.319. Iss.1. - Article number 012020.

16) Tulemissova Zh.S., Korobkin V.V., Buslov M.M. Correlation of the stratigraphic section with the estimate of the predicted hydrocarbon resources of the sedimentary basins of southern Kazakhstan (Shu-Sarysu, Ili and Balkhash) // Bulletin of KBTU. - Almaty, 2019. - No. 4 (51). - S. 177-185.

17) Tulemissova Zh.S., Bekmukhametova Z.A. Possibilities for the use of high-precision magnetic prospecting, gravity prospecting and electrical prospecting in the search for hydrocarbon raw materials // Vestnik KBTU. Almaty, 2019. - No. 4 (51). - S. 185-193.

18) Korobkin V.V., Tulemissova Zh.S. Estimation of the predicted hydrocarbon potential resources of the Shu-Sarysu, Ili and Balkhash sedimentary basins of South Kazakhstan. // Proceedings of the International Scientific and Practical Conference "State and Prospects for the Exploitation of Mature Fields" May 16-17, 2019. 1-volume. Aktau. S. 77- 90.

19) Tulemissova Zh.S., Korobkin V.V. Features of the Material Composition of the Main Oil and Gas Complex of the Shu-Sarysu Basin - International Journal of Engineering Research and Technology. ISSN 0974-3154, Volume 13, Number 5 (2020), PP. 1045-1056 © International Research Publication House.