

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

1 (451)

JANUARY – FEBRUARY 2022

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

Бас редактор

ЖҰРЫНОВ Мұрат Жұрынұлы, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Қазақстан Республикасы Ұлттық Ғылым академиясының президенті, АҚ «Д.В. Сокольский атындағы отын, катализ және электрохимия институтының» бас директоры (Алматы, Қазақстан) Н = 4

Редакциялық алқа:

ЖӘРМЕНОВ Әбдірәсіл Алдашұлы, техника ғылымдарының докторы, профессор, ҚР ҰҒА академигі, ҚР минералдық шикізатты кешенді қайта өңдеу жөніндегі Ұлттық орталығының бас директоры (Алматы, Қазақстан) Н = 4

КҮЛДЕЕВ Ержан Итеменұлы, геология-минералогия ғылымдарының кандидаты, қауымдастырылған профессор, Қ.И. Сатпаев атындағы ҚазҰТЗУ Корпоративтік даму жөніндегі проректоры, (Алматы, Қазақстан) Н = 3

ӘБСАМЕТОВ Мәліс Құдысұлы, геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, «У.М. Ахмедсафина атындағы гидрогеология және геоэкология институтының» директоры (Алматы, Қазақстан) Н = 2

ЖОЛТАЕВ Герой Жолтайұлы, геология-минералогия ғылымдарының докторы, профессор, Қ.И. Сатпаев атындағы геология ғылымдары институтының директоры (Алматы, Қазақстан) Н=2

СНОУ Дэниел, Ph.D, қауымдастырылған профессор, Небраска университетінің Су ғылымдары зертханасының директоры (Небраска штаты, АҚШ) Н = 32

ЗЕЛЬТМАН Реймар, Ph.D, табиғи тарих мұражайының Жер туралы ғылымдар бөлімінде петрология және пайдалы қазбалар кен орындары саласындағы зерттеулердің жетекшісі (Лондон, Англия) Н = 37

ПАНФИЛОВ Михаил Борисович, техника ғылымдарының докторы, Нанси университетінің профессоры (Нанси, Франция) Н=15

ШЕН Пин, Ph.D, Қытай геологиялық қоғамының тау геологиясы комитеті директорының орынбасары, Американдық экономикалық геологтар қауымдастығының мүшесі (Пекин, Қытай) Н = 25

ФИШЕР Аксель, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) Н = 6

КОНТОРОВИЧ Алексей Эмильевич, геология-минералогия ғылымдарының докторы, профессор, РҒА академигі, А.А. Трофимука атындағы мұнай-газ геологиясы және геофизика институты (Новосибирск, Ресей) Н = 19

АБСАДЫКОВ Бахыт Нарикбайұлы, техника ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, А.Б. Бектұров атындағы химия ғылымдары институты (Алматы, Қазақстан) Н = 5

АГАБЕКОВ Владимир Енокович, химия ғылымдарының докторы, Беларусь ҰҒА академигі, Жаңа материалдар химиясы институтының құрметті директоры (Минск, Беларусь) Н = 13

КАТАЛИН Стефан, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) Н = 20

СЕЙТМҰРАТОВА Элеонора Юсуповна, геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, Қ.И. Сатпаев атындағы Геология ғылымдары институты зертханасының меңгерушісі (Алматы, Қазақстан) Н=11

САҒЫНТАЕВ Жанай, Ph.D, қауымдастырылған профессор, Назарбаев университеті (Нұр-Сұлтан, Қазақстан) Н = 11

ФРАТТИНИ Паоло, Ph.D, Бикокк Милан университеті қауымдастырылған профессоры (Милан, Италия) Н = 28

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген № **KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2022

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

Главный редактор

ЖУРИНОВ Мурат Журинович, доктор химических наук, профессор, академик НАН РК, президент Национальной академии наук Республики Казахстан, генеральный директор АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского» (Алматы, Казахстан) Н = 4

Редакционная коллегия:

ЖАРМЕНОВ Абдурасул Алдашевич, доктор технических наук, профессор, академик НАН РК, генеральный директор Национального центра по комплексной переработке минерального сырья РК (Алматы, Казахстан) Н= 4

КУЛЬДЕЕВ Ержан Итеменович, кандидат геолого-минералогических наук, ассоциированный профессор, проректор по корпоративному развитию КазННТУ им. К.И. Сатпаева (Алматы, Казахстан) Н = 3

АБСАМЕТОВ Малис Кудысович, доктор геолого-минералогических наук, профессор, академик НАН РК, директор Института гидрогеологии и геоэкологии им. У.М. Ахмедсафина (Алматы, Казахстан) Н = 2

ЖОЛТАЕВ Герой Жолтаевич, доктор геолого-минералогических наук, профессор, директор Института геологических наук им. К.И.Сатпаева (Алматы, Казахстан) Н=2

СНОУ Дэниел, Ph.D, ассоциированный профессор, директор Лаборатории водных наук университета Небраски (штат Небраска, США) Н = 32

ЗЕЛЬТМАН Реймар, Ph.D, руководитель исследований в области петрологии и месторождений полезных ископаемых в Отделе наук о Земле Музея естественной истории (Лондон, Англия) Н = 37

ПАНФИЛОВ Михаил Борисович, доктор технических наук, профессор Университета Нанси (Нанси, Франция) Н=15

ШЕН Пин, Ph.D, заместитель директора Комитета по горной геологии Китайского геологического общества, член Американской ассоциации экономических геологов (Пекин, Китай) Н = 25

ФИШЕР Аксель, ассоциированный профессор, Ph.D, технический университет Дрезден (Дрезден, Берлин) Н = 6

КОНТОРОВИЧ Алексей Эмильевич, доктор геолого-минералогических наук, профессор, академик РАН, Институт нефтегазовой геологии и геофизики им. А.А. Трофимука СО РАН (Новосибирск, Россия) Н = 19

АБСАДЫКОВ Бахыт Нарикбаевич, доктор технических наук, профессор, член-корреспондент НАН РК, Институт химических наук им. А.Б. Бектурова (Алматы, Казахстан) Н = 5

АГАБЕКОВ Владимир Енокович, доктор химических наук, академик НАН Беларуси, почетный директор Института химии новых материалов (Минск, Беларусь) Н = 13

КАТАЛИН Стефан, Ph.D, ассоциированный профессор, Технический университет (Дрезден, Берлин) Н = 20

СЕЙТМУРАТОВА Элеонора Юсуповна, доктор геолого-минералогических наук, профессор, член-корреспондент НАН РК, заведующая лабораторией Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) Н=11

САГИНТАЕВ Жанай, Ph.D, ассоциированный профессор, Назарбаев университет (Нурсултан, Казахстан) Н = 11

ФРАТТИНИ Паоло, Ph.D, ассоциированный профессор, Миланский университет Бикокк (Милан, Италия) Н = 28

«Известия НАН РК. Серия геологии и технических наук».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан № **KZ39VPY00025420**, выданное 29.07.2020 г.

Тематическая направленность: *геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соединений.*

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© Национальная академия наук Республики Казахстан, 2022

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

Editor in chief

ZHURINOV Murat Zhurinovich, doctor of chemistry, professor, academician of NAS RK, president of the National Academy of Sciences of the Republic of Kazakhstan, general director of JSC “Institute of fuel, catalysis and electrochemistry named after D.V. Sokolsky» (Almaty, Kazakhstan) H = 4

Editorial board:

ZHARMENOV Abdurasul Aldashevich, doctor of Technical Sciences, Professor, Academician of NAS RK, Director General of the National Center for Integrated Processing of Mineral Raw Materials of the Republic of Kazakhstan (Almaty, Kazakhstan) H=4

KULDEEV Yerzhan Itemenovich, Candidate of Geological and Mineralogical Sciences, Associate Professor, Vice-Rector for Corporate Development, Satbayev University (Almaty, Kazakhstan) H = 3

ABSAMETOV Malis Kudysovich, doctor of geological and mineralogical sciences, professor, academician of NAS RK, director of the Akhmedsafin Institute of hydrogeology and hydrophysics (Almaty, Kazakhstan) H = 2

ZHOLTAEV Geroy Zholtaevich, doctor of geological and mineralogical sciences, professor, director of the institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) H=2

SNOW Daniel, Ph.D, associate professor, director of the laboratory of water sciences, Nebraska University (Nebraska, USA) H = 32

Zeltman Reymar, Ph.D, head of research department in petrology and mineral deposits in the Earth sciences section of the museum of natural history (London, England) H = 37

PANFILOV Mikhail Borisovich, doctor of technical sciences, professor at the Nancy University (Nancy, France) H=15

SHEN Ping, Ph.D, deputy director of the Committee for Mining geology of the China geological Society, Fellow of the American association of economic geologists (Beijing, China) H = 25

FISCHER Axel, Ph.D, associate professor, Dresden University of technology (Dresden, Germany) H = 6

KONTOROVICH Aleksey Emilievich, doctor of geological and mineralogical sciences, professor, academician of RAS, Trofimuk Institute of petroleum geology and geophysics SB RAS (Novosibirsk, Russia) H = 19

ABSADYKOV Bakhyt Narikbaevich, doctor of technical sciences, professor, corresponding member of NAS RK, Bekturov Institute of chemical sciences (Almaty, Kazakhstan) H = 5

AGABEKOV Vladimir Enokovich, doctor of chemistry, academician of NAS of Belarus, honorary director of the Institute of chemistry of new materials (Minsk, Belarus) H = 13

KATALIN Stephan, Ph.D, associate professor, Technical university (Dresden, Berlin) H = 20

SEITMURATOVA Eleonora Yusupovna, doctor of geological and mineralogical sciences, professor, corresponding member of NAS RK, head of the laboratory of the Institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) H=11

SAGINTAYEV Zhanay, Ph.D, associate professor, Nazarbayev University (Nursultan, Kazakhstan) H = 11

FRATTINI Paolo, Ph.D, associate professor, university of Milano-Bicocca (Milan, Italy) H = 28

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: *geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.*

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© National Academy of Sciences of the Republic of Kazakhstan, 2022

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS

OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278

Volume 1, Number 451 (2022), 76-82

<https://doi.org/10.32014/2022.2518-170X.143>

UDC: 550.83 (574)

Rakhmanova S.N.*, Umirova G.K., Ablessenova Z.N.

¹NJSC The Kazakh Satpayev National Research Technical University, Almaty, Kazakhstan.
E-mail: symbat_3098@mail.ru

STUDY OF THE GREATER KARATAU'S SOUTH-WEST BY RANGE OF GEOPHYSICAL SURVEYS IN SEARCH OF THE CRUST-KARST TYPE POLYMETALLIC MINERALISATION

Abstract. The Big Karatau is a recognised major mining region since the mid-XX century, with discoveries of not only lead and zinc deposits, but also those of gold, vanadium, granular phosphorites, barite and others. According to the Mineral Resources Development Programme, the Republic of Kazakhstan (RK) is one of the world's top ten countries in terms of ferrous and non-ferrous metal reserves. However, a significant part of the reserves seems to be uncompetitive for the fact that production volumes exceed the growth rate for almost all types of minerals. Considering that it takes at least 15 years from prospecting to development preparation, development of critical situation is expected in the RK copper, lead-zinc and gold-ore sectors in near future. On the other hand, the production decline has already led to socio-economic problems. Over the last ten years mining was halted at virtually all major deposits in South Kazakhstan: Mirgalimsai, Achisai, Bayzhansai. The Achpolymetal enterprise is the Kentau's city-forming enterprise, and the relevance of discovering new commercially significant ore objects in this area is indisputable.

The purpose of the work is to investigate the prospects of the southwest of the Greater Karatau ridge for polymetallic mineralization of crust-karst type within the limits of the Ayusai deposit.

The object of the study are lithological and stratigraphic irregularities of undivided deposits of the Jurassic and Triassic deposits of Ayusai. The article presents a short review of the results of prospecting and geological surveys and the analysis of the geological and mineralogical assumptions. The results of scientific research suggest the discovery of the crust-karst-type commercial objects with complex lead-zinc-iron-bauxite ores within the study area of highly aluminous deposits with increased lead and zinc content. The results of complex geophysical methods can provide a geophysical basis for further geological exploration of the area, 3D-modelling and calculation of reserves.

Key words: polymetallic mineralization of the crust-karst type, the Greater Karatau, magnetic survey, electrical survey, lead, zinc, undivided Jurassic-Triassic deposits, Paleozoic basement depressions.

Introduction. The Ayusai site is located in the Baidibek administrative district of the South Kazakhstan oblast. The first information on the geological structure of the Greater Karatau Ridge is contained in the works of I.L. Severtsev, D.M. Romanovsky and I.V. Mushketov. The works of R. Frese and A.P. Tatarnikov (1866-1877) resulted in a description of the geological structure of the Achisay and Turlan deposits [1,3].

In the early XX century, geological surveys were carried out in the Greater Karatau Mountains to search and explore polymetal deposits. Interest in the Karatau region increased sharply after the discovery of the Achisai deposit. In 1928 prospecting and exploration works were started in Biresek, Bayaldir and Djagalati areas. I.S. Komishin, I.I. Knyazev, N.A. Bryzgalov, E.A. Nemov, D.N. Rasha, A. Yakovlev and others took part in the works. As a result of these studies, the Mirgalimsai deposit and a large number of mineralisation points were discovered.

Systematic geological research in the Greater Karatau began in 1932, when N.V. Dorofeev, N.M. Salov, I.I. Mashkara, V.S. Malyavkin, T.A. Mordvilko and others carried out geological survey work, which resulted in a brief description of the geological structure of the Karatau Ridge and compilation of a geological map of scale 1:200 000.

In 1964, generalization of geological and geophysical materials based of results of large-scale (1:50 000) geological survey works (V.V. Galitsky, N.A. Nozdrev, A.S. Pirgo, I.I. Bok, E.A. Ankinovich, M.A. Senkevich

and others) allowed producing the State Geological Maps of 1:200 000 scale on sheets K-42-II (O.S. Grum-Grzhimaylo), K-42-III (L.V. Belyakov).

The 1970s are characterized by the introduction of geophysical methods in assessment of prospects of Paleozoic deposits in western regions of South Kazakhstan (O.A. Fedorenko et al.). During this period, the helicopter high-accuracy aeromagnetic survey (1:10,000) of the south-western foothills of the Greater Karatau was conducted by the South Kazakhstan Geological Expedition (Ignatyuk O.V., 1971; Krivorotenko A.N., 1973). Numerous positive anomalies of small size were identified, the drilling of which allowed detecting several ore occurrences and a small bauxite deposit Kutyrghan on the southwestern slopes of the Boroldai ridge.

The Ayusai ore field was discovered in 1987 in the process of gamma-gamma logging works ("GGK-50") by the "Yerubay PSP" of the "Karatau State District Exploration Expedition" under the supervision of E.T. Tursunkulov. Notably, at the time the Shaimerden deposit was not yet discovered, and increased contents of lead and zinc associated with bauxite and allite layer were of no interest.

The high prospects of the Ayusai site for the discovery of the Shaimerden type lead and zinc commercial mineralisation were identified in the course of additional site appraisal ("GDP-200" by the AGP "Geological Prospecting and Exploration Expedition"), after discovery within its boundaries of a bauxite object with estimated prognostic resources of commercial conditions. Each of the boreholes that penetrated the Triassic-Jurassic bauxite deposits had increased zinc and lead contents to the first percent values. Lignite layers up to 20 m thick were identified in the overlying Jurassic sediments. These factors justified further prospecting and appraisal work [4].

Most of the drilling and mining activity at that time was concentrated within the previously found depressions of the Paleozoic basement aiming to assess the revealed zinc-lead mineralisation. And eventually these areas were found to have lead and zinc of less than 80% of the total lead and zinc reserves of the Ayusai area. Practically all occurrences of lead and zinc are confined to aluminous rocks, therefore reserves of lead, zinc, aluminous rocks and iron extracted during processing of bauxite-allite deposits were calculated according to categories C2 and P1. Alumina and iron were calculated as by-products [4, 7].

Extensive geophysical surveys (magnetic surveying, VES, MGIP) and drilling works in search for new depressions in the Paleozoic basement arrived to no success. It was established that the level of lead-zinc mineralisation of Triassic-Jurassic bauxite-bearing sediments does not reach commercial contents, remaining within tenths of a percent, occasionally reaching 1.5-2.0% in some samples [10].

Thus, analysis of the earlier studies conducted within the Ayusai field and areas in vicinity indicated a rather low level of geological and geophysical knowledge. Geophysical works at the end of the XX century were carried out with equipment and machinery which cannot compete today. Modern equipment in terms of accuracy, precision, processing and interpretation technology can provide high quality geophysical research in the area.

The Ayusai ore field is located at the southern end of the Central Karatau synclinorium. The ore deposits lie in the core of the Ayusai syncline and are confined to the lower part of the Mesozoic-Cenozoic sediments, which unconformably lie on carbonate and terrigenous-carbonate rocks of Carboniferous age [12].

The geological section of the Central Karatau is represented by Devonian, Carboniferous and Mesozoic-Cenozoic sediments. The Paleozoic sediments belong to the Greater Karatau structural-formation zone. The Alpine structural layer is represented by sediments of the Syr-Darya structural-formation zone. Its northern boundary is controlled by rocks of the north-eastern end of the Leontiev graben [1, 3].

The lower part of the Paleozoic sediments is represented by red-coloured terrigenous rocks of continental mollasse of the Middle-Late Devonian period (Tulkubas suite). Further, there is continuous interbedded carbonate and terrigenous-carbonate lithofacies of marine genesis of the Late Devonian-Middle Carboniferous period (sediments of the Randysay-Aktas section type). According to V.M. Buvtyshkin's ideas, accumulation of the Late Devonian-Middle Carboniferous deposits took place inside the carbonate platform, which was formed at the place of development of red-coloured sandstones of Tulkubas suite under the influence of prolonged sea transgression on the passive continental margin (2008) [5, 9].

The lower part of the Randysay-Aktas sediments contains carbonate-terrigenous deposits of the Korpesh suite of the Frasnian age. In the Famennian sediments lie the lower unit of the Khantaga series, the Randysay series and the basal Turlan and Shilbyr suites. Rocks of the Late Famennian-Early Tournaisian age are represented by deposits of Aktasian complex and rocks of Aktasian reef complex. The Aksai, Orgailysai, and Ayusai suites and structures of the Ayusai Reef Complex date to the Early to Late Tournai. The Kazanbuzar suite (Early Visae) and the Zhartoba suite (Middle Visae-Bashkirian) occur upward in the section [4].

The Mesozoic-Cenozoic formations are represented by Triassic, Jurassic, Cretaceous, Paleogene and Neogene rocks. They comprise the upper part of the Syrdarya depression and the Leontiev graben.

In terms of morphology, the Paleozoic age foundation is a paleo-depression-type structure of 1.6x2.5 km, unclosed on the southern side of the deposit. The roof is dissected by numerous faults of small amplitudes. The faults extend to north-east and north-west. Drilling and electrical surveys indicated submeridional troughs of up to 1.6x350m within the depression. The depressions are separated by basement protrusions up to 90 m high, limited by sub-vertical faults. The relief of the Paleozoic basement is overlaid by the clastic cemented deposits of the Mesozoic-Cenozoic. Undivided Triassic-Early Jurassic and Jurassic sediments also fall out of the section. This indicates tectonic activity and permanent alteration of the basement relief during the Triassic and Jurassic periods. The basement roof sediments (up to 150 m thick) contain karsts shaped as cavities, caverns and cracks with serrated irregular walls. They are filled with iron oxides, fragments of host limestone and white calcite [2, 8].

Analysis of geological and tectonic features, sampling, coring and laboratory tests indicate that the undivided Triassic-Early Jurassic sediments at the Ayusai deposit are productive deposits with the identified lead-zinc-iron-bauxite ores [6].

Materials and methods. The presented materials allowed justifying a set of geophysical methods including magnetic and electrical exploration. Within the Ayusai deposit, the magnetic survey resulted in geological mapping, confirmation and detailing of the previously identified magnetic field anomalies and in discovering new ones. The survey was conducted on a 100m x 10m grid with 50m x 5m detailing. A ground station provided the recording of the magnetic field variations. Control measurements amounted to 7.3% with the RMS error of ± 2.8 nTl. The achieved accuracy allowed compiling maps of the anomalous magnetic field with an isodynamic cross-section of 5 nT. The core capping was a merit of the work: it was carried out in the drilled boreholes with a field magnetic susceptimeter KP-01 for studies of the magnetic properties of rocks [1].

Results. Analysis of prior data showed that the study area is located predominantly in a negative magnetic field with a north-eastern direction of -4 to -5 nT per 1 km. The latest surveys in the field not only confirmed the previously identified anomalies, but also revealed a number of small size positive anomalies with intensities from +30 to +200 nT (Fig.1).

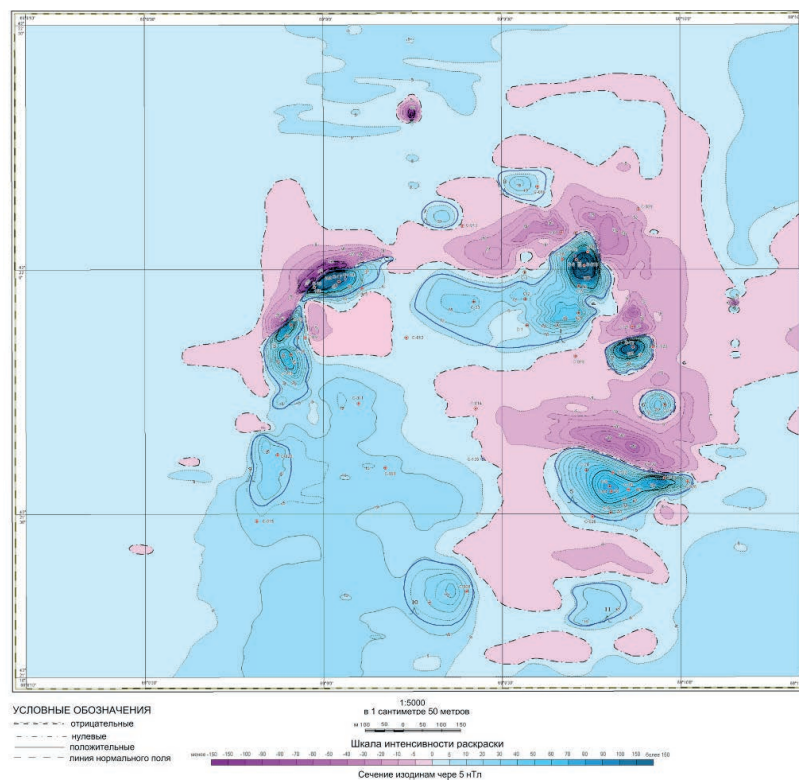


Fig. 1 - Map of the Ayusai deposit anomalous magnetic field ΔT [1]

Geologically, these anomalies allow mapping the ferruginous bauxite varieties of undissected Triassic-Early Jurassic deposits. The magnetic susceptibility of the light grey low-iron bauxites and allites was $90-400 \cdot 10^{-6}$ CGS, in isolated cases reaching $1,100-2,200 \cdot 10^{-6}$ CGS; in ferruginous varieties $4,000-7,000 \cdot 10^{-6}$ CGS,

in single cases $70,000 \cdot 10^{-6}$ CGS; in magnetite-bearing sandy-siltstone sediments of Jurassic carbonaceous sequence (rare cases) $2,000-3,590 \cdot 10^{-6}$ CGS. In order to determine the lithology of magnetically active rocks, all magnetic anomalies were verified by drilling.

In order to identify and trace faults, to delineate ore bodies and to determine their occurrence parameters in the Ayusai deposit, electrical prospecting was carried out using the vertical electrical sounding (VES) and the induced polarizability in modification of the median gradient (MGIP) methods. The MGIP method was used to detail the detected anomalies within the observation system of $AB=2,200$ m, $MN=100$ m in a 200×100 m profile grid.

The VES survey was to clarify the topography of the Paleozoic crystalline basement and to detail the structure of possible ore objects. The VES work was planned as follows: AB up to 1,500 m, the 200 m step on profiles. Power was supplied with help of a 4.5 kW generator group, using a converter-rectifier (up to 1,000V) and a control device of supply and receiving lines. The MGIP supply line used 1.5m x 0.8m galvanised sheets buried 0.7m to 0.9m down and watered abundantly. The VES supply line used 1x0.2m galvanised sheets buried up to 0.5m down and flooded too.

Non-polarising ceramic electrodes with an intrinsic polarisation of no more than 2 mV were used in the receiving line of the electrical survey methods. Repeated measurements were conducted at the beginning, in the end and at every tenth measurement point along the profile. Mean relative errors under the VES and MGIP methods were 4.4% for polarizability and 2.3% for resistivity. [1]

The MGIP exploration method resulted in four zones of high apparent resistivity of up to 2,000 Ohm and five zones of increased polarizability of more than 3.5% (Table 1, Fig. 2).

Table 1. The MGIP exploration results

Zone no.	Location in the Ayusai site	Value ρ_k , Oh·m	Value η_k , %	Geological nature of resistance anomalies
1	2	3	4	5
I	The north-western part	10,000.	2	Reef outcrops of the Lower Carboniferous age
II	The north-eastern part	6,000.	4	To the north of the site, there are outcrops of reef formations of the Ayusai reef complex
III	The central part	3,500.	4,5	To the north of the site, there are outcrops of reef formations of the Ayusai reef complex, deposited at shallow depth (as per the drilling data) and overlain by loose sediments
IV	The south-eastern part	2,500.		

The high polarizability values in Zone II could be conditioned by highly waterlogged porous reef structures as the Ayusai Brook flows through this area.

The deposits of the Ayusai reef complex, to which anomaly III is confined (a bauxite-bearing sequence up to 60 m thick in places and located at this depth), are highly mineralised.

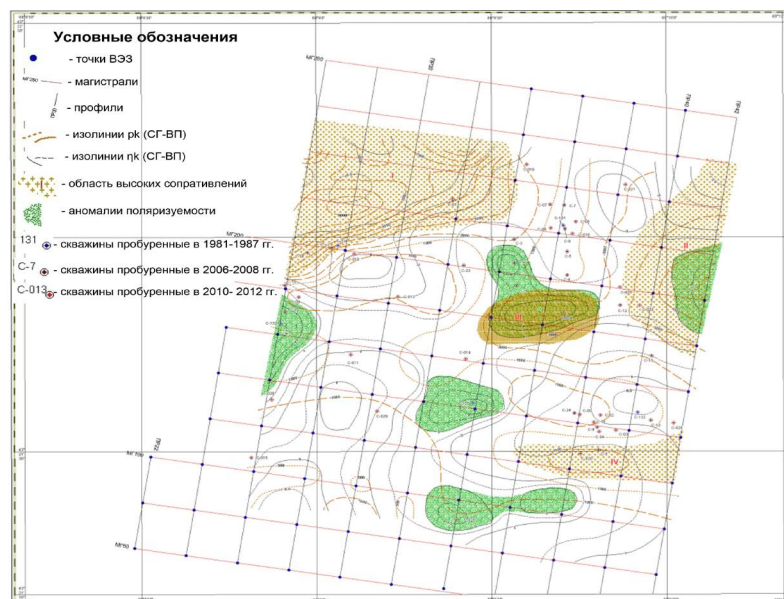


Fig.2 - The map of the Ayusai field VES exploration results [1]

Table 2. The VES exploration results

Anomaly's no.	Value η_k , %	Size, km	Geological nature of polarizability anomalies
1	2	3	5
1	5	Not delineated	waterlogged reef formations of the Lower Carboniferous Ayusaic complex (rfC, as)
2	4.5	0,4*0,4	waterlogged reef formations of the Lower Carboniferous Ayusaic complex (rfC, as)
3	4	Not delineated	waterlogged reef formations of the Lower Carboniferous Ayusaic complex (rfC, as)
4	5	0,35*0,2	waterlogged reef formations of the Lower Carboniferous Ayusaic complex (rfC, as)
5	4	0,6*0,2	waterlogged reef formations of the Lower Carboniferous Ayusaic complex (rfC, as)

Discussion. The VES study of the upper part of the ore section allowed constructing the apparent resistivity (ρ_k) sections along profiles (Fig. 3). The use of VES data makes it possible to construct a map of iso-thicknesses of loose deposits and determine the depth and relief of the Paleozoic basement roof.

Thus, the study presented in the article shows that lead-zinc mineralization of the Shaimerden type is a new commercial type under conditions of the Greater Karatau. This type of mineralization is associated with destruction of Paleozoic sediments under active crusting processes occurring in the Mesozoic time. Stratimorphic polymetallic mineralisation dispersed in the basement sediments had eventually localised into ore formations within the terrigenous Mesozoic rocks.

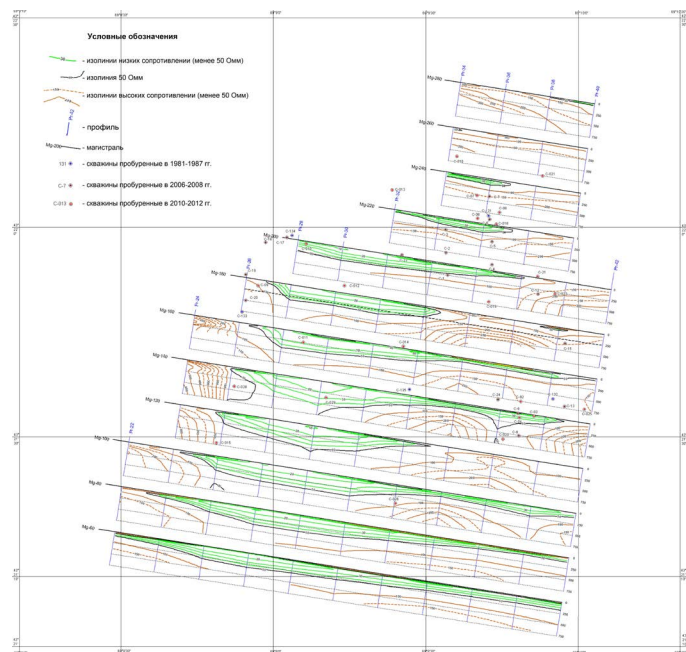


Fig.3 - The map of apparent resistivity sections as per VES exploration results [1]

Conclusion. The results of the prospecting works and of the geological and mineralogical assumptions on the area suggest discovery of crust-karst-type commercial objects here with complex lead-zinc-iron-bauxite ores. The implemented geophysical survey is the basis for further geological exploration of the area, including, development of criteria to calculate polymetallic ore reserves within the Ayusaic deposit.

Рахманова С.Н.*, Умирова Г.К., Аблесенова З.Н.

КЕАҚ Қазақ ұлттық техникалық зерттеу университеті Қ.И. Сәтпаев атындағы, Алматы, Қазақстан.

E-mail: *symbat_3098@mail.ru*

ҚАБЫҚ-КАРСТ ТИПТІ ПОЛИМЕТАЛЛ КЕНДЕНУІН АНЫҚТАУ МАҚСАТЫНДА ҮЛКЕН ҚАРАТАУ ЖОТАСЫНЫҢ ОҢТҮСТІК-БАТЫС БЕТКЕЙІН ГЕОФИЗИКАЛЫҚ ӘДІСТЕР КЕШЕҢІМЕН ЗЕРТТЕУ

Аннотация. Үлкен Қаратау XX ғасырдың ортасынан бастап танылған, ірі тау-кен өңірі болып табылады, онда қорғасын мен мырыш кенорындары ғана емес, сонымен қатар алтын, ванадий, түйіршікті фосфорит, барит және басқа да кенорындары ашылған. Қара және түсті металдар қорлары

бойынша минералдық-шикізат кешенін дамыту бағдарламасына сәйкес Қазақстан Республикасы (ҚР) әлемнің жетекші елдерінің ондығына кіреді. Алайда бұл қорлардың едәуір бөлігі бәсекеге қабілетсіз болып табылады. Себебі, пайдалы қазбалардың барлық түрлері бойынша өндіру көлемі олардың өсімінен асып түседі. Егер іздеу сатысынан бастап кенорнын игеруге дайындауға дейін кемінде 15 жыл талап етілетінін ескеретін болсақ, онда жақын арада ҚР мыс, қорғасын-мырыш және алтын кені салаларында дағдарыстық жағдайдың дамуын күтуге болады. Сонымен қатар, өндіру көлемінің төмендеуі қазірдің өзінде әлеуметтік-экономикалық проблемалардың дамуына алып келеді. Мысалы, соңғы он жылда Оңтүстік Қазақстанда барлық ірі, яғни Мырғалымсай, Ащысай, Байжансай кенорындарында өндіру тоқтатылды. Егер «Ачполиметалл» кәсіпорны Кентау қаласы үшін қала құраушы болып табылатынын ескеретін болсақ, онда осы ауданда жаңа өнеркәсіптік маңызы бар кен объектілерін табудың өзектілігі даусыз.

Жұмыстың мақсаты – Үлкен Қаратау жотасының оңтүстік-батысындағы Аюсай кенорны шегінде сиыр-карст типті полиметалл кенденуін анықтау перспективаларын зерттеу болып табылады.

Зерттеу нысаны – Аюсай кенорнының юра және триас шөгінділерінің литологиялық-стратиграфиялық әртектілігі.

Мақалада іздеу және геологиялық түсіру жұмыстарының нәтижелеріне қысқаша шолу, сондай-ақ геологиялық және минерагендік алғышарттарға талдау жасалды. Ғылыми зерттеулердің нәтижелері қорғасын мен мырыштың жоғары құрамы бар жоғары сазды шөгінділер таралған зерттеу аймағында күрделі қорғасын-мырыш-темір-боксит кендері бар қабатты-карст типіндегі өнеркәсіптік нысандарды табуды болжауға мүмкіндік береді. Кешенді геофизикалық әдістердің нәтижелері ауданды одан әрі геологиялық жете зерттеу, үш өлшемді модельдерді құру және қорларды есептеу үшін геофизикалық негіз бола алады.

Түйінді сөздер: қабатты-карст типтес полиметалл кендену, Үлкен Қаратау, магниттік барлау, электрлік барлау, қорғасын, мырыш, бөлінбеген Юра-триастық шөгінділер, палеозойлық іргетастың депрессиясы.

Рахманова С.Н.*, Умирова Г.К., Аблесенова З.Н.

¹ НАО Казахский национальный исследовательский технический университет имени К.И. Сатпаева, Алматы, Казахстан.
E-mail: : symbat_3098@mail.ru

ИЗУЧЕНИЕ ЮГО-ЗАПАДА БОЛЬШОГО КАРАТАУ КОМПЛЕКСОМ ГЕОФИЗИЧЕСКИХ ИССЛЕДОВАНИЙ С ЦЕЛЬЮ ОБНАРУЖЕНИЯ ПОЛИМЕТАЛЛИЧЕСКОГО ОРУДЕНЕНИЯ КОРОВО-КАРСТОВОГО ТИПА

Аннотация. Большой Каратау с середины XX века является признанным, крупным горнорудным регионом, в котором открыты не только месторождения свинца и цинка, но и месторождения золота, ванадия, зернистых фосфоритов, барита и других. В соответствии с Программой развития минерально-сырьевого комплекса по запасам черных и цветных металлов Республика Казахстан (РК) входит в десятку ведущих стран мира. Однако значительная часть этих запасов является неконкурентоспособной. Причина заключается в том, что практически по всем видам полезных ископаемых объемы добычи превышают их прирост. Если учесть, что, начиная от стадии поисков до подготовки месторождения к освоению требуется, как минимум, 15 лет, то уже в ближайшее время можно ждать развитие кризисной обстановки в медной, свинцово-цинковой и золоторудной отраслях РК. Вместе с тем, снижение объемов добычи уже сейчас ведет к развитию социально-экономических проблем. Например, за последние десять лет в Южном Казахстане прекращена добыча практически на всех крупных месторождениях: Миргалымсай, Ачисай, Байжансай. Если учитывать, что предприятие «Ачполиметалл» является градообразующим для города Кентау, то актуальность обнаружения новых промышленно значимых рудных объектов в этом районе является бесспорной.

Цель работы сводится к исследованию перспектив юго-запада хребта Большой Каратау на обнаружение полиметаллического оруденения корово-карстового типа в пределах месторождения Аюсай.

Объектом исследований являются литолого-стратиграфические неоднородности нерасчлененных отложений юры и триаса месторождения Аюсай.

В статье представлен короткий обзор результатов поисковых и геологосъемочных работ, а также проведен анализ геологических и минерагенических предпосылок. Результаты научных исследований дают возможность предполагать обнаружение промышленных объектов корово-карстового типа с комплексными свинцово-цинково-железо-бокситовыми рудами в пределах района исследований, где распространены высокоглиноземистые отложения с повышенными содержаниями свинца и цинка. Результаты комплексных геофизических методов могут стать геофизической основой для дальнейшего геологического доизучения площади, построения трехмерных моделей и подсчета запасов.

Ключевые слова: полиметаллическое оруденение корово-карстового типа, Большой Каратау, магниторазведка, электроразведка, свинец, цинк, нерасчлененные юрско-триасовые отложения, депрессии палеозойского фундамента.

Information about the authors:

Rakhmanova Symbat Nurlanovna – 2nd year Master student of Educational programme 7M07105 “Oil, Gas and Ore Geophysics”, NJSC The Satpayev Kazakh National Research Technical University. E-mail: symbat_3098@mail.ru, <https://orcid.org/0000-0002-8598-2570>;

Umirova Gulzada Kubashevna – PhD, assistant professor in the Chair of Geophysics, NJSC The Satpayev Kazakh National Research Technical University. E-mail: gulmuha@mail.ru, <https://orcid.org/0000-0001-5185-3132>;

Ablessenova Zuhra Nigmatzhanovna – Tutor in the Chair of Geophysics, NJSC The Satpayev Kazakh National Research Technical University. E-mail: zuhjan_b@mail.ru, <https://orcid.org/0000-0002-4090-5029>.

REFERENCES

- [1] Buvtyshkin V.M. (2012). Prospecting and appraisal works for polymetals at the Ayusai deposit. (In Rus.).
- [2] Antonenko A.A., Togizov K.S., Khojimuratova A.T., Karbozova J.A. (2020). Local search criteria of karst mineralisation in the example of Achisay ore district (South Kazakhstan) - SGEM 2020, Science and technologies in geology, exploration and mining. Albena, Bulgaria, 147–153.
- [3] Togizov K.S., Antonenko A.A. (2020). Structural and tectonic position and prognostic criteria for lead-zinc karst mineralisation Achisay ore district (South Kazakhstan), SGEM 2020, Science and technologies in geology, exploration and mining. Albena, Bulgaria, 335-340.
- [4] Abdullin A.A. (1986). Geology and metallogeny of Karatau. Volume I and II, Nauka, Alma-Ata. (In Rus.).
- [5] Alekseev V.A. (1975). Regularities of location of lead-zinc deposits in Devonian-Carboniferous sediments of Kazakhstan (In Rus.).
- [6] Galatsky V.V. (1967). Tectonics of the Karatau Ridge. Alma-Ata. (In Rus.).
- [7] Kassin N.G. (1981). Regularities of zinc-lead mineralisation distribution in Karatau. Alma-Ata. (In Rus.).
- [8] Bronguleev V.V. (1961). The structure of the Middle Paleozoic structural level of the Central Karatau. Moscow. (In Rus.).
- [9] Esenov Sh. E. (1971). Geology of the USSR, Southern Kazakhstan. Moscow, Nedra. (In Rus.).
- [10] Primakhanov A.P. (1980). Report on prospecting work of the Achisayskaya GPP in Central Karatau, 1:10000. Yuzhkazgeologiya. (In Rus.).
- [11] Ryzhenko G.E., Komarov A.M. (1983). Report on the results of gravity survey and aeromagnetic prospecting. Kazgeophysika. (In Rus.).
- [12] Bykodarov V.A., Komarnitsky B.E., Loseva A.V., Nikitin E.A., Fedorenko O.A., Tsirelson B.S. (1966). Bulletin of the Moscow Society of Nature Explorers. Department of Geology. “Once again about Mesozoic and Tertiary deposits of the Karatau Ridge in South Kazakhstan”. Vol. 41, Issue 2, Moscow, P.8. (In Rus.).
- [13] Fomichev V.I., Kulkashev N.T. (1989). Tectonofacial position of lead-zinc mineralization of the Hercynian Karatau complex (Southern Karatau). // Tectonophations and geology of ore objects. A-A-. P.48-54. (In Rus.).
- [14] Zaharov E.E. (1960). Metallogeny of Karatau. // Patterns of mineral placement. T.3. M., P.380-417. (In Rus.).
- [15] Knyazev I.I. (1960). Patterns of distribution of lead-zinc mineralization in Karatau (Southern Kazakhstan). // Basic ideas, N.G. Cassina in the geology of Kazakhstan. A-A., P.379-400 (In Rus.).

CONTENTS

Absametov M.K., Itemen N.M., Murtazin Ye.Zh., Zhexembayev E.Sh., Toktaganov T.Sh. FEATURES OF THE ISOTOPIC COMPOSITION OF GROUNDWATER IN THE MANGYSTAU REGION.....	6
Akimbek G.A., Aliyarov B.K., Badaker V.C., Akimbekova Sh.A. METHODOLOGY AND EXPERIMENTAL SETUP FOR THE STUDY OF RELATIVE ABRASIVENESS OF BULK SOLIDS.....	14
Baibolov K., Artykbaev D., Aldiyarov Zh., Karshyga G. EXPERIMENTAL INVESTIGATIONS OF THE COARSE-GRAINED SOIL IN THE DAM OF THE PSKEM HEP.....	21
Bolatova A., Kutybayev A., Kainazarov A., Hryhoriev Yu., Lutsenko S. USE OF MINING AND METALLURGICAL WASTE AS A BACKFILL OF WORKED-OUT SPACES.....	33
Hajiyeva G.N., Hajiyeva A.Z., Dadashova Kh.D. IMPACT OF URBAN LANDSCAPE POLLUTION ON HUMAN HEALTH.....	39
Hayitov O.G., Zokirov R.T., Agzamov O.O., Gafurov Sh.O., Umirzoqov A.A. CLASSIFICATION OF HYDROCARBON DEPOSITS IN THE SOUTH-EASTERN PART OF THE BUKHARA-KHIVA REGION, JUSTIFICATION OF ITS METHODOLOGY AND ANALYSIS OF THE RESULTS.....	46
Kabylbekov K.A., Abdrakhmanova Kh.K., Kuatbekova R.A., Makhanov T.S., Urmashiev B. COMPUTER SIMULATION OF RADIONUCLIDE ISOTOPE SEPARATION USED IN NUCLEAR ENERGY AND MEDICINE.....	53
Kassenov A.Zh., Abishev K.K., Absadykov B.N., Yessaulkov V.S., Bolatova A.B. ANALYSIS AND JUSTIFICATION OF THE LAYOUT OF A MULTIPURPOSE MACHINE FOR THE DEVELOPMENT OF MINERAL DEPOSITS.....	63
Kaumetova D.S., Koizhanova A.K., Toktar.G., Magomedov D.R., Abdyldaev N.N. STUDY OF THE FINELY-DISPERSED GOLD RECOVERY PARAMETERS.....	69
Rakhmanova S.N., Umirova G.K., Ablessenova Z.N. STUDY OF THE GREATER KARATAU'S SOUTH-WEST BY RANGE OF GEOPHYSICAL SURVEYS IN SEARCH OF THE CRUST-KARST TYPE POLYMETALLIC MINERALISATION.....	76
Oitseva T.A., D'yachkov B.A., Kuzmina O.N., Bissatova A.Y., Ageyeva O.V. LI-BEARING PEGMATITES OF THE KALBA-NARYM METALLOGENIC ZONE (EAST KAZAKHSTAN): MINERAL POTENTIAL AND EXPLORATION CRITERIA.....	83
Sarmurzina R.G., Boiko G.I., Lyubchenko N.P., Karabalin U.S., Demeubayeva N.S. ALLOYS FOR THE PRODUCTION OF HYDROGEN AND ACTIVE ALUMINUM OXIDE.....	91
Suleyev D.K., Uzbekov N.B., Sadykova A.B. MODERN APPROACHES TO SEISMIC HAZARD ASSESSMENT OF THE TERRITORY OF KAZAKHSTAN.....	99
Temirbekova M.N., Temirbekov N.M., Wojcik W., Aliyarova M.B., Elemanova A.A. THE USE OF ORGANIC FRACTION OF SOLID HOUSEHOLD WASTE TO GENERATE ETHANOL AND BIOGAS USING A SIMULATION MODEL.....	105

Tulegulov A.D., Yergaliyev D.S., Bazhaev N.A., Keribayeva T.B., Akishev K.M. METHODS FOR IMPROVING PROCESS AUTOMATION IN THE MINING INDUSTRY.....	115
Tulemisova G., Abdinov R., Amangosova A., Batyrbaeva G. STUDY OF THE BOTTOM SEDIMENTS OF RESERVOIRS OF URAL-CASPIAN BASIN.....	126
Turgazinov I.K. Mukanov D.B. ANALYSIS OF FLUID FILTRATION MECHANISMS IN FRACTURED RESERVOIRS.....	135
Uakhitova B., Ramatullaeva L.I., Imangazin M.K., Taizhigitova M.M., Uakhitov R.U. ANALYSIS OF THE LEVEL OF OCCUPATIONAL INJURIES ON THE EXAMPLE OF AN INDUSTRIAL ENTERPRISE OF A METALLURGICAL CLUSTER.....	145
Yurii Feshchuk, Vadym Nizhnyk, Valeriia Nekora, Oleksandr Teslenko IMPROVING THE SYSTEM FOR RESPONDING TO FIRE IN AREAS CONTAMINATED BY THE CHERNOBYL DISASTER.....	152
Sherov A.K., Myrzakhmet B., Sherov K.T., Absadykov B.N., Sikhimbayev M.R. METHOD FOR SELECTING THE LOCATION OF THE CLEARANCE FIELDS OF THE LANDING SURFACES OF GEAR PUMP PARTS WITH A BIAXIAL CONNECTION.....	159
Khamroyev J.Kh., Akmalaiuly K., Fayzullayev N. MECHANICAL ACTIVATION OF NAVBAHORSK BENTONITE AND ITS TEXTURAL AND ADSORPTION CHARACTERISTICS.....	167
Zhurinov M.Zh., Teltayev B.B., Aitbayev K.A., Loprencipe G., Tileu K.B. MODELING OF NON-STATIONARY TEMPERATURE MODE OF A MULTI-LAYER ROAD STRUCTURE.....	175

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see <http://www.elsevier.com/postingpolicy>), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service <http://www.elsevier.com/editors/plagdetect>.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайтах:

[www:nauka-nanrk.kz](http://www.nauka-nanrk.kz)

<http://www.geolog-technical.kz/index.php/en/>

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Редакторы: *М.С. Ахметова, А. Ботанқызы, Д.С. Аленов, Р.Ж. Мрзабаева*
Верстка на компьютере *Г.Д.Жадыранова*

Подписано в печать 14.02.2022.

Формат 60x881/8. Бумага офсетная. Печать – ризограф.

11,5 п.л. Тираж 300. Заказ 1.