

## ABSTRACT

of the dissertation for the degree of Doctor of Philosophy (PhD) in specialty 6D070700 – Mining

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### **Development of technological evaluation criteria for the selection of promising sites for coalbed methane production**

**Relevance.** One of the most important factors is the high natural gas content of the seams, which increases with the deepening of mining operations from 15 to 30 m<sup>3</sup>/t in the conditions of the Karaganda coal basin. The low rate of degassing directly affects the safety of underground coal mining and is considered a limiting factor.

In the dissertation work, a criterion rating of the prospects of sites for the industrial production of methane from coal seams was developed on the basis of studies of the filtration-capacitive properties of coal samples taken in various areas of the Karaganda basin. According to various sources, the Karaganda coal basin at a depth of up to 1800 m contains from 1.0 to 4.0 trillion. m<sup>3</sup> of gas. About 85% of methane is in a sorbed state, so modern coal deposits are essentially coal and gas, since their methane reserves are comparable to those of natural gas.

However, during underground mining of coal seams, about 500 million m<sup>3</sup> of methane are extracted annually by means of degassing and ventilation. In this case, only about 15% is used as fuel.

In world practice today, the technology for drilling directional wells is widespread, which allows to significantly increase the productivity of wells to 10-20 m<sup>3</sup>/day of methane and coal production by increasing the load on the longwall to 10-20 thousand tons / day.

The use of technology for drilling directional wells is promising and solves the global problem of the safety of mining operations, while simultaneously receiving industrial gas.

**The purpose of the work.** Compilation of a criterion rating of the prospects of sites for the extraction of methane from coal seams based on geological and technological factors affecting the process of gas release from the coal strata.

**The idea of the work** is to select areas, taking into account the peculiarities of the coal seams of the Karaganda basin in terms of mining-geological and mining-technical parameters, the most promising for the production of coalbed methane.

**The object of study.** Mining and technical parameters of mine fields and coal seams of the Karaganda coal basin.

**The tasks of the study:**

- to analyze the methods of identifying promising areas in the countries of the world leading the extraction of methane;

- to investigate the current state of the coalbed methane production industry in the structure of the world fuel and energy balance;
- to carry out a comparative analysis of geological and technological factors and investigated the filtration and storage properties of coal seams in the Karaganda basin;
- to study the influence of the stages of coal metamorphism and the depth of its occurrence on the distribution of the natural methane content of the coal seam;
- on the basis of pilot tests, determine the dependence of a number of geological and technological factors characterizing the prospects of the sites;
- to make a geological and economic calculation of possible design solutions for the technological stages of methane extraction from coal seams.

**Research methodology.** Based on the analysis of domestic and foreign experience, literary and fund materials, the purpose of the work and the main tasks of the study were formulated. On the basis of computer modeling methods, design solutions were substantiated and calculations of methane volumes were made in areas considered promising. Using the methods of mathematical statistics, the results of laboratory studies and experimental observations are processed.

**Scientific novelty:**

- technological criteria for the selection of promising areas of methane production based on mining and geological, petrographic and technological factors (properties) of the coal massif;
- technical recommendations for the selection of sites based on the ranking of technological criteria;
- the established regularities of changes in the gas content of coals and enclosing rocks of areas promising for methane production.

**Scientific provisions to be defended:**

- an increase in the content of natural moisture by 10% leads to the locking of up to 20% of methane gas in the sorbed state and a decrease in the yield of volatiles by 2%;
- the gas content of the reservoir increases according to the hyperbolic dependence on the stratigraphic depth in the direction of increasing the degree of metamorphism;
- the developed factor-point criteria are fundamental for assessing the site from the point of view of the prospects for methane production.

**The reliability and validity of scientific provisions,** results and conclusions are confirmed by a set of theoretical and experimental research works. The results of field indicators are very close to the data obtained from the results of computer modeling based on the fundamental laws of mass transfer of methane in coal seams.

**Practical significance of the work** lies in the determination of the most favorable areas of the Karaganda coal basin for the extraction of coal bed methane, as well as the production and economic forecast of the feasibility of using the developed geological and technological evaluation criteria that determine the prospects for methane production at the site.

**Application area.** Coal industry.

**The author's personal contribution** consists in setting tasks and identifying ways to solve them, formulating and substantiating scientific provisions for determining the main criteria for choosing promising sites for coalbed methane production. The author took an active part in research and development work, which were carried out in production laboratories on the territory of the Karaganda coal basin, as well as in the methane energy laboratory of the NJSC KarTU.

**The structure and volume of the work.** The dissertation work consists of an introduction, 4 chapters, a conclusion, a list of the used sources and applications. The work is presented on 148 pages, contains 65 illustrations, 46 tables and references of 71 titles.

**Testing of the work and publications.** The main provisions of the work were reported and approved: at the scientific seminar of the "Mineral deposits development" Department, KSTU, Karaganda (April 2018, September 2019); at the scientific seminar of the Gubkin Russian State University of Oil and Gas (National Research University) "Extraction of methane from coal deposits. Problems and Prospects ", Moscow (April 2019); Scientific and technical council of KSTU (October 2019); at meetings of the technical council of the Department of Management of ArcelorMittal Temirtau JSC (2018), TaldyKuduk-Gas LLP (2017). The results of scientific research obtained in the dissertation are introduced into the educational process of NJSC "KarTU" in the core disciplines of the bachelor's degree in the "Mining" specialty.

The main provisions of the dissertation are published in 13 scientific works, including 2 of them published in the journal included in the Scopus database, 3 in publications recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 8 works in the materials of foreign and international conferences.

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