

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

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ  
Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

# Х А Б А Р Л А Р Ы

---

---

## ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК  
РЕСПУБЛИКИ КАЗАХСТАН  
Казакский национальный исследовательский  
технический университет им. К. И. Сатпаева

## NEWS

OF THE ACADEMY OF SCIENCES  
OF THE REPUBLIC OF KAZAKHSTAN  
Kazakh national research technical university  
named after K. I. Satpayev

**SERIES  
OF GEOLOGY AND TECHNICAL SCIENCES**

**3 (435)**

**MAY – JUNE 2019**

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.*

Б а с р е д а к т о р ы  
э. ғ. д., профессор, ҚР ҰҒА академигі

**И.К. Бейсембетов**

Бас редакторының орынбасары

**Жолтаев Г.Ж.** проф., геол.-мин. ғ. докторы

Р е д а к ц и я а л қ а с ы:

**Абаканов Т.Д.** проф. (Қазақстан)  
**Абишева З.С.** проф., академик (Қазақстан)  
**Агабеков В.Е.** академик (Беларусь)  
**Алиев Т.** проф., академик (Әзірбайжан)  
**Бакиров А.Б.** проф., (Қырғыстан)  
**Беспәев Х.А.** проф. (Қазақстан)  
**Бишимбаев В.К.** проф., академик (Қазақстан)  
**Буктуков Н.С.** проф., академик (Қазақстан)  
**Булат А.Ф.** проф., академик (Украина)  
**Ганиев И.Н.** проф., академик (Тәжікстан)  
**Грэвис Р.М.** проф. (АҚШ)  
**Ерғалиев Г.К.** проф., академик (Қазақстан)  
**Жуков Н.М.** проф. (Қазақстан)  
**Қожахметов С.М.** проф., академик (Қазақстан)  
**Конторович А.Э.** проф., академик (Ресей)  
**Курскеев А.К.** проф., академик (Қазақстан)  
**Курчавов А.М.** проф., (Ресей)  
**Медеу А.Р.** проф., академик (Қазақстан)  
**Мұхамеджанов М.А.** проф., корр.-мүшесі (Қазақстан)  
**Нигматова С.А.** проф. (Қазақстан)  
**Оздоев С.М.** проф., академик (Қазақстан)  
**Постолатий В.** проф., академик (Молдова)  
**Ракишев Б.Р.** проф., академик (Қазақстан)  
**Сейтов Н.С.** проф., корр.-мүшесі (Қазақстан)  
**Сейтмуратова Э.Ю.** проф., корр.-мүшесі (Қазақстан)  
**Степанец В.Г.** проф., (Германия)  
**Хамфери Дж.Д.** проф. (АҚШ)  
**Штейнер М.** проф. (Германия)

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

**ISSN 2518-170X (Online),**

**ISSN 2224-5278 (Print)**

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

Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде  
30.04.2010 ж. берілген №10892-Ж мерзімдік басылым тіркеуіне қойылу туралы куәлік.

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/>

---

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2019

Редакцияның Қазақстан, 050010, Алматы қ., Қабанбай батыра көш., 69а.

мекенжайы: Қ. И. Сәтбаев атындағы геология ғылымдар институты, 334 бөлме. Тел.: 291-59-38.

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

Г л а в н ы й р е д а к т о р  
д. э. н., профессор, академик НАН РК

**И. К. Бейсембетов**

Заместитель главного редактора

**Жолтаев Г.Ж.** проф., доктор геол.-мин. наук

Р е д а к ц и о н н а я к о л л е г и я:

**Абаканов Т.Д.** проф. (Казахстан)  
**Абишева З.С.** проф., академик (Казахстан)  
**Агабеков В.Е.** академик (Беларусь)  
**Алиев Т.** проф., академик (Азербайджан)  
**Бакиров А.Б.** проф., (Кыргызстан)  
**Беспаяев Х.А.** проф. (Казахстан)  
**Бишимбаев В.К.** проф., академик (Казахстан)  
**Буктуков Н.С.** проф., академик (Казахстан)  
**Булат А.Ф.** проф., академик (Украина)  
**Ганиев И.Н.** проф., академик (Таджикистан)  
**Грэвис Р.М.** проф. (США)  
**Ергалиев Г.К.** проф., академик (Казахстан)  
**Жуков Н.М.** проф. (Казахстан)  
**Кожаметов С.М.** проф., академик (Казахстан)  
**Конторович А.Э.** проф., академик (Россия)  
**Курскеев А.К.** проф., академик (Казахстан)  
**Курчавов А.М.** проф., (Россия)  
**Медеу А.Р.** проф., академик (Казахстан)  
**Мухамеджанов М.А.** проф., чл.-корр. (Казахстан)  
**Нигматова С.А.** проф. (Казахстан)  
**Оздоев С.М.** проф., академик (Казахстан)  
**Постолатий В.** проф., академик (Молдова)  
**Ракишев Б.Р.** проф., академик (Казахстан)  
**Сейтов Н.С.** проф., чл.-корр. (Казахстан)  
**Сейтмуратова Э.Ю.** проф., чл.-корр. (Казахстан)  
**Степанец В.Г.** проф., (Германия)  
**Хамфери Дж.Д.** проф. (США)  
**Штейнер М.** проф. (Германия)

«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 и архивов Министерства культуры и информации Республики Казахстан №10892-Ж, выданное 30.04.2010 г.

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://nauka-nanrk.kz/geology-technical.kz>

---

© Национальная академия наук Республики Казахстан, 2019

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

E d i t o r i n c h i e f

doctor of Economics, professor, academician of NAS RK

**I. K. Beisembetov**

Deputy editor in chief

**Zholtayev G.Zh.** prof., dr. geol-min. sc.

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

**Abakanov T.D.** prof. (Kazakhstan)  
**Abisheva Z.S.** prof., academician (Kazakhstan)  
**Agabekov V.Ye.** academician (Belarus)  
**Aliyev T.** prof., academician (Azerbaijan)  
**Bakirov A.B.** prof., (Kyrgyzstan)  
**Bespayev Kh.A.** prof. (Kazakhstan)  
**Bishimbayev V.K.** prof., academician (Kazakhstan)  
**Buktukov N.S.** prof., academician (Kazakhstan)  
**Bulat A.F.** prof., academician (Ukraine)  
**Ganiyev I.N.** prof., academician (Tadjikistan)  
**Gravis R.M.** prof. (USA)  
**Yergaliev G.K.** prof., academician (Kazakhstan)  
**Zhukov N.M.** prof. (Kazakhstan)  
**Kozhakhmetov S.M.** prof., academician (Kazakhstan)  
**Kontorovich A.Ye.** prof., academician (Russia)  
**Kurskeyev A.K.** prof., academician (Kazakhstan)  
**Kurchavov A.M.** prof., (Russia)  
**Medeu A.R.** prof., academician (Kazakhstan)  
**Muhamedzhanov M.A.** prof., corr. member. (Kazakhstan)  
**Nigmatova S.A.** prof. (Kazakhstan)  
**Ozdoev S.M.** prof., academician (Kazakhstan)  
**Postolatii V.** prof., academician (Moldova)  
**Rakishev B.R.** prof., academician (Kazakhstan)  
**Seitov N.S.** prof., corr. member. (Kazakhstan)  
**Seitmuratova Ye.U.** prof., corr. member. (Kazakhstan)  
**Stepanets V.G.** prof., (Germany)  
**Humphery G.D.** prof. (USA)  
**Steiner M.** prof. (Germany)

**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 periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 10892-Ж, issued 30.04.2010

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://nauka-nanrk.kz/geology-technical.kz>

---

© National Academy of Sciences of the Republic of Kazakhstan, 2019

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: 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 3, Number 435 (2019), 225 – 230

<https://doi.org/10.32014/2019.2518-170X.89>

UDC 622.831.322

**R. Khojaye<sup>1</sup>, R. Gabaidullin<sup>1</sup>, S. Lis<sup>2</sup>, Sh. Shapalov<sup>3</sup>, N. Medeubayev<sup>4</sup>, G. Ivahnuk<sup>5</sup>**<sup>1</sup>GeoMark Research Center, Karaganda, Kazakhstan,<sup>2</sup>The Institute For Comprehensive Development Of Underground Resources LLP, Karaganda, Kazakhstan,<sup>3</sup>Silkway international university, Shymkent, Kazakhstan,<sup>4</sup>Karaganda State technical university, Karaganda, Kazakhstan,<sup>5</sup>Petersburg State Institute of Technology (Technical University), Saint-Petersburg, Russian Federation.

E-mail: khodzhayev.rustam@bk.ru, gabaydullin.ravgat@bk.ru, lis.sergey.2018@bk.ru,

shermahan\_1984@mail.ru, nmedeubayev@bk.ru, ivakhnyukg@list.ru

**REGULARITIES OF ROCK PRESSURE DISTRIBUTION  
UNDER SAFETY PILLARS AND COAL STRATUM EDGES**

**Abstract.** The development of formation formations leads to the formation of a large number of zones of high rock pressure (HRP) in the thickness of rocks, formed by the influence of the reference pressure of the boundary parts of the massif and the pillar left on the adjacent layers. The presence of HRP zones sharply worsens the condition and preparatory workings of capital in the development of the Suite of layers. The article presents the results of the analysis of the observations in the areas of underground workings of coal mines of the Karaganda coal basin, located under the pillar and the regional parts of the overlying coal seams. The results of the studies showed that in all the workings in which observations were carried out, the height of the work site located under the whole (the regional part) varies wavelike. In the result of the analysis proved the wave nature of the stationary reference pressure and the regularities of its distribution under the pillars and boundary parts of coal seams.

**Key words:** bearing pressure, coal target, edge part of coal seam, zone of increased rock pressure, formation, preparatory development, harmonic process.

**Introduction.** It is known that the rock pressure changes gradually in areas adjacent to stratum edge (Webber wave). It's most comprehensively studied in [1] for areas adjacent to breaking face. Another study, [2], notes that the kinetics of front abutment pressure forms in a wave shape. These studies have demonstrated that the abutment pressure has an undular profile with developed periodic sequence of elevated and reduced front abutment pressure zones.

Reference [3] studies the undular nature of abutment pressure under safety pillars and stratum edges, revealing the damped sinusoid pressure pattern along the stratum proportional to distance from the source of abutment pressure.

**Material and Methods.** The analysis of these studies shows that the formation of abutment pressure has a periodic nature (damped sinusoid). The acoustic studies show that the periodic process (whether damped or continuous) can never be the result of interfering, nonlinearity of medium, dispersion or frequency dependence of whatever nature. All these processes and features of medium may cause nonlinear distortions, generate harmonic oscillations, but may never actually generate oscillations, which requires separate oscillatory system [4].

All natural sciences, as acoustics, mechanics, electrodynamics, nuclear physics deal with oscillations. The physical nature of oscillatory processes varies widely, e.g. the oscillations of a railway bridge and the oscillations in a LC contour are of completely different nature. However even a brief study of these oscillations reveals that they have much in common. Detailed analysts shows that the oscillatory processes we observe follow the major common rules regardless of their nature [5]. This raises the question: to what extent the oscillatory process generated by the abutment pressure corresponds to the common laws of oscillatory theory, acoustics in particular.

As per acoustic data the oscillatory systems of coal stratum are uniform plane parallel lithologic units. Such resonating layers comprising of bounding lithologic units - limestone, sandstone, siltite, argyllite - are the half-wave longitudinal thickness-shear resonators, so that

$$h = \lambda/2 = V_{\phi}/2f_0,$$

where  $h$  - thickness of resonating layer;  $\lambda$  - medium specific wave length;  $V_{\phi}$  - characteristic frequency of resonator layer;  $f_0$  - phase velocity of compression waves.

The coal, combustible shale or liquid strata are non-resonating layers. Such non-resonating layers being merely a sound wave guide in carbonaceous rock does not distort the spectral composition of the echo of impact force applied to resonator layers.

The geoacoustic measurements use the ability of coal stratum (non-resonating layer) to acoustically decouple resonating layers located to both sides of it (top rock and bedrock). This decoupling ability allows differentiating top rock and bedrock echoes during acoustic investigation, thus making it possible to separately study features of top and bedrock.

Acoustic features of resonating layer determine the following:

- its surface oscillability;
- the amplitudes distribution over the surface of resonating layer;
- spatial distribution of own oscillations.

When applied to abutment pressure propagating under the safety pillars and stratum edges these stipulations are transformed into the following:

1) the resonating layers are presented by strong rock types (limestone, sandstone, slitstone), because the coal layer and other incompetent layers, being porous and fractures, adsorb rock pressure by inelastic deformation thus being unable to resonate.

2) coal layer and other incompetent layers do not add anything to the qualitative representation of distribution of abutment pressure due to their non-resonating nature;

3) the features of resonating layer (sandstone, slitstone) define distribution of oscillation amplitudes and their spatial distribution along the layer;

4) the wavelength of periodic process caused by redistribution of abutment pressure in resonating layer is defined routinely by the equation applicable to any halfwave P-wave resonator:

$$\lambda/2 = h_{c.p.}$$

where  $h_{c.p.}$  - thickness of resonating layer, meters.

**Results and discussion.** Studies confirm these hypotheses. Wherever elevated rock pressure were observed it showed wave nature. The comparison of half wave length of abutment pressure  $\lambda/2$  with the thickness of top rock  $h_{o.k.}$  located over the mine showed direct dependence (figure 1) corresponding to the following equation:

$$\lambda/2 = h_{o.k.}$$

The intensity of manifestation of abutment pressure depends on the following factors: the thickness of rock layer located between the mine and influencing layer  $h_m$  and extracted thickness of influencing layer  $m_g$ . Here the extracted thickness of influencing layer defines the mass of rock supported by coal safety pillar or stratum edge. The more the thickness, the more rock is supported by safety pillar or mine edge and more severely the abutment pressure manifest. This is why it is reasonable to use the comprehensive value of the distance from the excavation to the source of abutment pressure - overworking index  $K_H$ :

$$K_H = h_m/m_g$$

Using this value and basing on the observations it is possible to find the dependence of the angles formed by the line connecting the border of the crests of the wave with the edge of safety pillar (stratum edge) and the plane of the influencing layer on the distance from the source of the reference pressure is determined (figure 2). This dependence shows the wave nature of abutment pressure. The waves spread from the source of abutment pressure in the depth of rock. However the elevated rock pressure is observed only in areas corresponding to crests of such waves. This is clearly seen on the curve, figure 3.

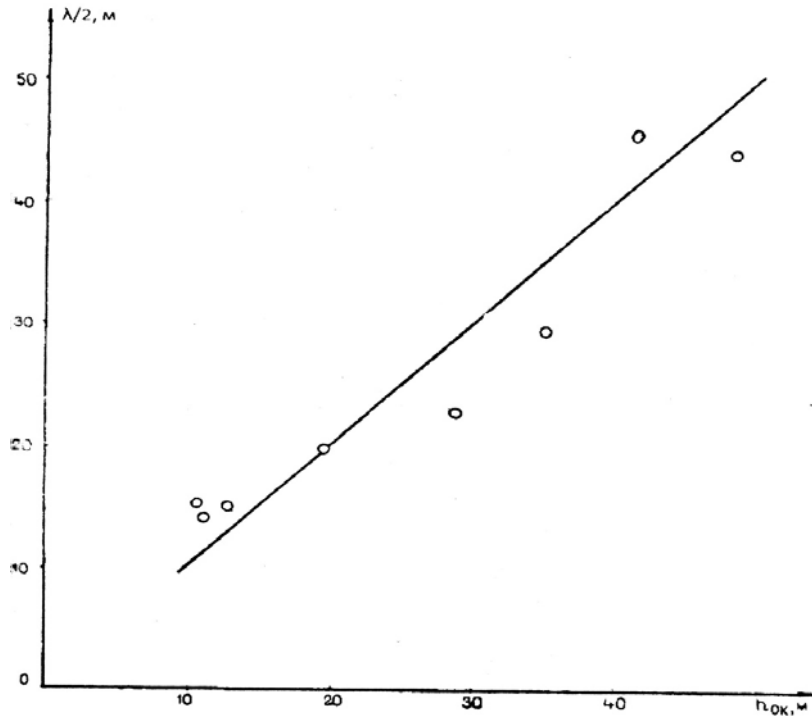


Figure 1 – Wavelength of abutment pressure  $\lambda$  versus toprrock thickness  $h_{0,\kappa}$ .

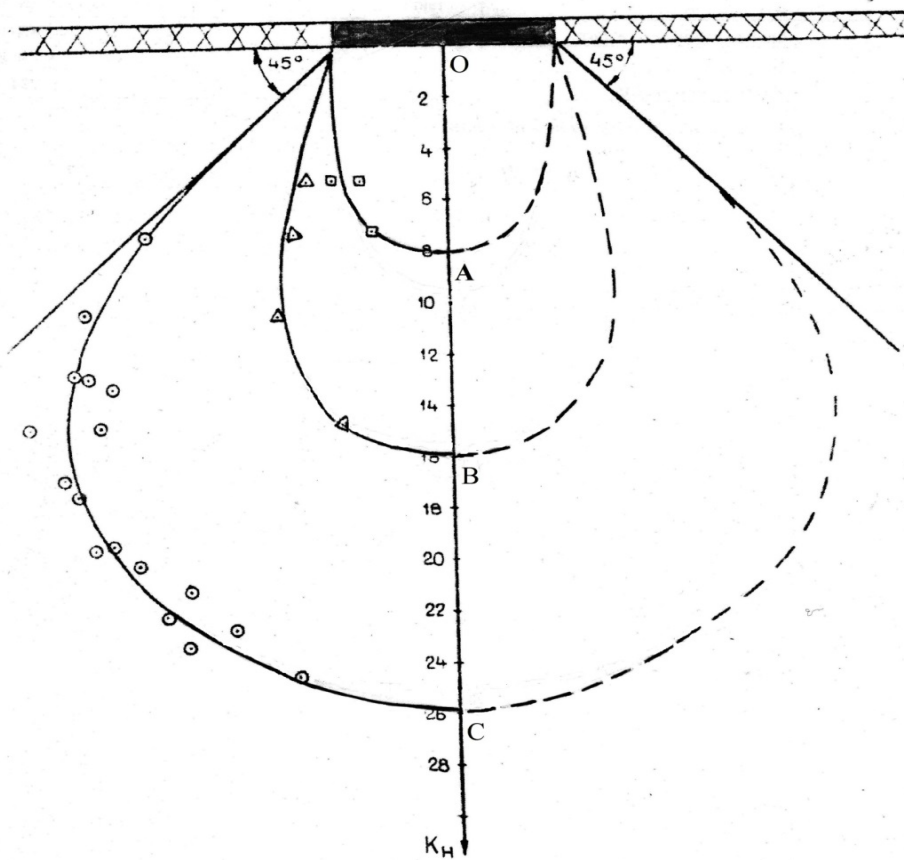


Figure 2 – The distribution of rock pressure waves above the safety pillar



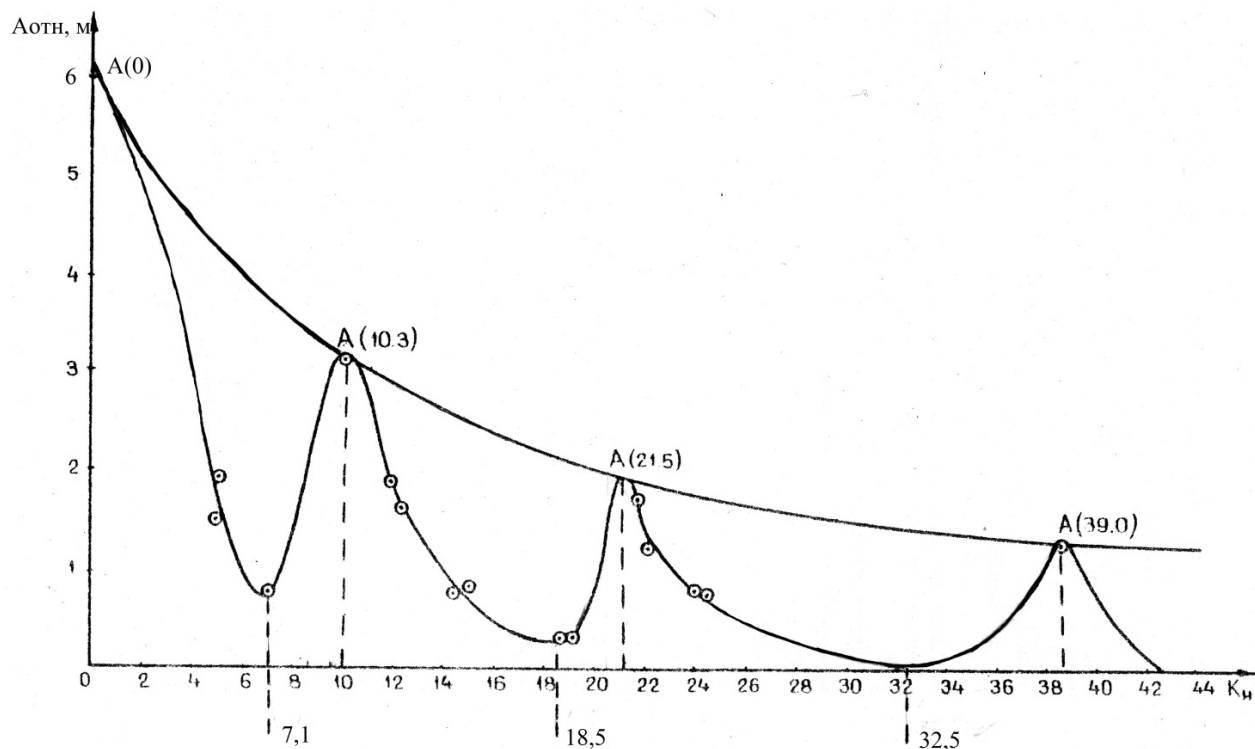


Figure 3 – The change of relative amplitude of a wave  $A_{om}$  versus the folding of overworking  $K_n$

The comparison of absolute values of mine height oscillation amplitude obtained during studies is of no scientific value as the studies were performed in various conditions (absolute depth, rock composition, life time). Thus, to make comparisons of mines possible, the relative amplitude  $A_{om}$  is introduced. The relative amplitude is the ratio of maximum amplitude of the wave  $A_{max}$  to the value of decrease of mine height during its life time outside of abutment pressure zone  $A_0$  (i.e. the difference between the original mine height and the height of mine where the wave axis is located). This allows to null out the differences of actual rock conditions and only take into consideration the influence of abutment pressure. The dependence of relative amplitude  $A_{om}$  on the distance from the abutment pressure source  $K_n$  shows the same crests of pressure waves as on the figure 2, and also shows the areas subject to elevated rock pressure. As seen from the graph the areas subject to elevated rock pressure are interleaved by the areas free from rock pressure [9].

The dependencies represented on figures 2 and 3 allow to find yet another regularity in distribution of abutment pressure. The distances AO, BO and CO (figure 2) are in the following relationship:

$$AO/BO = 8/16 = 0,5;$$

$$BO/CO = 16/25,9 = 0,618,$$

i.e. they agree with the sequence stated in [6] for the zones of higher strength adjacent to mine according to the following equation:

$$X^{n+1} + X - 1 = 0, (1)$$

where  $X$  – the ratio of the distance from the edge of previous zone to the edge of the following zone of elevated rock pressure, and  $n$  – ordinal number of the zone counting from the base of safety pillar.

The exact values of (1) are given in table 1.

Table 1 – The roots of equation (1)

n	0	1	2	3	4	5	6	7	8
X	0.50	0.6180	0.6823	0.7245	0.7549	0.7781	0.7965	0.8117	0.8243

The values of relative amplitudes of wave crests (figure 3) are also connected by this consequence:

$$\begin{aligned} A_{(10,3)}/A_{(0)} &= 3,1/6,2 = 0,5; \\ A_{(21,5)}/A_{(10,3)} &= 1,92/3,1 = 0,619; \\ A_{(39,0)}/A_{(21,5)} &= 1,31/1,92 = 0,682. \end{aligned}$$

The distances  $R$  to minimums of relative amplitudes of the wave follow the below equation:

$$\begin{aligned} 7,1/18,5 &= 0,384 \\ 18,5/32,5 &= 0,569 \end{aligned}$$

i.e. they agree with the sequence stated in [7;8] for the zones of lower strength (fractured zones) adjacent to mine during their zonal disintegration according to the following equation:

$$X^{n+1/2} + X - I = 0 \quad (2)$$

The exact values of (2) are given in table 2.

Table 2 – The roots of equation (2)

$n$	0	1	2	3	4	5	6	7	8
$X$	0.3820	0.5698	0.6540	0.7055	0.7408	0.7654	0.7894	0.8039	0.8182

This correspondence shows that these zones are the zones free from rock pressure, because they fall onto the lower strength (fractured) zones adjacent to mine during their zonal disintegration

**Conclusions.** Thus, the revealed wave nature regularities of distribution of rock pressure above (under) safety pillars and stratum edges allow predicting the zones of elevated rock pressure and its manifestation in such zones. The identification of patterns of pressure redistribution above (under) the safety pillars and stratum edges of coal layers will allow to develop reliable methods and recommendations for the identification of elevated rock pressure zones for investigation and producing mines, reduce the length of mines located in the zones influenced by safety pillars and stratum edges of adjacent layers, due to scientifically grounded determination of the configuration and range of influence of elevated rock pressure zones and, as a result, will significantly reduce the cost of managing rock pressure in the investigation and producing mines during excavation of coal strata.

Р. Р. Ходжаев<sup>1</sup>, Р. И. Габайдуллин<sup>1</sup>, С. Н. Лис<sup>2</sup>, Ш. К. Шапалов<sup>3</sup>, Н. А. Медеубаев<sup>4</sup>, Г. К. Ивахнюк<sup>5</sup>

<sup>1</sup>«ГеоМарк» ғылыми-инженерлік орталық, Қарағанды, Қазақстан,

<sup>2</sup>Жауапкершілігі шектеулі серіктестік «Жер қойнауын кешенді игеру мәселесі Институты»,  
Қарағанды, Қазақстан,

<sup>3</sup>Silkway халықаралық университеті, Шымкент, Қазақстан,

<sup>4</sup>Қарағанды мемлекеттік техникалық университеті, Қарағанды, Қазақстан,

<sup>5</sup>Санкт-Петербург мемлекеттік технологиялық институты (техникалық университет), Санкт-Петербург, Ресей

## КӨМІР ПЛАСТАРЫНЫҢ ЖИЕГІНДЕГІ БӨЛІКТЕР МЕН ТІРЕКТЕР АСТЫНДАҒЫ ҚОЛДАУ ҚЫСЫМЫН ТАРАТУ ЗАҢДЫЛЫҒЫ

**Аннотация.** Пластар свитасын әзірлеу тау жыныстарының қалыңдықтарында үлкен мөлшерде тау-кен қысымының жоғарлауы ТКҚЖ шекарасының түзілуіне алып келеді, ол дегеніміз көрші пластардан қалған массив пен тірек жиектеріндегі қысым әсерінен пайда болған. ТКҚЖ тау-кен қысымының жоғарлау шекарасы пластар свитасын әзірлеу барысында капиталды және дайындалған өңдеулер жағдайын шұғыл түрде нашарлатады. Бұл мақалада жоғарғы жатқан көмір пластарының жиектері мен тірек астындағы Қарағанды көмір бассейні көмір шахтасының жер асты өңдеулері аймағында жүргізілген талдау нәтижелері келтірілді. Жүргізілген зерттеулер нәтижелері көрсеткендей, яғни тіреу астында орналасқан барлық қаралған өңдеулер аймақтарының ұзындығы толқынға ұқсас өзгеріп отырады. Жүргізілген талдау нәтижесінде стационарлы қысымның толқынды өзгеру сипаттамасы дәлелденді және оның көмір пластарының жиектері мен тіреулер астарында таралу заңдылығы анықталды.

**Нұйын сөздер:** қолдау қысымы, көмір тіреулері, көмір пластарының жиек бөліктері, тау-кен қысымының жоғарғы шекарасы, пластар свитасы, дайындалған өңдеулер, гармоникалық үрдіс.

**Р. Р. Ходжаев<sup>1</sup>, Р. И. Габайдуллин<sup>1</sup>, С. Н. Лис<sup>2</sup>, Ш. К. Шапалов<sup>3</sup>, Н. А. Медеубаев<sup>4</sup>, Г. К. Ивахнюк<sup>5</sup>**

<sup>1</sup>Научно-инженерный центр «ГеоМарк», Караганда, Казахстан,

<sup>2</sup>Товарищество с ограниченной ответственностью «Институт проблем комплексного освоения недр», Караганда, Казахстан,

<sup>3</sup>Международный университет Silkway, Шымкент, Казахстан,

<sup>4</sup>Карагандинский государственный технический университет, Караганда, Казахстан,

<sup>5</sup>Санкт-Петербургский государственный технологический институт (технический университет), Санкт-Петербург, Россия

### **ЗАКОНОМЕРНОСТИ РАСПРОСТРАНЕНИЯ ОПОРНОГО ДАВЛЕНИЯ ПОД ЦЕЛИКАМИ И КРАЕВЫМИ ЧАСТЯМИ УГОЛЬНЫХ ПЛАСТОВ**

**Аннотация.** Разработка свит пластов приводит к образованию в толще пород большого количества зон повышенного горного давления (ПГД), образованных влиянием опорного давления краевых частей массива и целиков, оставленных на соседних пластах. Наличие зон ПГД резко ухудшает состояние подготовительных и капитальных выработок при разработке свит пластов. В статье приводятся результаты анализа проведенных наблюдений на участках подземных выработок угольных шахт Карагандинского угольного бассейна, находящихся под целиками и краевыми частями вышележащих угольных пластов. Результаты проведенных исследований показали, что во всех выработках, в которых проводились наблюдения, высота участка выработки, расположенного под целиком (краевой частью) изменяется волнообразно. В результате проведенного анализа доказан волновой характер стационарного опорного давления и выявлены закономерности его распространения под целиками и краевыми частями угольных пластов.

**Ключевые слова:** опорное давление, целик угля, краевая часть угольного пласта, зона повышенного горного давления, свита пластов, подготовительная выработка, гармонический процесс.

#### **Information about authors:**

Khojayevev Rustam, Dr. Eng, GeoMark Research Center, Karaganda, Kazakhstan; khodzhaev.rustam@bk.ru; <https://orcid.org/0000-0002-8499-9012>

Gabaydullin Ravgat, Candidate of Science, GeoMark Research Center, Karaganda, Kazakhstan; gabaydullin.ravgat@bk.ru; <https://orcid.org/0000-0002-8450-2651>

Lis Sergey, Senior Fellow, The Institute For Comprehensive Development of Underground Resources LLP, Karaganda, Kazakhstan; lis.sergey.2018@bk.ru; <https://orcid.org/0000-0001-6034-5519>

Shapalov Shermakhan, PhD Department of chemistry and biology, Silkway international university, Shymkent, Kazakhstan; shermahan\_1984@mail.ru; <https://orcid.org/0000-0002-3015-5965>

Medeubayev Nurmukhambet, candidate of technical science, associate professor, Karaganda State technical university, Karaganda, Kazakhstan; nmedeubayev@bk.ru; <https://orcid.org/0000-0002-6249-2958>

Ivahnyuk Gregory, doctor of technical science, professor of St. Petersburg State Institute of Technology (Technical University), Saint-Petersburg, Russia; ivakhnyukg@list.ru; <https://orcid.org/0000-0002-3401-158X>

#### **REFERENCES**

[1] Chernyak I.L., Burchakov Yu.I. Management of mining pressure in the preparatory workings of deep mines. M.: Nedra, 1984. 300 p.

[2] Kuzyara V.I., Kolesnikova V.G., Komlev E.S., Svetlichnyy V.N. Regularities of formation of the reference pressure ahead of mines // Ugol Ukrainy. 1990. N 11. P. 15-16.

[3] Lis S.N. The results of studies of the wave nature of the bearing pressure under the pillars and boundary parts of coal seams // Gornyy zhurnal Kazakhstana. 2018. N 7. P. 23-27.

[4] Primeneniye i ispolzovaniye apparatury «Rezonans» – Metodicheskiye rekomendatsii (Application and use of the equipment "Resonance" – Methodical recommendations). L.: LGI, 1987. 102 p.

[5] Strelkov S.P. Introduction to the theory of oscillations. M.: Nedra, 1964. 437 p.

[6] Lis S.N., Varekha Zh.P. Patterns of disintegration of rocks close to the capital and preparatory workings // Kompleksnoye ispolzovaniye mineralnogo syria. 2012. N 2. P. 23-29.

[7] Lis S.N., Varekha Zh.P. Patterns of disintegration of rocks close to the capital and preparatory workings // Gornyy zhurnal Kazakhstana. 2013. N 9. P. 14-18.

[8] Lis S.N. Patterns of disintegration of rocks close to the capital and preparatory workings // Energeticheskaya bezopasnost Rossii: novyye podkhody k razvitiyu ugolnoy promyshlennosti: Sbornik trudov XV mezhdunarodnoy nauchno-prakticheskoy konferentsii. 8–11 oktyabrya 2013. Kemerovo: KVK «Ekspo-Sibir», 2013. P. 155-158.

[9] Seitmuratova E.Yu., Zeylik B.S., Dautbekov D.O., Baratov R.T. // National academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences. 2018. Vol. 6, N 432. P. 210-220. ISSN 2224-5278. <https://doi.org/10.32014/2018.2518-170X.51>

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

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

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

Верстка Д. Н. Калкабековой

Подписано в печать 11.06.2019.

Формат 70x881/8. Бумага офсетная. Печать – ризограф.

15,7 п.л. Тираж 300. Заказ 3.