

ANNOTATION

Annotation of the dissertation work of Dilyara Urmanova on the topic:
"Assessment of the hydrocarbon potential of the sedimentary complex of the south of the Precaspian Basin (including the water area of the Northern Caspian Sea) based on the results of basin modeling and determination of prospects," submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D07206 "Geology of oil and gas."

Relevance of the work. The Precaspian oil and gas province occupies an economically significant role in terms of the concentration of proven hydrocarbon reserves in Kazakhstan. Given its importance, it is characterized by previously uneven geological study both in area and in section. The state of the hydrocarbon system mineral resource base is characterized by high exploration and involvement in the development of existing deposits associated mainly with the subsalt complex.

Over the years, the territory of the Precaspian basin has been covered by a dense network of seismic reflection profiles and common depth point studies. The on-board zones have been most studied by drilling, the central part of the Precaspian basin has been less studied. Drilling of deep prospects as exploration and parametric wells was undertaken in the early 1980s. With seismic surveys and exploratory drilling, it was possible to establish the oil and gas potential of the Lower Permian deposits within the limits of the southern flank zone of Precaspian basin.

Since the beginning of the 1990s, the intensity of geological exploration within the southern area has sharply decreased. As a result, prospects for oil and gas potential of deep-lying subsalt deposits remain unexplored.

The geological and geophysical study of the southern side of the Precaspian basin is characterized by unevenness in area and section, which necessitates a revision of the model of formation of hydrocarbon systems and justification of further directions of exploration.

Scientific analysis and improvement of the quality of scientific support for exploration is of key importance for planning the replenishment and search for the resource base of hydrocarbon system against the background of the natural depletion of existing reserves. Due to the high cost of parametric and exploratory drilling, a comprehensive justification of well sites and improving the quality of scientific support for exploration can reduce geological risks and increase the efficiency of exploration.

The relevance of the research is due to the need to clarify the hydrocarbon potential in the research area based on revision and generalization of accumulated and new geological-geophysical and geological-geochemical information in the light of new research methods and geological concepts.

Based on the accumulated extensive geological material (the results of drilling deep parametric and exploration wells, the results of 2D and 3D seismic surveys, the results of paleogeographic reconstructions) in the research area, there is a need to update the model of the structure of the subsalt complex of Upper Paleozoic deposits based on lithological and facies analysis, geochemical studies, and basin analysis methods. All the above determine the relevance of the study.

The purpose of the work. To determine the oil and gas development potential on the basis of a comprehensive study of hydrocarbon systems of the Upper Paleozoic subsalt complex of the southern side of the Precaspian basin and to assess the state and prospects of oil and gas potential on the basis of oil and gas geological zoning.

Research objectives. In accordance with the set goals, the following tasks were solved:

1. Collection, systematization, and investigation of the geological and geophysical study of subsalt deposits of the hydrocarbon system, comparison of lithological and stratigraphic sections of wells, and the study of sedimentation models.
2. Investigation of the tectonic evolution of the hydrocarbon system and the structural and formation structure of the subsalt complex, analysis of the tectonic structure, and geothermal conditions.
3. Collection, generalization, and analysis of geological and geochemical characteristics of the section and source rocks, study of the type and thermal maturity of the rocks, conducting new RockEval pyrolysis analyses, and study of genetic links between oils and rocks based on biomarker analysis.
4. The study of hydrocarbon systems for subsalt deposits of hydrocarbon system, the study of the process of maturation of hydrocarbons, the analysis of models of generation and migration of hydrocarbons based on the concept of hydrocarbon systems.
5. Analysis of oil and gas potential, clarification of oil and gas geological zoning, and identification of promising areas of oil exploration in the research area.

Material and research methods. During the long-term period of work at KMG Engineering LLP, the author studied the primary geological documentation, sections of deep wells, and the results of seismic studies of the southern side zone of the

Precaspian basin, as well as the results of petrographic and micropaleontological studies. The author conducted a geochemical study of the core of the Tasym SE, Burbaytal deposits and selected representative core samples for petrographic, pyrolysis, and chemostratigraphic studies. The author directly participated in the sample preparation of 20 samples for isotope and pyrolysis studies, mastered the methodology of lithological and petrographic studies of carbonate rocks. To study the hydrocarbon systems of subsalt deposits, the results of the latest geochemical studies using chromatography-mass spectrometry of oil and organic matter extracts from published and stock sources have been collected and analyzed.

To carry out the latest pyrolysis and geochemical studies, core samples from 7 wells drilled within the southern side zone of the Precaspian basin and uncovered deep-lying subsalt deposits from the Upper Devonian to the Lower Permian were used.

Scientific novelty:

1. For the first time, a generalization of the available disparate geochemical data and the correlation of oils of subsalt deposits in the stratigraphic range from the Upper Devonian to the Lower Permian within the southern boundary zone of the Precaspian basin was carried out. The genotypes of oils have been established and the classification of hydrocarbon systems based on geological and geochemical criteria has been carried out.

2. Original litho-geochemical data were obtained for the core material of the Tasym, Burbaytal wells based on isotopic composition of carbon and oxygen for KT-III, MKT, KT-II.

The main defended statements:

1. The first defended statement

Development of HC systems: The site on which the Maksat, Ogayskaya carbonate buildups are located has been at a higher hypsometric level than the surrounding area for a long period of geological time. Most of the reefs in the area stopped growing during the Bashkirian stage of the Middle Carboniferous, and the Southern one grew up to the Artinskian stage of the Permian period. Upon global sea-level fall, the crest of the reef was subaerially exposed, which led to erosion across its roof. Erosion products formed a carbonate-terrigenous breccia on the carbonate platform in the Artinskian stage, overlapping more submerged reef structures and coming into direct contact with the slopes of the Tengiz Reef.

2. The second defended statement

The South Embian carbonate platform is much younger than the Tengiz-Kashagan one. The carbonate deposits within its limits occupy a narrower stratigraphic interval, covering the period from the end of the Lower Carboniferous – Early Visean to the Asselian-Sakmarian stages of the Lower Permian, inclusive.

3. The third defended statement

A refined scheme of oil and gas geological zoning and prospects of oil and gas potential of the subsalt complex of the southern flank of the Precaspian basin is proposed, reflecting the current state of geological and geochemical knowledge of hydrocarbon systems.

The connection of this work with other research projects. The author of the dissertation participated in the grant project of the Ministry of Education and Science of the Republic of Kazakhstan, IRN 00025 "Development of a regional digital model of the geological structure of the territory of the Caspian sedimentary basin of Kazakhstan" (2020-2022) as a responsible specialist (senior researcher).

Practical significance. The conclusions and results of the dissertation research are of considerable interest to petroleum geologists when planning exploration and are recommended for further application in order to improve the quality of scientific support for exploration. Based on the current state of geological and geochemical knowledge, oil and gas geological zoning of the southern side of the Precaspian basin has been updated. The systematization and generalization of disparate data on the geological and geochemical characteristics of subsalt deposits and associated liquid hydrocarbons in the research area were carried out.

Personal contribution of the author. The author independently collected and studied literary works in Russian and English on the topic of the dissertation and defined the tasks of the work. The results of the structural and facies zoning of the subsalt complex are summarized, indicator diagrams of geochemical parameters are constructed and an assessment of the catagenetic zonation of potential source rocks is carried out.

The author, with the advice of Professor John Humphrey (King Fahd University of Petroleum and Minerals), conducted geochemical studies of the Tasym area for the first time. The author participated in the discussion and interpretation of the results during an overseas research internship at the King Fahd University of Petroleum and Minerals.

The author, in consultation with Professor Raymond Michels (University of Lorraine), for the first time conducted analyses of artificial maturation of the Tasym area samples. The author participated in the discussion and interpretation of the results during an overseas research internship at Lorraine University.

Based on a comprehensive analysis, the author carried out reconstructions of the thermal history of well-studied well sections, carried out calibration of modeling results, and analysis of the results obtained.

The author of the dissertation research directly participated in the selection and sample preparation of samples and conducting geochemical studies together with laboratory specialists, as well as in the laboratory of Tomsk Polytechnic University and conducted active scientific work on the topic of the dissertation for

publication of the results. The author, together with scientific supervisors, has prepared scientific conclusions and recommendations on the realization of the hydrocarbon potential of subsalt deposits of the southern flank of Precaspian basin.

Approbation of research results and publications. The results of the dissertation research were reported and discussed at the SPE Annual Caspian Technical Conference 2021, international geological and geophysical conference "GeoEurasia-2022. Exploration Technologies: Science and Business" (Moscow, 2022), as well as the International Geological Forum and Conference "Features of carbonate Rocks and Reservoir Modeling issues" (Turkestan, 2022). 7 publications have been published on the topic of the work, including six in publications recommended by The Committee for Quality Assurance in the field of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and one publication in the peer-reviewed journal Scopus with the Q3 quartile.

The reliability of the results of the work. The materials of geological and geophysical studies of recent years based on published and stock sources were used: the results of interpretation of seismic studies, the results of stratigraphic dissection of well sections that revealed a subsalt complex of sediments; the results of geophysical studies of deep wells, including measurements of reservoir temperatures; photographs and descriptions of core, sections; data on the mineral composition and petrophysical properties of rocks; the results of biostratigraphic studies.

Laboratory and analytical studies were performed using the latest equipment and techniques.

Pyrolytic studies were performed using the Rock-Eval 6 Turbo analyzer with verification of the standard sample IFP 160000 in the Laboratory of Oil and Gas Fields of the National Research Tomsk Polytechnic University (TPU). The isolation and comparison of various oil genotypes is based on the results of complex geochemical studies using gas chromatography and mass spectrometry (GC, GC-MS) methods. Petromod and Themis Flow software packages were used to simulate the thermal history and reconstruction of the burial. Statistical data processing was carried out using modern methods of analysis.

The structure and scope of the dissertation. The dissertation work consists of an introduction, 5 sections, a conclusion, with a volume of ___ pages, illustrated with ___ drawings, contains ___ tables, ___ appendices and is accompanied by a list

of references from ___ titles.

The author expresses special gratitude and gratitude to the scientific supervisors - Dr. H.B. Abilkhasimov, Professor J.D.Humphrey, Professor R. Michels - for the materials provided, guidance of the work, discussion of the results and recommendations for the approbation of intermediate and final research results.

The author expresses her deep gratitude to the staff of the Laboratories of the King Fahd University of Petroleum and Minerals (Dhahran, Saudi Arabia), the University of Lorain (Nancy, France), Tomsk Polytechnic University (Tomsk, Russia) for the opportunity to undergo foreign research internships.

The author expresses sincere gratitude to associate Nesipbekov G. - for assistance in finding an overseas scientific supervisor.

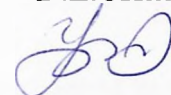
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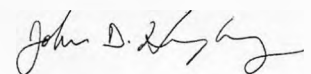
PhD candidate

D.E.Urmanova



Scientific Supervisor, PhD

J.D.Humphrey



Head of the Department of Hydrogeology,
Engineering and Oil and Gas Geology,
Candidate of Technical Sciences



E.S. Auelkhan