

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

2 (452)
MARCH – APRIL 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**

Ғылыми хатшы

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

Редакциялық алқа:

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

ЖОЛТАЕВ Герой Жолтайұлы (бас редактордың орынбасары), 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, РФА академигі, А.А. Трофимука атындағы мұнай-газ геологиясы және геофизика институты (Новосибирск, Ресей) **Н = 19**

АГАБЕКОВ Владимир Еноквич, 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**

Ученый секретарь

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

Редакционная коллегия:

АБСАМЕТОВ Малис Кудысович, (заместитель главного редактора), доктор геологоминералогических наук, профессор, академик НАН РК, директор Института гидрогеологии и геоэкологии им. У.М. Ахмедсафина (Алматы, Казахстан) **Н = 2**

ЖОЛТАЕВ Герой Жолтаевич, (заместитель главного редактора), доктор геологоминералогических 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**

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.

Editorial 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**

Scientific secretary

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

E d i t o r i a l b o a r d:

ABSAMETOV Malis Kudysovich, (deputy editor-in-chief), 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, (deputy editor-in-chief), 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**

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 2, Number 452 (2022), 6-16

<https://doi.org/10.32014/2022.2518-170X.156>

ISSN 2224-5278 (Print)

UDC 550.348

**A.U. Abdullaev¹, Sh.S.Yusupov², L.Yu. Shin², A.V. Rasulov²,
Y.Zh. Yessenzhigitova¹**

¹Institute of Seismology MES RK, Almaty, Kazakhstan;

²Institute of Seismology of the AS RUz. Tashkent, Uzbekistan.

E-mail: shuhrat-1951@mail.ru

HYDROGEOSEISMOLOGICAL PRECURSORS SUSAMYR EARTHQUAKE 1992

Abstract. On August 19, 1992, in the central spurs of the Northern Tien-Shan in the Susamyr ridge, one of the strongest earthquakes in Central Asia in the last century occurred, which value $M=7.5$ in magnitude. The Susamyr earthquake, named after the place of origin, was preceded by anomalies in the seismic regime, geophysical, hydrogeological and geochemical fields, were noted in the Tashkent, Fergana, Bishkek, Almaty, Issyk-Kul, Dzhungar and Urumchi seismic prognostic fields. As a result of synchronization of the anomaly occurrence time for this event for all polygons, it was possible to note that the earliest anomalies in the hydrogeodynamic, hydrogeochemical and gas composition of groundwater were recorded 2-2.5 months before. The greatest interest is caused by the development of the anomaly in the far zones in the Tashkent geodynamic test site. This paper presents the results of routine observations of the seismohydrogeological parameters of groundwater in seismically active zones of Uzbekistan. The research period covers the time of preparation and implementation of the strongest earthquake over the last century. Hydrogeochemical, hydrogeodynamic, geophysical conditions of manifestation and seismotectonic conditions of localization of the source and location of observation water points relative to the epicenter of this earthquake on the territory of the Republic of Uzbekistan are considered. A complete review of all materials shows that anomalies of destructive earthquakes arise mainly as a result of renewal of large, global faults that limit multidirectional tectonic

structures, which affected the spread of anomalous precursor phenomena over a vast territory.

Key words: precursor, magnitude, tectonic conditions, anomaly, variation, background value, hydrogeoseismology, seismogenic zones, gas concentration, isotopic composition.

**А.У. Абдуллаев¹, Ш.С. Юсупов², Л.Ю. Шин², А.В. Расулов²,
Е.Ж. Есенжігітова¹**

¹ҚР ТЖМ Сейсмология институты, Алматы, Қазақстан;

²ӨР ҒА Сейсмология институты, Ташкент, Өзбекстан.

E-mail: shuhrat-1951@mail.ru

1992 ЖЫЛҒЫ СУСАМЫР ЖЕРСІЛКІНІСІНІҢ ГИДРОГЕОСЕЙСМОЛОГИЯЛЫҚ БЕЛГІЛЕРІ

Аннотация. 1992 жылы 19 тамызда Солтүстік Тянь-Шаньның орталық сілемдерінде Сусамыр жотасында өткен ғасырдағы Орталық Азиядағы ең күшті жер сілкіністерінің бірі болып, магнитудасы $M=7,5$ -ке жетті. Сусамыр жер сілкінісі пайда болған жердің атымен аталған, оның алдында сейсмикалық режимдегі, геофизикалық, гидрогеологиялық және геохимиялық өрістердегі ауытқулар байқалды және олар Ташкент, Ферғана, Бішкек, Алматы, Ыстықкөл, Жоңғар және Үрімші сейсмикалық болжамдық бақылау полигондарында орын алды. Барлық полигондар үшін аномалиялардың пайда болу уақытын синхрондау нәтижесінде жер асты суларының гидрогеодинамикалық, гидрогеохимиялық және газдық құрамындағы ең ерте ауытқулар осыдан 2-2,5 ай бұрын тіркелгенін атап өтуге болады. Ең үлкен қызығушылық Ташкент геодинамикалық полигонындағы алыс аймақтардағы аномалия дамуымен байланысты. Бұл мақалада Өзбекстанның сейсмикалық белсенді аймақтарындағы жер асты суларының сейсмогидрогеологиялық параметрлерін жоспарлы бақылау нәтижелері берілген. Зерттеу кезеңі өткен ғасырдағы ең мықты жер сілкінісінің дайындық және жүзеге асқан уақытын қамтиды. Өзбекстан Республикасы аумағындағы осы жер сілкінісінің эпицентріне қатысты бақыланытын су нүктелерінің көзі мен орналасуының гидрогеохимиялық, гидрогеодинамикалық, геофизикалық көріністері мен сеймотектоникалық жағдайлары қарастырылады. Барлық материалдарды толық шолу жойқын жер сілкіністерінің аномалиялары негізінен кең аумақта аномальды прекурсорлық құбылыстардың таралуына әсер еткен көп бағытты тектоникалық құрылымдарды шектейтін ірі, ғаламдық жарықшақтардың жаңаруы нәтижесінде туындайтынын көрсетеді.

Түйін сөздер: алдын ала болжау, магнитуда, тектоникалық жағдайлары, ауытқуы, вариациясы, фондық мәні, гидрогеосейсмология, сейсмогендік аймақтар, газ концентрациясы, изотоптық құрам.

**А.У. Абдуллаев¹, Ш.С Юсупов², Л.Ю. Шин², А.В. Расулов²,
Е.Ж. Есенжигитова¹**

¹Институт сейсмологии МЧС РК, г. Алматы, Казахстан;

²Институт сейсмологии АН РУ, Ташкент, Узбекистан.

E-mail: shuhrat-1951@mail.ru

ГИДРОГЕОСЕЙСМОЛОГИЧЕСКИЕ ПРЕДВЕСТНИКИ СУСАМЫРСКОГО ЗЕМЛЕТРЯСЕНИЯ 1992 ГОДА

Аннотация. 19 августа 1992 года в центральных отрогах Северного Тянь-Шаня в хребте Сусамыр произошло одно из самых сильных за последние столетие в Средней Азии землетрясение, которое достигло по магнитуде $M=7,5$. Названное по месту возникновения Сусамырское землетрясение предвлялось аномалиями в сейсмическом режиме, геофизических, гидрогеологических и геохимических полях, отмечались на Ташкентском, Ферганском, Бишкекском, Алматинском, Иссык-Кульском, Джунгарском и Урумчинском сейсмопрогностических полях. В результате синхронизации времени возникновения аномалии по данному событию по всем полигонам удалось отметить, что наиболее ранние аномалии в гидрогеодинамическом, гидрогеохимическом и газовом составе подземных вод зафиксировано за 2-2,5 месяца. Наибольший интерес вызван развитием аномалии в дальних зонах в Ташкентском геодинамическом полигоне. В данной работе приведены результаты режимных наблюдений за сейсмогидрогеологическими параметрами подземных вод сейсмоактивных зон Узбекистана. Период исследований охватывает время подготовки и реализации сильнейшего землетрясения за последнее столетие. Рассматриваются гидрогеохимические, гидрогеодинамические, геофизические условия проявления и сеймотектонические условия локализации очага и нахождения, наблюдательных водопунктов относительно эпицентра этого землетрясения на территории Республики Узбекистан. Полное рассмотрение всех материалов показывает, что аномалии разрушительного землетрясения возникают в основном в результате обновлений крупных, глобальных разломов, ограничивающих разнонаправленные тектонические структуры, что и отразилось на распространение аномальных явлений – предвестников на огромной территории.

Ключевые слова: предвестник, магнитуда, тектонические условия, аномалия, вариация, фоновое значение, гидрогеосейсмология, сейсмогенные зоны, газовая концентрация, изотопный состав.

Introduction. The main characteristics of the Susamyr earthquake. One of the strongest earthquakes in Central Asia over the past century - the Susamyr earthquake occurred on August 19, 1992 with $M=7.4$, at a depth of 25 km (coordinates 42.07N, 73.63E) on the territory of Northern Kyrgyzstan in the Northern spurs of the Northern Tien-Shan. This earthquake affected a large territory of Central Asia, including all seismogenic zones in Kazakhstan, Kyrgyzstan and Uzbekistan (Abdullaev, 2002). In view of the large amount of data, this article presents the materials received on the territory of Uzbekistan.

The focal mechanism of the Susamyr earthquake is reverse fault with a small shear component; both possible planes have a sublatitudinal position, which is confirmed by the sublatitudinal strike of two sections of the rupture that emerged to the surface. The position of the compression axis is submeridional and near-horizontal, the tension axis is near-vertical (Sultankhodzhaev et al, 1983), (Kuchay et al, 2002).

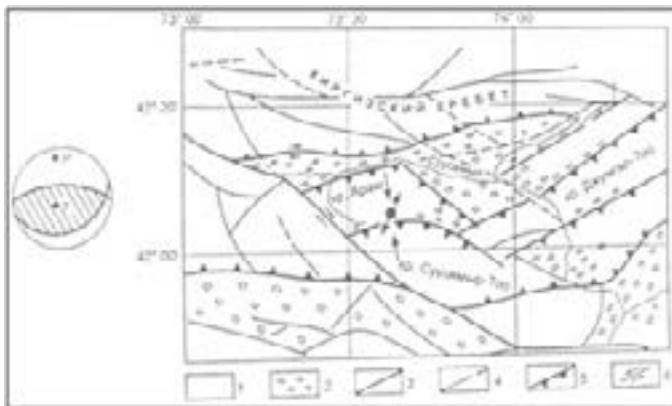


Fig. 1. Geological and tectonic scheme of the area of the Susamyr earthquake (Bagachkin et al., 1993).

1-Pre-Cenozoic sediment, 2-Cenozoic sediment, 3-major marginal faults, 4-predicted faults, 5-thrusts and thrusts, 6-strike-slip faults. The arrows show the compression and extension axes at the epicenter of the Susamyr earthquake. To the left of the main figure is a diagram of the source mechanism of the main earthquake according to the Harvard CMT catalog (upper hemisphere).

According to the seismological study, the source of the Susamyr earthquake was located in the disjunctive node of the intersection of faults of the near-

latitudinal Tien-Shan (Aramsuupthrust) and Northwest Talas-Fergana (Ichkeletau-Susamyr) orientations (Bagachkin et al., 1993).

The Susamyr earthquake occurred in the zone of seismic calm, which was considered characteristic of the inner part of the Tien Shan, at $M = 7.4$ it was felt in the epicentral area with an intensity of 9-10 points. It was accompanied by a large number of aftershocks that lasted for several years. Taking into account that the aftershock with $M = 6.7$ lags slightly behind the main shock both in time (after 1 hour and 8 minutes) and in magnitude (by 0.7 units), in the case of the Susamyr earthquake we can speak of a conjugate double shock (Kalmetyeva et al., 2009).

Materials and methods of research. Hydrogeodynamic and hydrogeochemical observations at geodynamic test sites. Abnormal displays of hydrogeoseismological and geophysical parameters were observed at many seismic forecast stations in Uzbekistan. The layout of the forecasting stations is shown in Fig. 2. The Susamyr earthquake affected the vast territory of Central Asia (Sultankhodzhaev et al, 1983), which can be confirmed by anomalous displays in the wells of Chartak (180 km), Khodjabad (190 km), Chimion (268 km), Tashkent (370 km), Khavatag (480 km), Shurchi (650 km) and Bukhara (850 km). At all stations, the M/LgR value was greater than 2.5 (where M is the magnitude and R is the epicentral distance of earthquakes). For convention, this value will be denoted by $M/LgR = I$. The value of I is used as a parameter characterizing the intensity of earthquake preparation processes, taking into account the remoteness of the corresponding sources from the center of the polygon (Serafimova & Kopylova. 2010).

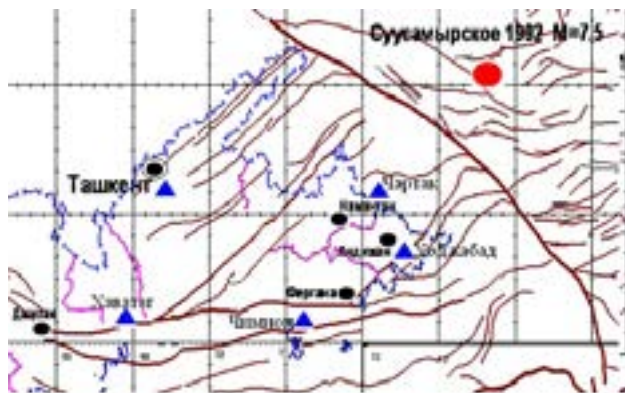


Fig. 2. Schematic map of the location of the HGH and HGD water points for observations of the epicenter of the Susamyr earthquake.

- the epicenter of the earthquake;
- city names;
- GGS forecast stations

For Central Asia, as practice shows, earthquakes with values of the sensitivity zone of the parameter - I is greater than or equal to 2.5, can be considered as included in the sensitivity zone of the HGS observations (Nurmatov et al., 2016).

Table 1

	M	Tashkent		Chartak		Andijan		Jimyeon		Hawatagh		Zhumbazaar		Shurchi		Bukhara		Zhangeldi	
		R, km	I	R, km	I	R, km	I	R, km	I	R, km	I	R, km	I	R, km	I	R, km	I	R, km	I
19.08.1992	7,5	380	2.90	180	3.25	180	3.32	270	3.08	470	2.80	610	2.69	670	2.65	820	2.57	870	2.55

Apparently, as seen in Table 1, the anomalous displays of HGSP before the Susamyr earthquake reflect displays of the stress-strain state of seismotectonic structures of different ranks in the region, i.e. vast territory of Central Asia (Abdullaev, 2002).

The Susamyr earthquake on August 19, 1992, affected a large territory of Central Asia, i.e., in all seismogenic zones of Uzbekistan, for all forecast stations the value of I ($M/\lg R$) was more than 2.5. Despite the anisotropy of the environment and the separation of the earth's crust space between the earthquake source and observation points by breaks, all these stations (water points) reacted to the preparation and implementation of the Susamyr earthquake with displays of anomalous changes in various indicators of groundwater.

In the generalizing works (Abdullaev & Yusupov, 2020), (Kopylova & Voropaev, 2006) the most well-known data on hydrogeochemical precursors are given and it is shown that these data allow one to estimate the general regularities of these anomalies with future earthquakes and the characteristic times and lead times of their manifestation. Obtaining such estimates is a primary task in providing a scientific basis for the use of hydrogeoseismological (HGS) methods for predicting earthquakes.

The following materials were used in the work: the time series of observation data for the GGS parameters of groundwater at the forecasting stations of Uzbekistan (artesian basins of the Pritashkent and Fergana, the Khavatag, Zhumbazar and Shurchi fields, at the Bukhara well) obtained for 1991-1992. Seismic Prognostic Monitoring Center of the Ministry of Emergency Situations of the Republic of Uzbekistan.

The traditional method of hydrogeochemical observations is continuous monitoring of water-gas systems of groundwater at self-flowing wells and springs, followed by gas-chemical analysis of water composition in laboratory conditions. The frequency of hydrogeochemical observations ranges from weekly to several times a week.

This method of searching for earthquake precursors is based on the sensitivity

of the underground hydrosphere to changes in the stress-strain state of the earth's crust at the stages of earthquake preparation (Sultankhodzhaev et.al, 1983), (Abdullaev, 2002). It is a system of hydrogeodynamic (water level, flow rate of sources and wells, reservoir pressure), hydrogeochemical (composition of water, gases and isotopes) and temperature indicators.

Research results. Let us consider for all water points individual parameters that appeared during the preparation and implementation of the Susamyr earthquake.

Carbondioxide. Carbon dioxide is one of the most active and informative earthquake precursors for our region. It showed itself as a harbinger before such earthquakes as Tavaksay, Nazarbek, Izbaskan, Uchkurgan and other earthquakes.

In parallel with the study of the concentration of carbon dioxide in groundwater, the isotopic composition of carbon $\delta^{13}\text{C}$ in CO_2 dissolved in groundwater in the Tashkent geodynamic test site and partially at the wells of the Chartak forecasting station was measured. Isotopic studies have shown that anomalous displays of carbon dioxide are associated with stress-strain processes in the carbonate gas-water-rock system, and $\delta^{13}\text{C}$ acts as an indicator.

As you can see, one of the most active and informative HGSPs, CO_2 , manifested itself in almost all water points in all seismically active regions of Uzbekistan. One of the visible features of this precursor is that the closer the observation post is to the epicenter, the anomaly manifests itself before the earthquake and the further from the epicenter it manifests itself during or after the earthquakes. Abnormal displays of carbon dioxide in groundwater are mainly explained by imbalance in the carbonate system (gas-water-rock) of groundwater and cracking in water-bearing rocks during changes in the stress-strain states of the earth's crust (Nurmatov et al., 2016).

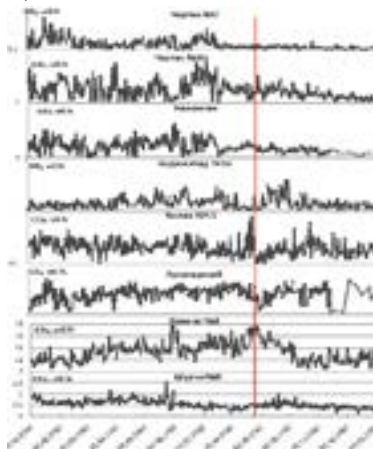


Fig. 3. Abnormal CO_2 variations in groundwater in Uzbekistan during Susamyr earthquake.

Changes in the organic components of the gas composition can also be attributed to anomalous displays, i.e. content of methane (CH_4) in groundwater (Fig. 4).

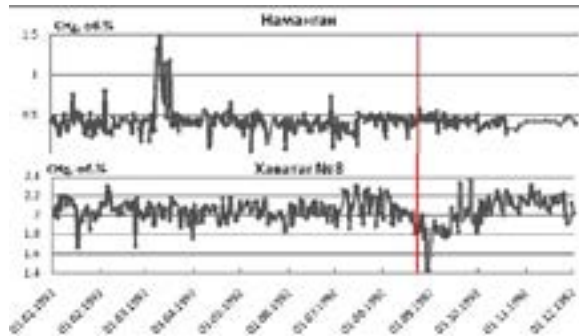


Fig. 4. Anomalous variations in CH_4 temperature in groundwater in seismically active regions of Uzbekistan during the Susamyр earthquake.

It can be seen from Fig. 4 that, at the nearest station, a positive organic gas anomaly manifests itself before the earthquake (at the beginning of March, 5 months ahead), and at the distant station, i.e. in Hawatagh manifested itself during the events (negative anomaly).

In terms of temperature, there were anomalies in all wells in the groundwater. Basically, an increase in temperature (Chartak, Khodjabad, Khavatah) before the earthquake, and in Tashkent wells, anomalies were observed during earthquakes (Fig. 5).

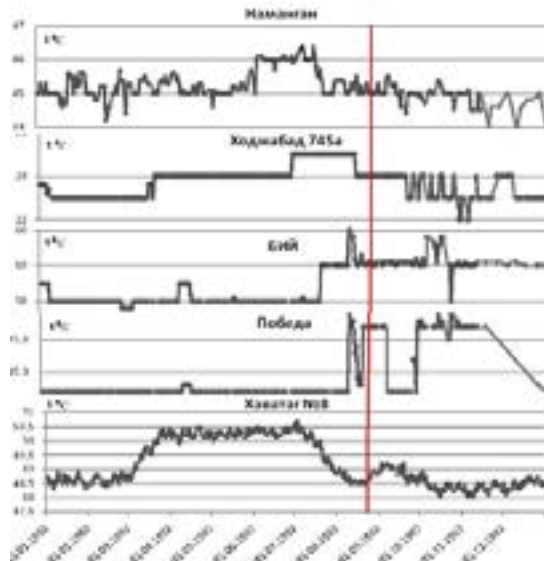


Fig. 5. Abnormal temperature variations ($t^{\circ}\text{C}$) in groundwater during the Susamyр earthquake.

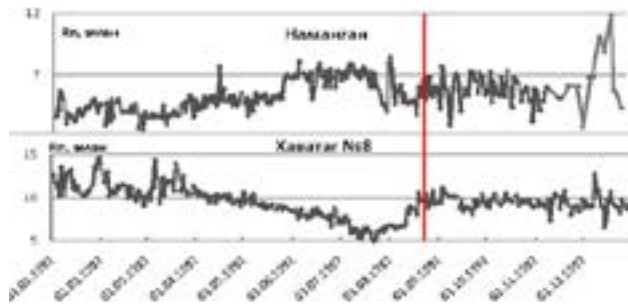


Fig. 6. Abnormal variations in Rn content in groundwater during the Susamyр earthquake.

Dissolved gas - radon also manifested itself at the nearest station (well Namangan) before the earthquake with a positive anomaly and at the distant station (Khavtat), also before the earthquake, but with a negative anomaly. Apparently, the processes of compression (Namangan) and extension (Khavtat) of mountain water-bearing layers played a role here.

The indicators of the groundwater environment (pH-Eh) experienced anomalous variations during the implementation of the Susamyр earthquake (see Fig. 7).

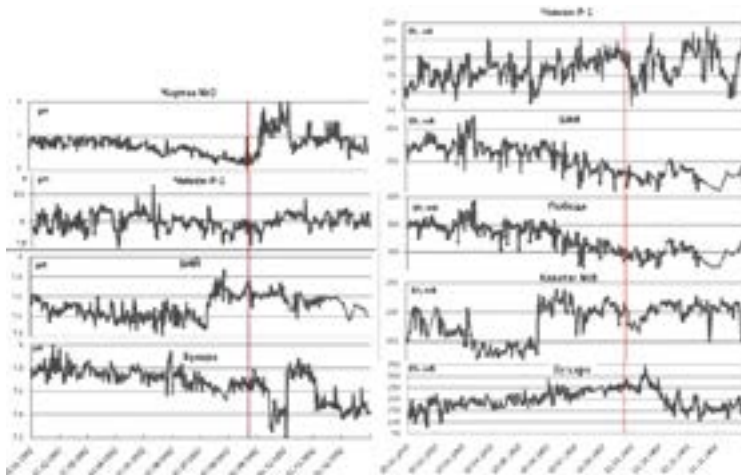


Fig. 7. Anomalous variations in pH and Eh in groundwater of the Susamyр earthquake.

Thus, in the manifestation of earthquakes and associated precursors, a special place is occupied by the spatial position of tectonic blocks and seismogenic faults limiting them. In the manifestation of precursors over long distances, the decisive role is played by the scales of tectonic blocks, along the boundaries of which the impulse of tectonic stresses propagates.

The degree of «sensitivity» of individual points, the nature, intensity and

time of manifestation of precursor anomalies are primarily due to the generality or difference in the structural-geological and seismotectonic conditions of the location of earthquake foci and observation points, as well as the power (strength) of the impending earthquake. The ambiguous behavior of the precursor parameters, even when the earthquake source is located relatively close to the observation point, indicates that there are other factors that control the displays of precursor deformation at different scale levels (ranks). Until now, the mechanism of transmission of the precursor disturbance over long distances has not been established.

Conclusion. The main reason for all displays of earthquake precursors, apparently, is due to a change in the stress-strain state of the earth's crust of the entire region.

Table 2 shows us the general tendency of the stress-strain state of the earth's crust on a regional scale and, as a result, changes in the gas-chemical composition in groundwater act as indicators of the degree of the deformed state of the earth's crust in a given region. For clarity, in the table, all the parameters that manifested themselves in pre-seismic activation were marked in green, the parameters that manifested themselves in co-seismic activation were marked in yellow, and the parameters that were manifested already post-seismic were marked in red.

Table 2

Station	Wells	R, km	M/LgR	Doseismic parameters	Koseimich. parameters	Postseism. parameters	Note
Chartak	Well 2	180	3,25	CO ₂ , He, °t, Eh, H		P	
	Well 6			CO ₂ , He			
	Well. Namangan			CO ₂ , He, °t CH ₄	Eh		
Khojab.		180	3,32		°t	CO ₂ , Cl ⁻ , P, HCO ₃ ⁻	
Chimion	Well R-1	210	3,08	°t, pH, Eh, Si ₂ O			
	Sq. HP-1			CO ₂ ,			
Tashkent	BIIT	380	2,90		CO ₂ , °t, Eh		
	Victory				°t, Rn, Eh		
Hawatag		410	2,89	Rn, °t, , CH ₄	CO ₂ , Eh		
Shurchi		670	2,65			CO ₂ ,	
Bukhara		820	2,57			Eh, pH	

The precursors of the Susamyr earthquake manifested themselves mainly at close distances, i.e. closer to the epicenter of earthquakes. The farther from the epicenter, the less the predictive abilities of the HGH parameters were manifested. On the other hand, these anomalies are directly proportional to the energy of earthquakes, which can be seen from the example of the Susamyr earthquake.

This indicates to us that, regardless of the geological and tectonic conditions for strong earthquakes, like Susamyr (M = 7.4), the propagation of the deformation field goes far beyond the limits of one polygon, covers large territories (thousands of km₂).

Information about the authors:

Abdullaev A.U. – Doctor of Geological and Mineralogical Sciences, Academician, Head of laboratory of the Institute of Seismology of the Ministry of Emergency Situations of the Republic of Kazakhstan, <https://orcid.org/0000-0003-1975-4569>;

Yusupov Sh.S. – Doctor of Geological and Mineralogical Sciences, Head of lab. Hydrogeoseismology of the Institute of Seismology of the Academy of Sciences of the Republic of Uzbekistan; <https://orcid.org/0000-0001-7259-028X>;

Shin L.Yu. – Junior researcher, lab. Hydrogeoseismology of the Institute of Seismology of the Academy of Sciences of the Republic of Uzbekistan;

Rasulov A.V. – junior researcher, lab. Hydrogeoseismology of the Institute of Seismology of the Academy of Sciences of the Republic of Uzbekistan;

Esenzhigitova E.Zh. – Chief researcher, candidate of geological-mineralogical sciences, PhD of the Institute of Seismology of the Ministry of Emergency Situations of the Republic of Kazakhstan <https://orcid.org/0000-0001-5736-9990>.

REFERENCES

[1] Abdullaev A.U. (2002). Fluid regime of the earth's crust as a reflection of modern geodynamic processes (on the example of the Tien- Shan). Almaty. Evero. 352.

[2] Abdullaev A.U., Yusupov Sh. (2020). «Optimization of quantitative indicators of seismic hydrogeochemical monitoring for studying modern geodynamic processes and forecasting earthquakes». News of the National Academy of Sciences of the Republic of Kazakhstan series of geology and technical sciences.V.2, 14-20.<https://doi.org/10.32014/2020.2518-170X.26>.

[3] Bagachkin B.M., Pletnev K.G., Rogozhin E.A. (1993). Susamyr earthquake of 1992: materials of geological and seismological study in the near zone // Seismicity and seismic zoning of Northern Eurasia. M., Geoinformmark, 143-147.

[4] Kuchay O.A., Muraliev A.M., Abdrakhmatov K.E. et al. (2002). The 1992 Susamyr earthquake and the deformation field of the after-shock sequence / Geology and Geophysics. vol. 43(11). 1038-1048.

[5] Kopylova G.N., Voropaev P.V. (2006). Processes of formation of post seismic anomalies in the chemical composition of thermomineral waters // Volcanology and seismology. 5. 42-48.

[6] Kalmetyeva Z.A., Mikolaichuk A.V., Moldobekov B.D. et al. (2009). Atlas of earthquakes in Kyrgyzstan. Bishkek: CAIIE. 73.

[7] Nurmatov U.A., Yusupov Sh.S., Shin L.Yu., Yusupdzhanova U.A. (2016). Relationship between the features of manifestation of hydrogeoseismological precursors of earthquakes with seismotectonic conditions//Geology and Mineral Resources. Tashkent, 2. 38-43.

[8] Sultankhodzhaev A.N., Latipov S.U., Zigan F.G. and other (1983). Hydrogeoseismological precursors of earthquakes. Ed. acad. Mavlyanova G.A., Tashkent, FAS, 136.

[9] Serafimova Yu.K., Kopylova G.N. (2010). Medium-term precursors of strong ($M \geq 6.6$) earthquakes in Kamchatka 1987-2007: a retrospective assessment of their informativeness for forecasting // Volcanology and seismology. 4. 3-12.

CONTENTS

A.U. Abdullaev, Sh.S. Yusupov, L.Yu. Shin, A.V. Rasulov, Y.Zh. Yessenzhigitova HYDROGEOSEISMOLOGICAL PRECURSORS SUSAMYR EARTHQUAKE 1992.....	6
N.A. Abdimutalip, A.K. Kurbaniyazov, G. Toychibekova, G. Koishieva, G. Shalabaeva, N. Zholmagambetov INFLUENCE OF CHANGES IN THE LEVEL OF SALINITY OF THE ARAL SEA ON THE DEVELOPMENT OF ECOSYSTEMS.....	17
Zh.K. Aidarbekov, S.A. Istekova CLASSIFICATION OF GEOPHYSICAL FIELDS IN THE STUDY OF GEOLOGICAL AND STRUCTURAL FEATURES OF THE ZHEZKAZGAN ORE DISTRICT.....	33
B. Almatova, B. Khamzina, A. Murzagaliyeva, A. Abdygalieva, A. Kalzhanova NATURAL SORBENTS AND SCIENTIFIC DESCRIPTION OF THEIR USE.....	49
Zh.A. Baimuratova, M.S. Kalmakhanova, SH.S.Shynazbekova, N.S. Kybyraeva, J.L. Diaz de Tuesta, H.T. Gomes MnFe ₂ O ₄ /ZHETISAY COMPOSITE AS A NOVEL MAGNETIC MATERIAL FOR ADSORPTION OF Ni(II).....	58
Ye.Z. Bukayev, G.K. Mutalibova, A.Z. Bukayeva A NEW TECHNOLOGY FOR MANUFACTURING POLYMER-CEMENT COMPOSITION FROM LIMESTONE-SHELL MINING WASTE.....	73
A.Zh. Kassenov, K.K. Abishev, A.S. Yanyushkin, D.A. Iskakova, B.N. Absadykov RESEARCH OF THE STRESS-STRAIN STATE OF HOLES WITH NEW BROACH DESIGNS.....	89
J.Kh. Khamroyev, K. Akmalaiuly, N. Fayzullayev MECHANICAL ACTIVATION OF NAVBAHORSK BENTONITE AND ITS TEXTURAL AND ADSORPTION CHARACTERISTICS.....	104

A.N. Kopobayeva, G.G. Blyalova, A. Bakyt, V.S. Portnov, A. Amangeldikyzy THE NATURE OF RARE EARTH ELEMENTS ACCUMULATION IN CLAY LAYERS AND COALS OF THE SHUBARKOL DEPOSIT.....	117
A. Leudanski, Y. Apimakh, A. Volnenko, D. Zhumadullayev, N. Seitkhanov CALCULATION OF FLOTATOR'S AERATOR FOR SEPARATION OF GROUND PLASTICS.....	131
Zh.T. Mukayev, M.M. Ulykpanova, Zh.O. Ozgeldinova, B.E. Kenzheshova, A.B. Khamitova CONTENT OF COPPER IN DESERT SOILS AND PLANTS OF EAST KAZAKHSTAN REGION.....	149
G. Sapinov, A. Imashev, Z. Mukhamedyarova CURRENT STATE OF THE PROBLEM OF MINING INDUCED SEISMICITY AND PROSPECT OF USING SEISMIC MONITORING SYSTEMS.....	161
V.G. Stepanets, V.L. Levin, G.K. Bekenova, M.S. Khakimzhanov, K.S. Togizov ACCESSORY COPPER ORE MINERALS AS A KEY ISSUE IN UNDERSTANDING THE GENESIS OF THE MAYATAS META-CARBONATITE ORES (ULYTAU, CENTRAL KAZAKHSTAN).....	172
S.A. Syedina, L.S. Shamganova, N.O. Berdinova, G.B. Abdikarimova MULTIVARIANT GEOMECHANICAL ESTIMATION OF THE DESIGN PARAMETERS' STABILITY OF SLOPE AND BENCH IN SOUTH SARBAI MINE.....	192
S.A. Tarikhazer, I.I. Mardanov INDICATORS OF ECOGEOMORPHOLOGICAL RISK FOR THE PURPOSE OF SUSTAINABLE DEVELOPMENT OF MOUNTAIN TERRITORIES.....	204
Zh.T. Tleuova, D.D. Snow, M.A. Mukhamedzhanov, E.Zh. Murtazin ASSESSMENT OF THE IMPACT OF HUMAN ACTIVITY ON GROUNDWATER STATUS OF SOUTH KAZAKHSTAN.....	217

Ye.A. Tseshkovskaya, A.T. Oralova, E.I. Golubeva, N.K. Tsoy, A.M. Zakharov	
DUST SUPPRESSION ON THE SURFACES OF STORAGE DEVICE OF TECHNOGENIC MINERAL FORMATIONS.....	230
B.T. Uakhitova, L.I. Ramatullaeva, M.K. Imangazin, M.M. Taizhigitova, R.U. Uakhitov	
ANALYSIS OF INJURIES AND PSYCHOLOGICAL RESEARCHES OF WORKERS IN THE MELTING SHOPS OF THE AKTUBINSK FERRALOYS PLANT.....	242
G.T. Shakulikova, S.M. Akhmetov, A.N. Medzhidova, N.M. Akhmetov, Zh.K. Zaidemova	
IMPROVING THE DESIGN OF INCLINED WELLS AS THE BASIS FOR THE DEVELOPMENT OF HARD-TO-RECOVER HYDROCARBON RESERVES.....	259
K.T. Sherov, M.R. Sikhimbayev, B.N. Absadykov, T.K. Balgabekov, A.D. Zhakaba	
STUDY OF TEMPERATURE DISTRIBUTION DURING ROTARY TURNING OF WEAR-RESISTANT CAST IRON.....	271

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 19.04.2022.

Формат 70x90^{1/16}. Бумага офсетная. Печать – ризограф.

11,5 п.л. Тираж 300. Заказ 2.