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

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
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

6 (444)

NOVEMBER – DECEMBER 2020

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. Webof 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.

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Меншіктенуші: «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 және техникалық ғылымдар бойынша мақалалар жариялау.*

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Редакцияның мекенжайы: Қазақстан, 050010, Алматы қ., Қабанбай батыр көш., 69а.
Қ. И. Сәтбаев атындағы геология ғылымдар институты, 334 бөлме. Тел.: 291-59-38.

Типографияның мекенжайы: «NurNaz GRACE», Алматы қ., Рысқұлов көш., 103.

«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: *публикация статей по геологии и техническим наукам.*

Периодичность: 6 раз в год.
Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Адрес редакции: Казахстан, 050010, г. Алматы, ул. Кабанбай батыра, 69а.
Институт геологических наук им. К. И. Сатпаева, комната 334. Тел.: 291-59-38.

Адрес типографии: «NurNaz GRACE», г. Алматы, ул. Рыскулова, 103.

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: *publication of papers on geology and technical sciences.*

Periodicity: 6 times a year.
Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Editorial address: Institute of Geological Sciences named after K.I. Satpayev
69a, Kabanbai batyr str., of. 334, Almaty, 050010, Kazakhstan, tel.: 291-59-38.

Address of printing house: «NurNaz GRACE», 103, Ryskulov str, Almaty.

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 6, Number 444 (2020), 134 – 144 **https://doi.org/10.32014/2020.2518-170X.140**

UDC 504.45, 551.46
SRNTI 87.19

A. K. Kurbaniyazov[1], S. K. Berdibayeva[2], N. K. Mamutov[3], P. R. Reimov[3], K. A. Kosnazarov[3], E. U. Sagindykova[4]

[1]International Kazakh-Turkish University named after Khoja Akhmet Yassawi. Turkestan, Kazakhstan;
[2]Al-Farabi Kazakh National University, Almaty, Kazakhstan;
[3]Nukus Berdakh Karakalpak State University, Nukus, Uzbekistan;
[4]Sh. Esenov Caspian State University of Technology and Engineering, Aktau, Kazakhstan.
E-mail: kurbaniyazov@ayu.edu.kz, berdibayeva .sveta1@mail.ru,
mamutov@inbox.ru, reimov@mail.ru, k.03@mail.ru, elmira.s@mail.ru

SOME QUESTIONS STUDY OF DEFLATION PROCESSES AND SAND TRANSPORT IN THE DRAINED BOTTOM OF THE ARAL SEA

Abstract. The article discusses the results of the study of sandy deserts, which allowed us to obtain and reveal a number of important laws and mechanisms of formation, formation, movement and development of Aeolian landforms. The establishment of these patterns helps to solve a number of practical tasks to combat sand drifts in the sandy desert of various objects. In connection with the prospects for the development of this territory, it is very important to know the direction and intensity of the development of these processes. The obtained data on the mechanism and structure of the entire air-soil flow, starting from the moment of its formation, i.e. in the blowing zone, and ending with the transfer and deposition of soil particles by wind in the accumulation zone, make it possible to increase the level of scientific validity of the rational use of soil resources, as well as to take timely measures to protect the environment.

Key words: wind erosion, sand transport, Aeolian relief, deflation, mapping, relief, sand accumulation, sand desert, anthropogenic desertification.

Introduction. Relevance of the problem. The study of the influence of wind activity in the sandy desert is one of the most pressing problems of our time. Currently, this process is increasing due to climate changes and increased economic activity, which leads to rapidly changing environmental conditions in the ecosystems of sandy deserts.

The main terrain-forming factor in the sandy desert is wind activity, which leads to blowing, transferring and depositing sand. In practice, the transfer and deposition of sand leads to the formation of sand drifts, and blowing – to the exposure of the bases of various engineering structures and vegetation. Therefore, it is very important to know the direction and intensity of the development of these processes in the sandy desert. As a result of Aeolian processes that took place in sandy deserts for a long time, the original loose-sand layer was intertwined and dissected, and the modern Aeolian relief was formed, which acquired a certain wind-erosion stability over a large area and is in dynamic equilibrium. This is accompanied by a number of natural factors that cause overgrowth and compaction of the surface of Aeolian forms. A fairly persistent desert system can be disrupted. The reason for the violation of the natural balance may be a change in any natural factor or human economic activity. Released from the protective soil and vegetation cover, the loose sand mass under the influence of wind begins to move, and the process of active deflation begins. If this process occurs near economic objects, it is not difficult to imagine the consequences that it can lead to.

The surface of overgrown Aeolian forms under natural conditions (outside the influence of anthropogenic factors) has various degrees of deflation, but in General it is characterized by increased stability, which is caused by the presence of vegetation cover. The undifferentiated Aeolian relief is weakly exposed to natural deflation. For example, gently undulating Sands and mantle-like sand accumulations usually lack well-defined traces of removal, transfer, and accumulation of Aeolian material. The susceptibility to deflation of strongly dissected Aeolian forms is differentiated by terrain elements. Sandy ridge weakly breaks the lower part of the slopes and interbed lowering of the slopes due to the relatively dense vegetative composition, and bottoms, in addition, due to the greater content in sand dust particles and shallow occurrence of the primary little compacted sediments or groundwater, the local basis deflation. The tops of the ridges and the upper part of the slopes may show signs of deflation in the form of ulcers and raincoat-like accumulations of sand or even dunes. The process of deflation at the tops of ridges increases due to greater desiccation of soils and deeper wind influence [2,3,4].

Research methods. In the course of this work, we used methods of historical, engineering-geological, ecological and geographical analogues, methods of geobotanical indication, comparative morphological method of studying soil profiles, and others. Determination of morphology, granulometric composition, physical and chemical properties of soils was carried out in accordance with accepted methods in soil science. Statistical processing methods were used to analyze information accumulated in various areas in the form of various databases.

Discussion of results. The development of effective and economic measures to protect against sand drifts and blowing of economic objects is unthinkable without reliable information on the wind-erosion stability of the sandy surface.

Depending on the stage of design and construction of objects, the details of information will change. So, for a feasibility study (feasibility study) of the construction of an object, in which the important point is the choice of the location of its site or route, the characteristics of wind erosion resistance of sand should be for a significant area, but somewhat schematic, without fractional detailing of contours. The map scale should be small, of course.

When the locations of objects are determined (the stage of the technical project), it is impossible to do without a detailed study of the adjacent territory, without a large-scale map (scheme) that reflects all the variety of forms and intensity of deflation processes [1,2,7,19].

The practice of construction in the sand shows that active protective measures can be carried out only after the completion of the entire construction complex, when the original surface of the sand changes.

Most often, the option of studying the wind erosion resistance of the sand surface and drawing up a map (diagram) on an already built object is carried out. In this case, the developed classification and, accordingly, the map legend should take into account, in addition to the natural types of sand that reflect the natural process of Aeolian relief formation, also the anthropogenic forms (types) of sand surfaces formed as a result of construction work. These are so-called "technogenic Sands" [12,15,20].

An important point in mapping the wind erosion stability of sand is the development of a classification of wind erosion processes. Most researchers, when developing a classification of the relief of sandy deserts for mapping purposes, divide all Aeolian forms according to the degree of surface anchoring into two (overgrown and bare) or three (overgrown, semi-overgrown and bare) categories. In the latter classification, the category of semi-overgrown most often includes a barkhanno-bumpy complex, which is a transition stage from overgrown to overgrown or Vice versa. However, in the sandy desert, along with the three categories mentioned, there are a number of Aeolian forms whose sandy surface is at a stage of eroding or overgrowth that does not fit any of the categories mentioned. Meanwhile, it is very important to know the degree of substrate exposure, both for predicting the Aeolian process, and for developing specific measures to prevent it during economic development of the territory.

Classifications based only on geobotanical features do not allow us to fully determine the wind erosion state of the sandy surface. In this regard, along with the geobotanical method, the geomorphological method can be important, which can be used to study the intensity of deflation by the shape and mass of accumulating sand [5,10,11,17].

Since the accumulation of sand is the result of blowing and transferring its volume, it can serve as a criterion for the intensity of the process. Consequently, the larger the volume of accumulating sand, the more intense the deflation process. Thus, small accumulations of sand in the form of a raincoat on the overgrown surface of the Aeolian form can only indicate a weak deflation, and the presence of single dunes - more intense. At the same time, it should be assumed that in the desert, sand accumulation usually occurs in the immediate vicinity of the sources of removal. Exceptions are cases when Aeolian Sands are deposited on hard or compacted surfaces (takyrs, plateaus, salt marshes, etc.), where they acquire greater mobility. Sand is also transported over considerable distances in a wind regime characterized by the dominance of one direction. Such cases should be considered separately [3,8,10,11].

The presence of sand ripples is a sure sign of the process of sand transport over a bare or overgrown sandy surface to varying degrees. Only a well-drawn sandy surface with a dense shrub and especially grassy cover does not have obvious traces of sand ripples. However, it is impossible to talk about the absolute immobility of sand on overgrown Aeolian forms, since the dried-up surface horizon with a thickness of about 5 cm is devoid of sod that binds it, and some movement of the sand substrate occurs in strong winds. But for economic objects, this transfer is practically not dangerous.

The following classification of types of sandy surfaces according to the degree of exposure to deflation is proposed:

- No deflation - overgrown surface with no signs of sand ripples
- Deflation is weak – sand ripples and raincoat-like sand clusters without a characteristic ridge;
- Moderate deflation – sand ripples, raincoats, ridges and rare small (0.5-1.0 m) dune formations;
- Significant deflation – a combination of dunes and dune chains in combination with overgrown (more bumpy) forms;
- Deflation is strong, continuous – the presence of a bare dune field with individual plant specimens on inter-dune depressions.

The first type (no deflation) it is noted on overgrown weakly fragmented Aeolian formations, which usually form gently undulating Cumulus Sands and cloak-like sand clusters. The first and third are found mainly on the periphery of sandy massifs, and the second – on the edge of irrigated land, the banks of lakes and salt marshes. Under natural conditions, the overgrown sandy surface is not subject to deflation. However, if the upper sod layer is mechanically disturbed, deflation ulcers and accumulation of sand in the form of raincoats and even small dune forms can form on gently undulating Sands.

The second type (weak deflation) is most widely represented in the sandy desert. Typical for overgrown (slopes, peaks) and slightly overgrown (peaks) with varying degrees of dismemberment of ridge Sands and their combinations. The degree of exposure to deflation is differentiated by terrain elements. The lower part of the slopes and lower Aeolian forms are less susceptible to erosion, and the tops are more susceptible to erosion.

The third type (moderate deflation) is typical for poorly overgrown strongly dissected ridge Sands. Inter-ridge depressions and the lower parts of the slopes of the ridges are not subject to deflation. The tops and upper part of the slopes are heavily raked.

The fourth type (deflation) significant more often in his notes on undifferentiated Sands, sand-hilly complex. The degree of exposure to deflation is differentiated by types of terrain: continuous deflation is subject to dune forms, partially (weak) bumpy. Inter-barkhane depressions are mostly overgrown, the movement of barkhane forms is weak, more often there is only a rearrangement of ridges and an intensive transfer of sand in the form of a wind-sand stream.

The fifth type (strong, continuous deflation) includes sand dunes. The movement of sand material occurs in the form of wind-sand flow and the movement of Aeolian forms. In this type, two subtypes should be distinguished: barkhany Sands lying on a loose sandy substrate; barkhany Sands lying on dense rocks (takyrs, Shors, outcrops of bedrock, figures 1-2). The second subtype is characterized by greater mobility and, as a rule, worse growing conditions [2,6,7,11,12].

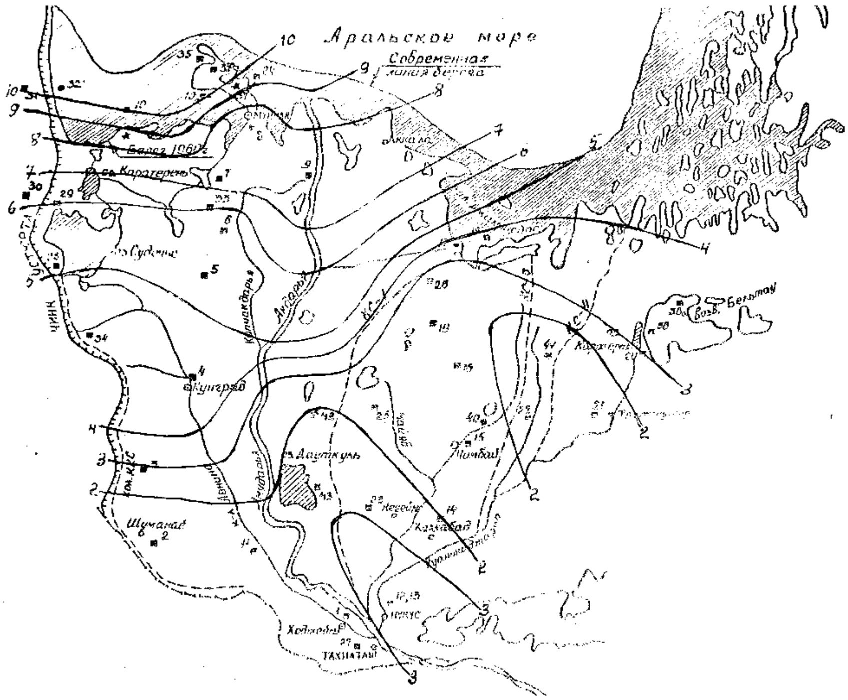

Figure 1 – Distribution of dry deposition of aerosols in the southern Aral sea, t/ha per year (2012-2016)

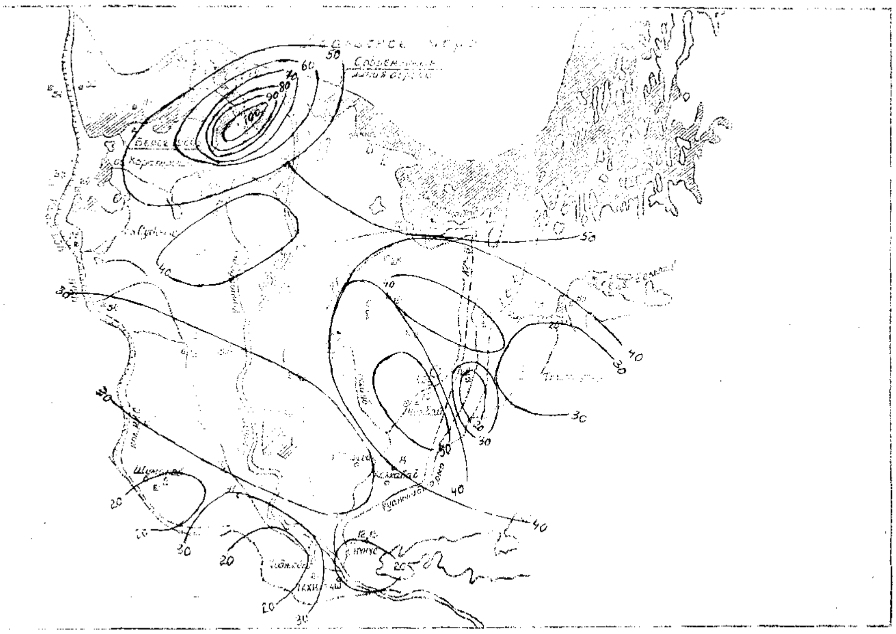

Figure 2 – The distribution of salt deposition from atmospheric dry aerosol in the southern Aral sea, kg/ha / year (2012-2016)

The latest research on this issue was conducted on 4 zones and the following data were obtained:

1) the zone of the drained bottom of the Aral sea for the stipulated period annually falls an average of 8-10 t/ha of dust and salt, of which their water-soluble salts range from 100 to 150 kg/ha.,

2) in the area of the Aral sea coast 7-8 t/ha and 70-100 kg/ha of salt,

3) in the non-irrigated zone 5-6 t/ha and 50-70 kg/ha

4) in the irrigated zone from 1.5-2.0 to 3.0-4.0 t/ha and, accordingly, salt from 20-30 to 40-50 kg/ha.

The composition of these aerosol precipitates is mainly dominated by sulfate and chloride, and less often by carbonate salts of calcium, magnesium, and sodium.The quantitative and qualitative composition of atmospheric precipitation significantly affects the normal growth, development and yield of numerous natural and cultivated plants, especially in the arid zone of the globe. In addition, this effect is also found in other biotic and abiotic environmental objects [5,9,10,11,13].

The analysis of precipitation shows that their quantitative assessment depends on the General regularities of natural and artificial processes.

The results of the analysis show that in the composition of dry aerosol precipitation, the General trend of water-soluble salts, depending on the intensive desalination of the former drained sea bottom, their accumulated amounts decreased by 1-2 or more times, and, conversely, the total amount of dry dust-salt precipitation increased by 2-3 or more times due to atmospheric phenomena and especially as a result of anthropogenic processes of drilling oil and gas operations, planning of the drained sea bottom for the purpose of phytomelioration or forest reclamation, etc. [4,6,7,9,16].

When studying and mapping types of sandy surfaces using the proposed method, it is possible to obtain the necessary characteristics of the intensity and direction of deflation processes in a particular territory. This will allow you to develop sound recommendations for the placement of objects, conduct a preliminary assessment of the need for protective measures, their locations and approximate volumes. For a broad and systematic study of deflation processes in the desert and drawing up maps that reflect with greater accuracy the distribution of various types of sandy surfaces, it is advisable to use satellite images and aerial photographs. This will significantly reduce the amount of expensive ground field work and time for mapping, as well as improve the quality of map material [14,16-18].

In the regional study and mapping of wind erosion stability of large territories for the purposes of economic development of the desert, it is necessary to highlight areas that are potentially resistant to deflation by their mechanical strength, determined mainly by the lithology of the initial deposits. They are favorable for the location of various objects.

According to the proposed classification, surfaces should be classified as areas that are not subject to deflation. In the drained bottom, such surfaces are represented by takyr outcrops, fragments of a clay Delta plain.

The development of protective measures at a specific site should be based on the results of studying and mapping the wind erosion resistance of sand on a larger scale. Here there is a large detail of the selected types of sand. In addition to the five types of sand surfaces identified above, various combinations, transition types, and subtypes can be contoured. In this mapping, the selected types of surface sand are grouped into two categories:

– sand that does not require fixing;
– sands that require fixing.

The first category includes the sand surface with a dense well-preserved turf or with a few ulcers of deflation. There is practically no sand transport formed here.

The second category should include surfaces with disturbed (varying degrees) sod with accumulation of sand from raincoats to dunes. Here, the number of types of sand surfaces identified reaches 8-9.

An important point in mapping the wind erosion resistance of a sandy surface for technical and economic purposes and for the development of protective measures is to determine the scale and area of the survey. Experience shows that for the first purposes, the scale of the map should not be less than 1:500,000, and the area is determined depending on the tasks and research program. To develop protective measures for a specific economic object, the survey scale should not be smaller than 1:20000 on linear objects (pipelines, roads, power lines), and on site - no smaller than 1:2000. If the area of the study area in the area of the projected site object allows, then the survey scale should be the largest, approaching the scale of the working drawing of the technical project as much as possible. This will also allow you to Express in scale all the planned protective measures (their type and parameters).

The mapped lane for linear items is determined by the length of the route, and the width is determined by the zone of influence, which, depending on the wind erosion state of the sand, can range from tens to hundreds of meters. The more uniform the sandy surface, the narrower the mapping band may be. The mapped area of a site object is also determined by the area of sand broken during construction [14,16].

The results of the study of wind erosion resistance of sand and the map compiled at the same time has a certain expiration date. After 5 years, they must be adjusted. Information on maps that characterize the wind-erosion state of the sandy surface allows you to plan the necessary protective measures with high confidence. However, they provide information about the quantitative side of the ongoing processes, which complicates the task of determining the width of the protective zone for objects with windward and leeward sides.

The intensity of the deflation processes, its quantitative characteristic is determined by post-processing of data of the wind regime observed at the stationary sites where deflationary processes are determined by instrumental fixation of the relief on the profiles, sites size of 1-2 ha, and also observed at quantifiable portable sand vetroresina thread.

In office conditions, the regime is subjected to a comprehensive analysis, since it is the wind that is the main relief-forming factor. The study of the wind regime of deserts is important for understanding the ongoing geomorphological processes and, in particular, for studying the processes of movement and accumulation of sand.

Currently, there are several methods for processing wind data. The simplest and most widely used method was Described by O. A. Drozdov (1957). The method suggests using the repeatability of wind directions (the number of cases) for 8 or 16 points and the average values of wind speeds for these points. Usually, a series of observations from 10 to 20 years is used to obtain stable data. The average values of wind speed, taking into account their direction, well reflect the General wind regime of a certain area, and allow you to identify the prevailing winds, i.e. those that can cause sand drifts and blowouts [3,17,20].

The considered method, as well as wind erosion maps, does not give a quantitative characteristic of the processes occurring. To some extent, the question of interest is solved by using not the average wind speeds and not the number of cases of winds of different points, but the sum of the wind speeds of certain points that cause sand transport. However, in this case, it is taken into account that sand material of various sizes begins to move only when the wind speed reaches a certain threshold value (table 1)

Table 1 – Start of sand movement depending on the size

№	Type of sand	Grain diameter, mm	Wind speed, m/s
1	Fine	0.1-0.25	4.5-6.7
2	Medium-grained	0.25-0.5	6.7-8.7
3	Coarse	0.5-1.0	9.8-11.4
4	Coarse grainy	1.0-2.0	11.4-13.0

We usually have materials for one-time observations per day of the wind direction and speed on the weather vane at an altitude of 10 m. Given the speed recorded by the weather vane is not identical to the wind speed at the surface (it is much lower at the earth's surface), the threshold ground speed is determined by calculation. It is proposed (Gvozdikov, 1966) for these purposes, the wind speed at a height of 10 cm above the dune surface is determined by the formula U10 = 0.475 U1000: over the sanded inter-dune takyrovidny decline by the formula U10 = 0.333 U1000; over a sand and pebble plain U10 = 0.333 U1000 . Here U1000 is the wind speed at an altitude of 10m [3,5,8].

For practical purposes, wind speeds greater than 5-6 m/s on the weather vane are taken as the threshold wind speed, since at these speeds sand grains begin to roll on the sand surface, and the wind speed itself at a height of 10 cm is 3.5-4 m/s.

Threshold speeds as mentioned above can be used to construct hodographs by the sum of cases or by the sum of speeds.

For a more visual graphical representation of the annual resulting wind activity, it is also possible to build hodographs that represent the vector sum of the number of cases of wind directions, deferred on a scale corresponding to the speed of each observed case, or the sum of the speeds for a certain observation period. This method has found application in practice. However, hodographs or wind roses based on the sum of active wind speeds or on the indicators of the resulting wind for a certain period give an idea of the wind regime of a particular area. They can only be used to judge the direction of the prevailing winds [3,4,8].

The order of construction of the hodograph is very simple and follows the sequence: 1) it is drawn from an arbitrary point corresponding to 1 January; 2) the direction and speed of wind are shown by segment (vector) emanating from the point in the direction the wind is blowing; the length of the vector is proportional to the observed wind speed in the adopted scale; 3) each subsequent (in order of observation) the case of sufficiently strong wind is also represented by a vector, the beginning of which coincides with the end of the previous. The result is a broken line, sometimes quite bizarre, reflecting successive changes in wind direction and speed.

The hodograph of this type gives a clear idea of the features of the wind regime: the longer the hodograph, the more active the wind; the more straight the hodograph line, the more pronounced the prevailing wind. A broken line indicates that the wind regime is unstable. Strong and stormy winds are well represented on the hodographs, and they are represented on the graph in longer segments.

Wind mode data processing is possible based on wind energy. Most researchers agree that the energy is proportional to the cube of speed. L. G. Dobrin (1965) for ease of use of the wind energy indicator suggests using coefficients that reflect the energy capacity of the wind of a particular speed, taking 4 m/s as a unit of the cube of wind speed [2].

Table 2 – Coefficients of wind energy increase (K) at different speeds (U)

№	U, м/с	K
1	5	2
2	6	3.4
3	7	5.4
4	8	8
5	9	11.4
6	10	15.6
7	11	21
8	12	27
9	13	34.4
10	14	43
11	15	53
12	16	64
13	17	77
14	18	94
15	19	113
16	20	125

Further data processing is performed according to the above method. However, they do not reflect the quantitative (m3/m) indicators of sand transport, but with high confidence indicate the direction of General sand transport by season [2 16,19, 20-25].

Currently, a number of methods have been proposed that allow us to obtain information about the quantitative transfer of sand by processing wind regime data. They will be discussed in detail below.

There are several ways to study deflationary processes that reflect the quantitative side of the process. Currently, the geodesic method is widely used. The essence of the method is that geodetic tools are used to monitor the dynamics of the terrain.

Depending on the purpose of the study (the study of General deflation processes, the dynamics of removal or accumulation, or only the movement of Aeolian forms), the survey using theodelite or level is performed once a year, once a season. When theodelite survey is selected characteristic area of 1-2 hectares. The angles of the characteristic sections are fixed by constant reference points. Large-scale site plans are a good material for comparative study of sand movement. When leveling, individual points of the profile are fixed. Based on the survey data, profiles of one point are drawn, which gives a fairly clear illustration of the ongoing changes in the structure of the relief [3,16,17,26,27].

Of the two considered geodetic methods for observing changes in the sand topography, the most complete information is provided by a planned survey of the sandy surface. The terrain plans reflect the overall displacement of the sand chains, the effect of lateral drift on the ridge displacements along the chain front, and the effect of vegetation on the overall course of terrain formation. Cross-section profiles are less informative. They only give an idea of the General displacement of the Aeolian relief. When solving the target task, it is advisable to combine both (methods) forms of observations on the same site, when the intervals between planned surveys are supplemented by measurements on profiles.

Conclusion. Thus, the paper shows the possibility of mapping and predicting the transformation processes of the newly formed sandy desert at various scales, and maps based on the classification of satellite images can serve as the basis for further detailed mapping of moving Sands using theodolite survey and other methods of topographic analysis of the terrain. The main content of medium – scale maps of deflationary transformation processes is showing the main characteristics of the sand transport process and mapping its intensity. It is in this capacity that they can be a really practical basis for detailed mapping, which is necessary both for sand protection works and for the design of engineering structures. The obtained data on the mechanism and structure of the entire air-soil flow, starting from the moment of its formation, i.e. in the blowing zone, and ending with the transfer and deposition of soil particles by wind in the accumulation zone, make it possible to increase the level of scientific validity of the rational use of soil resources, as well as to take timely measures to protect the environment.

А. К. Курбаниязов[1], С. К. Бердибаева[2], Н. К. Мамутов[3], П. Р. Реймов[3], К. А. Косназаров[3], Э. У. Сагиндыкова[4]

[1]Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Түркістан, Қазақстан;
[2]Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан;
[3]Қарақалпақ мемлекеттік университеті, Нүкіс, Өзбекстан;
[4]Ш. Есенов атындағы Каспий мемлекеттік технологиялар және инжиниринг университеті, Ақтау, Қазақстан

ДЕФЛЯЦИЯЛЫҚ ПРОЦЕСТЕРДІ ЖӘНЕ АРАЛ ТЕҢІЗІНІҢ ҚҰРҒАҒАН ТАБАНЫНДАҒЫ ҚҰМ ТАСЫМАЛДАУДЫ ЗЕРТТЕУДІҢ КЕЙБІР МӘСЕЛЕЛЕРІ

Аннотация. Мақалада құмды шөлді зерттеу нәтижелері қарастырылады, бұл эолалы рельеф формаларын қалыптастыру, жылжыту және дамытудың бірқатар маңызды заңдылықтары мен механизмдерін алуға және ашуға мүмкіндік берді. Заңдылықтарды орнату түрлі объектілердің құмды шөлдегі боранмен күресудің бірқатар практикалық мәселелерін шешуге ықпал етеді. Осы аумақтың даму перспективаларына байланысты аталған процестер бағыты мен қарқындылығын білу өте маңызды. Құмды шөлдегі жел қызметінің әсерін зерттеу қазіргі заманның өзекті мәселелерінің бірі болып саналады. Қазіргі уақытта бұл процесс климаттың өзгеруіне және экономикалық қызметтің ұлғаюына байланысты күшейе түсуде, бұл құмды шөл экожүйесінде жылдам өзгеретін экологиялық жағдайға әкеледі.

Құмды шөлдегі рельефті құрайтын негізгі фактор – желдің белсенділігі, бұл құмды үрлеп, тасымалдап әрі тұндырады. Іс жүзінде құмды тасымалдау және тұндыру құмды шөгіндінің пайда болуына, ал үрлеу түрлі инженерлік құрылымдар мен өсімдік негізін ашуға әкеледі. Сондықтан құмды шөлде аталған процестер бағыты мен қарқындылығын білу өте маңызды.

Құмды шөлде ұзақ уақыт бойы жүретін эолды процесс нәтижесінде бастапқы борпылдақ құм қабаты қайта өңделіп, бөлініп, эолды рельеф пайда болды, ол айтарлықтай аймақта белгілі бір жел эрозиясы тұрақты және динамикалық тепе-теңдікте болды. Бұл эол формаларының беткі қабатының өсуі мен тығыздалуын анықтайтын бірқатар табиғи факторлармен бірге жүреді. Шөлдің тұрақты жүйесінің бұзылуы мүмкін. Табиғи тепе-теңдіктің бұзылуының себебі кез-келген табиғи фактордың өзгеруі немесе адамның экономикалық белсенділігі себебінен болуы мүмкін. Қорғаныш топырақ – өсімдік жамылғысының астынан босатылған борпылдақ құм массасы жел әсерінен қозғалады, белсенді дефляция процесі басталады. Егер бұл процесс экономикалық объектілердің жанында пайда болса, оның салдарын да болжауға болады.

Жұмысты орындау барысында тарихи, инженерлік-геологиялық, экологиялық және географиялық ұқсастық, геоботаникалық индикациялау, топырақ пішінін зерттеудің салыстырмалы-морфологиялық әдісін және т.б. пайдаландық. Топырақ морфологиясын, гранулометриялық құрамын, физика-химиялық және химиялық қасиеттерін анықтау топырақ ғылымында қабылданған әдістерге сәйкес жүргізілді. Әртүрлі мәліметтер базасы түрінде бағыттар бойынша жинақталған ақпаратты талдау үшін статистикалық өңдеу әдістері қолданылды.

Дефляциялық процестердің қарқындылығы, оның сандық сипаттамасы жел режимінің деректерін камеральық өңдеу, дефляциялық процестер рельефті профильдерде көлемі 1-2 га алаңда аспаптық бекіту жолымен

айқындалатын стационарлық учаскеде байқау ұйымдастыру, сондай-ақ жел құм ағынында тасымалданатын құмды сандық есепке алу бойынша байқау ұйымдастыру жолымен айқындалады.

Камералық жағдайда режим жан-жақты талдаудан өтеді, өйткені бұл рельефтің негізгі факторы – жел. Шөлдің жел режимін зерттеу геоморфологиялық процестерді түсіну үшін, әсіресе, құмның жиналу процесін зерттеу үшін де маңызды.

Талдау нәтижелері құрғақ аэрозоль құрамында суда еритін тұздың жалпы тенденциясы, жиналған мөлшердің бұрынғы құрғатылған теңіз түбінің қарқынды тұздануына байланысты 1-2 және одан да көп есе азайғанын және керісінше, құрғақ шаң-тұз түсімінің атмосфералық құбылыстардың, әсіресе мұнай-газ жұмыстарын бұрғылаудың, фитомелиорациялық немесе орман мелиорациялық жұмыстарды жүргізу мақсатында құрғатылған теңіз түбін жоспарлаудың және т. б. салдарынан 2-3 және одан да көп есе артқанын көрсетеді.

Түйін сөздер: жел эрозиясы, құмды тасымалдау, эол рельефі, дефляция, картаға түсіру, рельеф, құмды жинақтау, құмды шөл, антропогенді шөлейттену.

А. К. Курбаниязов[1], С. К. Бердибаева[2], Н. К. Мамутов[3], П. Р. Реймов[3], К. А. Косназаров[3], Э. У. Сагиндыкова[4]

[1]Международный казахско-турецкий университет им. Х.А. Яссави, Туркестан, Казахстан;
[2]Казахский национальный университет им. аль-Фараби, Алматы, Казахстан;
[3]Каракалпакский государственный университет им. Бердаха, Нукус, Узбекистан;
[4]Каспийский государственный университет технологий и инжиниринга им. Ш. Есенова, Актау Казахстан

НЕКОТОРЫЕ ВОПРОСЫ ИЗУЧЕНИЯ ДЕФЛЯЦИОННЫХ ПРОЦЕССОВ И ПЕРЕНОСА ПЕСКА ОСУШЕННОГО ДНА АРАЛЬСКОГО МОРЯ

Аннотация. В статье рассматриваются результаты исследования песчаных пустынь, которые позволили получить и раскрыть ряд важных закономерностей и механизмов формирования, образования, передвижения и развития эоловых форм рельефа. Установление этих закономерностей помогает решить ряд практических задач по борьбе с песчаными заносами в песчаной пустыне различных объектов. В связи с перспективами освоения этой территории очень важно знать направленность и интенсивность развития упомянутых процессов. Изучение влияния ветровой деятельности в песчаной пустыне является одним из актуальных проблем современности. В настоящее время этот процесс, в связи с климатическими изменениями и увеличением хозяйственной деятельности, усиливается, что приводит к быстроизменяющимся экологическим условиям в экосистемах песчаных пустынь.

Главным рельефообразующим фактором в песчаной пустыне является ветровая деятельность, приводящая к выдуванию, переносу и отложению песка. На практике перенос и отложение песка приводят к образованию песчаных заносов, а выдувание – к обнажению оснований различных инженерных сооружений и растительности. Поэтому очень важно знать направленность и интенсивность развития упомянутых процессов в песчаной пустыне.

В результате эоловых процессов, протекающих в песчаных пустынях в течение длительного времени, перевивалась и расчленялась исходная рыхлопесчаная толща и формировался современный эоловый рельеф, который на значительной площади приобрел определенную ветроэрозионную устойчивость и находится в динамическом равновесии. Этому сопутствуют ряд природных факторов, обусловливающих зарастание и уплотнение поверхности эоловых форм. Довольно стойкая система пустыни может быть нарушена. Причиной нарушения природного равновесия может стать изменение какого-либо природного фактора или хозяйственная деятельность человека. Освободившаяся из-под защитного почвенно-растительного покрова рыхлопесчаная масса под воздействием ветра приходит в движение, начинается процесс активной дефляции. Если этот процесс возникает вблизи хозяйственных объектов, то нетрудно представить последствия, к которым он может привести.

В ходе выполнения данной работы мы использовали методы исторических, инженерно-геологических, экологических и географических аналогов, методы геоботанической индикации, сравнительно-морфологический метод изучения почвенных профилей и другие. Определение морфологии, гранулометрического состава, физико-химических и химических свойств почв проводили в соответствии с принятыми в почвоведении методиками. Для анализа информации, накапливаемой по различным направлениям в форме различных баз данных, использовались методы статистической обработки.

Интенсивность дефляционных процессов, ее количественная характеристика определяется путем камеральной обработки данных ветрового режима, организацией наблюдений на стационарных участках, где

дефляционные процессы определяются инструментальным путем фиксирования рельефа на профилях, площадках размером 1-2 га, а также организацией наблюдений по количественному учету переносимого песка в ветропесчаном потоке.

В камеральных условиях всесторонному анализу подвергается режим, так как именно ветер является основным рельефообразующим фактором. Изучение ветрового режима пустынь является важным для понимания протекающих геоморфологических процессов и, в особенности для изучения процессов движения и накопления песков.

Результаты анализа свидетельствуют, что в составе сухих аэрозольных выпадений общая тенденция водноарастворимых солей, в зависимости от интенсивного рассоления бывшего осушенного дна моря аккумулируемых их количества уменьшилась на 1-2 и более раза, и, наоборот, общее количество сухих пыле-солевых выпадений увеличилось в 2-3 и более раза за счет атмосферных явлений и особенно в результате антропогенных процессов бурения нефтегазовых работ, планировки осушенного дна моря в целях проведения фитомелиоративных или лесомелиоративных работ и т.д.

Ключевые слова: ветровая эрозия, перенос песка, эоловый рельеф, дефляция, картографирование, рельеф, аккумуляция песка, песчаная пустыня, антропогенное опустынивание.

Information about the authors:

Kurbaniyazov A.K., cand.g.s., Professor, International Kazakh-Turkish University named Khoja AkhmetYassawi. Turkestan, Kazakhstan; kurbaniyazov@ayu.edu.kz; https://orcid.org/0000-0002-2983-6763

Berdibayeva S.K., doc.psy.s., Professor, Al-Farabi Kazakh national university, Almaty, Kazakhstan; berdibayeva .sveta1@mail.ru; https://orcid.org/0000-0001-6716-3080

Mamutov N.K., cand.b.s., Nukus Berdakh Karakalpak state University, Nukus, Uzbekistan; mamutov@inbox.ru; https://orcid.org/0000-0003-1114-2728

Reimov P.R., cand.b.s., Nukus Berdakh Karakalpak state University, Nukus, Uzbekistan; reimov@mail.ru; https://orcid.org/0000-0001-8749-6368

Kosnazarov K.A., cand.ag.s., Nukus Berdakh Karakalpak state University, Nukus, Uzbekistan; k.03@mail.ru; https://orcid.org/0000-0003-4007-4760

Sagindykova E.U., cand.p.s., Sh. Esenov Caspian state University of technology and engineering, Aktau, Kazakhstan; elmira.s@mail.ru; https://orcid.org/0000-0003-2483-5937

REFERENCES

[1] Kurbaniyazov A.K. et.al. Research of transformation of biogenous elements in water ecosystems of the southern Aral Sea area // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Agricultural Sciences. ISSN 2224-526X. Vol. 3, N 51 (2019), 33-36. https://doi.org/10.32014/2019.2224-526X.32

[2] Gvozlikov A.V. Some questions of theory and practice of fixing and afforestation of Central Asian Sands Tr. Tatshi, 1966.

[3] Abdimutalip N.A., Toychibekova G.B., Kurbanyazov S.K. Study of the bio containers of optimal composition to improve the growth and development of plants // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Agricultural Sciences. ISSN 2224-526X. Vol. 2, N 50 (2019), 94-98. https://doi.org/10.32014/2019. 2224-526X.24

[4] Dobrin L.G. Basic laws of barkhana dynamics and their practical significance Ashkhabad, 1965.

[5] Drozlov O.A. Methods of quantitative processing of meteorological observations. L. Gidrometeoizdat. 1957.

[6] Zolotkrylin A.N. climate desertification. M.: Nauka. 2003. 246 p.

[7] Kosnazarov K.A., Razakov R.M. Processes of salt formation and Aeolian transport in the Aral sea region . Nukus. "Karakalpakstan". 1991. 96 p.

[8] Kuzmina Zh.V., Treshkin S.E., Mamutov N.K. Influence of climate change and irrigation on vegetation formation by experimental means in the dried-up part of the Aral sea // Arid ecosystems. 2004. Vol. 9, N 21. P. 82-94.

[9] Kuzmina Zh.V., Treshkin S.E., Mamutov N. K. Results of experimental formation of natural vegetation on saline lands of the dried-up part of the Aral sea // Arid ecosystems. 2006. Vol. 12, N 29. P. 27-39.

[10] Kuzmina Zh.V., Treshkin S.E. Climate changes in the Aral sea region and Central Asia // Arid ecosystems. 2016. Vol. 22, N 4 (69). P. 5-20.

[11] Matchanov A.T, Kosnazarov K.A., orazbaev T.Zh. On the state of environmental protection measures in the southern Aral sea region // Bulletin of Koonras. 2005. N 3. P. 12-13.

[12] Matchanov A.T., kosnazarov K.A. and others. Current recommendations for preventing the negative effects of dust and salt deposition on biotic and abiotic objects in the southern Aral sea region. Nukus. Bilim. 2005. 64 p.

[13] Orlova M.A. the role of the Aeolian factor in the salt regime of the territory. Alma ATA. Nauka. 1983. 233 p.

[14] Petrov M.P., Deserts of the earth Schara. L. Science. 1973. 435 p.

[15] Razakov R.M. Aral and the Aral sea region. Problems and solutions. T.: Mehnat. 1992. 170 p.

[16] Kurbaniyazov S., Abdimutalip N., et all (2017) Main Properties of Zeolites and their Multipurpose Application // News of the National Academy of Sciences of the Republic of Kazakhstan Series of Geology And Technical Sciences. ISSN 2224-5278. Vol. 5, N 425, 244-248.

[17] Abdimutalip N., et all (2015) Salinization of Construction Materials and Way Prevention of this Process // Bulletin of the National Academy of Sciences of the Republic of Kazakhstan. Issue 6. P. 110-113.

[18] Toychibekova G., et all (2015) The effect of Industrial Wastes of Ecotoxicants in the Soil System // Bulletin of National Academy of Sciences of the Republic of Kazakhstan. ISSN 1991-3494. Vol. 2, N 354, 167-171.

[19] Toychibekova G., et all (2016) Physical and Chemical Properties of the Studied Soils of the Turkestan Region // Bulletin of the National Academy of Sciences of the Republic of Kazakhstan. Issue 2. P. 39-43.

[20] Reimov P.R. Geoecological mapping of the southern Aral sea region based on satellite images // Bulletin of the CMT Academy of Sciences of Uzbekistan. 2005. N 3. P. 134-138.

[21] Reimov P.R. the phenomenon of geoecological interference and its indicative and environmental significance // Bulletin of the CMT Academy of Sciences of Uzbekistan. 2005. N 3. P. 112-138.

[22] Reimov P.R., Mamutov N.K., Abdireymov S.Zh., Statov V.A., Kapustin G.A. Indicative significance of micro-focal processes for early detection of ecosystem transformation trends // In: proceedings of the international conference "Use of geographical information systems and simulation models for research and decision-making in the river basins of Central Asia". Tashkent, 2004. P. 155-156.

[23] Tileumuratova B.S. influence of salt and dust transfer on sedimentation in the Aral sea region. Arid ecosystems. 2009. Vol. 29, N 3 (39). P. 29-33.

[24] Chepil V.S. Physics of wind erosion and the fight against it / V.S. Chepil, N.P. Woodruff // advances in agronomy, 1963. St. 15. P. 211-302.

[25] Monica G. Turner, Robert H. Gardner quantitative methods in landscape ecology: analysis and interpretation of landscape heterogeneity. Jumper. New York, 1994. 536 p.

[26] The degree of anthropogenic soil degradation / L.R. Oldeman [et al.] // In the book: World map of the state of anthropogenic soil degradation. Wageningen, 1991. Proceedings of the 16th world Congress of soil scientists. Montpellier, 20-26/08/1998.

[27] Abdimutalip N.A., Toychibekova G.B. and.oth. (2015) Salinization of construction materials and way prevention of this process // Bulletin of the National Academy of Sciences of the Republic of Kazakhstan, 2015. Issue 6. P. 110-113.

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 сайте:

www:nauka-nanrk.kz

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

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

Редакторы *М. С. Ахметова, Д. С. Аленов, А. Ахметова*
Верстка *Д. А. Абдрахимовой*

Подписано в печать 15.12.2020.
Формат 70х881/8. Бумага офсетная. Печать – ризограф.
17,6 п.л. Тираж 300. Заказ 6.

Национальная академия наук РК
050010, Алматы, ул. Шевченко 28, т. 272-13-19, 272-13-18