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

1 (445)

JANUARY – FEBRUARY 2021

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, 220 бөл.,
тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

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 технических 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 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/

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 1, Number 445 (2021), 127 – 134 **https://doi.org/10.32014/2021.2518-170X.18**

UDC 699.8

A. B. Sadykova, N. V. Silacheva, N. P. Stepanenko

Institute of Seismology, Almaty, Kazakhstan.
E-mail: a.sadykova5381@kpi.com.de, silacheva5381@ubogazici.in, n.stepanenko5381@murdoch.in

SEISMIC MICRO ZONING OF THE TERRITORY OF ALMATY ON A NEW METHODOLOGICAL BASIS

Abstract. In connection with the reform of regulatory framework for construction sector of the Republic of Kazakhstan, the development of seismic zoning maps poses an urgent problem. The article presents a set of seismic microzoning maps of Almaty, developed on a new methodological basis for Kazakhstan, and provides explanatory materials on the development, understanding and use. Calculation of background seismic hazard was carried out in accordance with the basic provisions of Eurocode 8. Seismic microzoning included the implementation of two main tasks - the assessment of background seismicity and taking into account influence of soil conditions. Based on the analysis results, a set of maps have been arranged. When taking into account the influence of engineering and geological conditions, Russian and Kazakh works were used. The main maps ready for use in regulatory documents are provided. Analysis of capacities of the sediments of same age in different blocks made it possible to understand the dynamics of tectonic regime of the city territory. In the process of neotectonic activation, almost all previously existing tectonic disturbances were improved. In the contemporary relief of the urban area, most faults are not expressed.

Keywords: structure and properties of soils, building regulations, macroseismic scale of intensity, geomorphology, repeatability laws for earthquakes.

Introduction. The Decree of Government of the Republic of Kazakhstan dated December 31, 2013 No. 1509, was accepted to improve the construction legal base, it approved the Concept for reforming the regulatory framework of the construction sector of the Republic of Kazakhstan. The concept was developed in order to integrate Kazakhstan's economy into European and world community. Eurocode 8 "Design of structures for earthquake resistance: General rules, seismic actions and rules for buildings" [1] is a section of the Construction Code of the Republic of Kazakhstan (SN RK EN), which is a set of several documents. With the introduction of SN RK EN 1998-1: 2004/2012 during the transition period, which ends in 2020, all non-relevant state standards of the Republic of Kazakhstan in the field of design and construction, and, therefore, previously developed SNiP, will be invalid. At the same time, without the National Appendix (indicative coefficients, i.e., nationally determined parameters), building codes SN RK EN 1998-1: 2004/2012 should not be used for the design of buildings and structures. Therefore, the development of seismic zoning maps based on Eurocode 8 is a National Application that takes into account the specific seismological national features and dangers of Kazakhstan. Its compilation is based on scientific research carried out in accordance with the requirements of Eurocode-8.

The development of seismic microzoning maps (SMZ) in Almaty was carried out by the Institute of Seismology LLP by order of the Ministry of Education and Science of the Republic of Kazakhstan within the framework of R&D program "Development of SMZ maps of the territory of Almaty on a new methodological basis". As co-contractors, specialists from the Seismological Experimental and Methodological Expedition LLP (SEME), the Kazakh Geotechnical Research Institute LLP (KazGIIZ) with the participation of the RSE Institute for Geophysical Research (IGR) were involved, consulting support was provided by the Kazakh Research and Development LLP Design Institute of Construction and Architecture" (KazNIISA).

Materials and methods. The seismic hazard assessment during seismic microzoning (SMZ) of the territory of the city of Almaty was carried out for the first time on the basis of methodology that complies with provisions of Eurocode 8 "Design of structures for earthquake resistance" [1]. When taking into account the influence of engineering and geological conditions, Russian and Kazakh works were used. The main distinguishing elements of the methodology: probabilistic approach to calculation of seismic hazard for 2 return periods of 475 and 2475 years; characteristic of seismic hazard in macroseismic intensities (MSK-64(K) and quantitative parameters of soil vibrations (peak accelerations PGA); a new for Kazakhstan methodological basis for calculating seismic hazard and taking into account the influence of soil conditions using updated experimental database.

Seismic microzoning included the implementation of two main tasks – the assessment of background seismicity and taking into account the influence of soil conditions. Based on the analysis results, a set of maps were prepared. A block of work related to the study of the structure and properties of soils, development of seismic-geophysical models for key areas for clarifying their seismic properties (a map of types of soil conditions by seismic properties) and engineering-geological zoning of the territory of Almaty was carried out by KazGIIZ LLP, partially – RSE "IGI" and in 2017 – AlmatyGeoCenter LLP. The systematization of the materials of engineering and geological surveys for the past years was carried out, as well as the drilling of new wells, laboratory tests of cores; conducting geophysical profiles to determine the velocity section of the studied areas, refining the mapping of tectonic faults. The complex of geophysical methods included seismic exploration by the method of refracted waves, electrical exploration by the method of vertical electric probing and georadar survey [2,3].

Assessment of the background and specified seismic hazard for Almaty for two levels of probability of exceeding the seismic effect – 10% (return period 475 years) and 2% (return period 2475 years) for 50 years was performed by the Institute of Seismology. The used methodology for analyzing seismic hazard and taking into account influence of soil conditions was considered in detail in [3-7]. It was made together with compilation of maps of the General seismic zoning of the territory of the Republic of Kazakhstan [8], and was used during the SMZ with significant detail at all stages of work.

In addition to the modern approach, an updated database was used for the SMZ, which included information currently available – an updated seismic catalog, a seismotectonic model (map of seismic generative zones), and modern ground motion attenuation models. When performing the calculation part, modern software was used, which allows for significantly more complete consideration of various information about seismicity. The use of the latest developments of Russian seismologists on the influence of soil conditions using continuously changing soil coefficients and on non-linearity has also become an innovative element in seismic microzoning [9]. The "continual" approach that was used [10] implies a continuous rather than abrupt change in characteristics. This allowed us to avoid errors due to incorrect relationships between the values of seismic intensities and accelerations inherent in the MSK-64 (K) seismic scale, to avoid discrete representation of continuous values and to proceed to direct calculation of final accelerations based on seismic rigidity obtained from engineering-geological and instrumental geophysical surveys.

Results and discussion. The result of the work was the making of a set of maps for the territory of Almaty using a new methodological basis. Maps were made using modern GIS technologies at a scale of 1:10 000. The set consists of a primary one and an additional one. The basic set includes 5 maps necessary for the development and updating of construction regulatory documents of Kazakhstan, which will be used at the state and city level to improve the seismic safety of Almaty. After inclusion in the regulatory documents, the maps will be intended for widespread use by specialists, the city administration and the population.

Map of calculated accelerations (figure 1). The map is intended for direct use in construction calculations. It was obtained on the basis of background seismic hazard maps of peak accelerations (PGA) and allows us to directly use its values for engineering calculations. On this map, the step of the contour lines is 0.02 g, and the values within the intervals do not change. The accelerations calculated in each point correspond to the maximum of two values – the peak ground acceleration at the return period of 475 years or 2/3 of peak ground acceleration at return period of 2475 years.

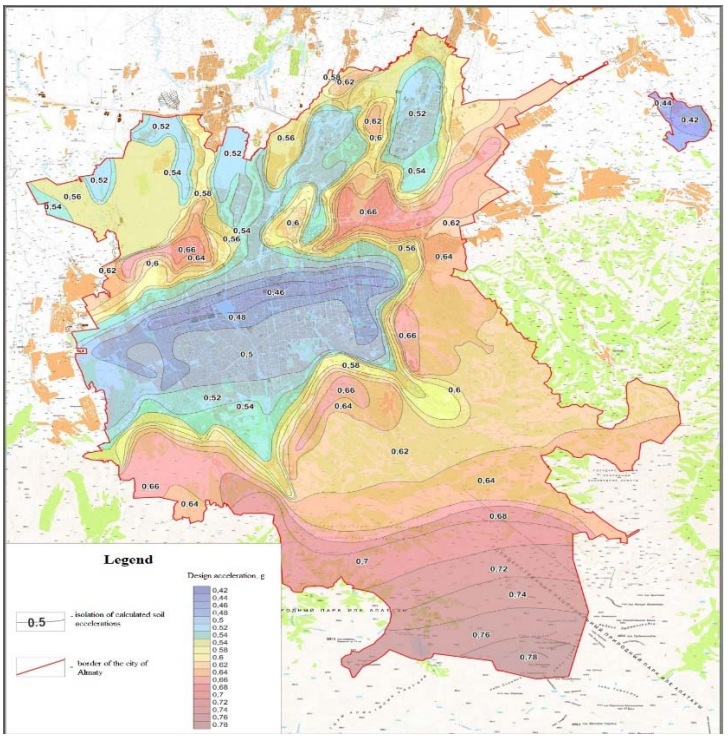

Figure 1 – Map of seismic microzoning (SMZ-1rasch) of the territory of the city of Almaty in calculated soil accelerations (in g units)

Probabilistic seismic microzoning maps in MSK-64 (K) macroseismic intensity scales for two return periods of 475 and 2475 years (the probability of exceeding the seismic intensity of 10% and 2% over 50 years) (figures 2-3).

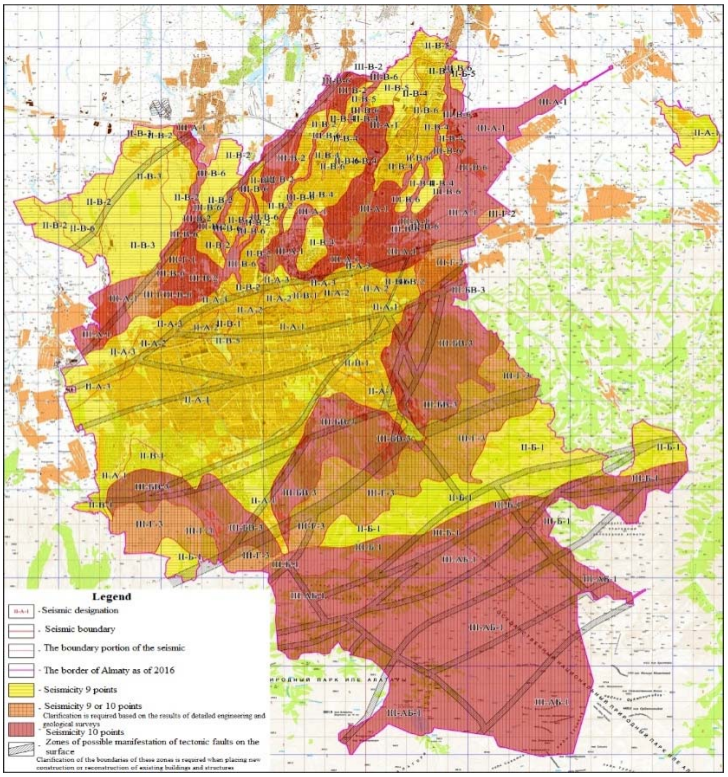

Figure 2 – The map of seismic microzoning (SMZ-2 $_{475}$) of the territory of Almaty in intensities of the MSK-64(K) macroseismic scale for return period of 475 years (probability of exceeding 10% over 50 years)

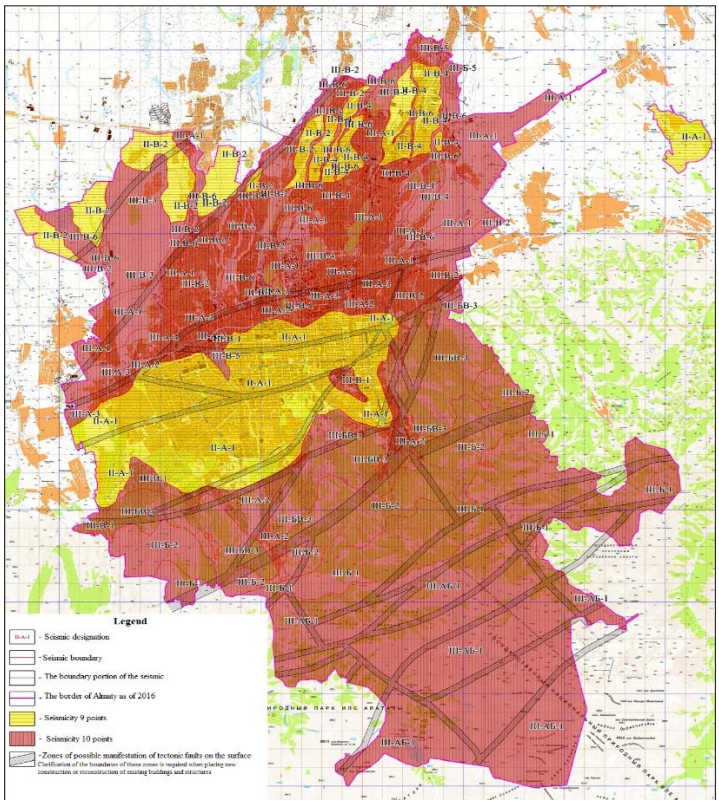

Figure 3 – The Map of seismic microzoning (SMZ-2 $_{2475}$) of the territory of Almaty in intensities of the MSK-64(K) macroseismic scale for return period of 2475 years (probability of exceeding 2% for 50 years)

The map of types of soil conditions by seismic properties (figure 4).

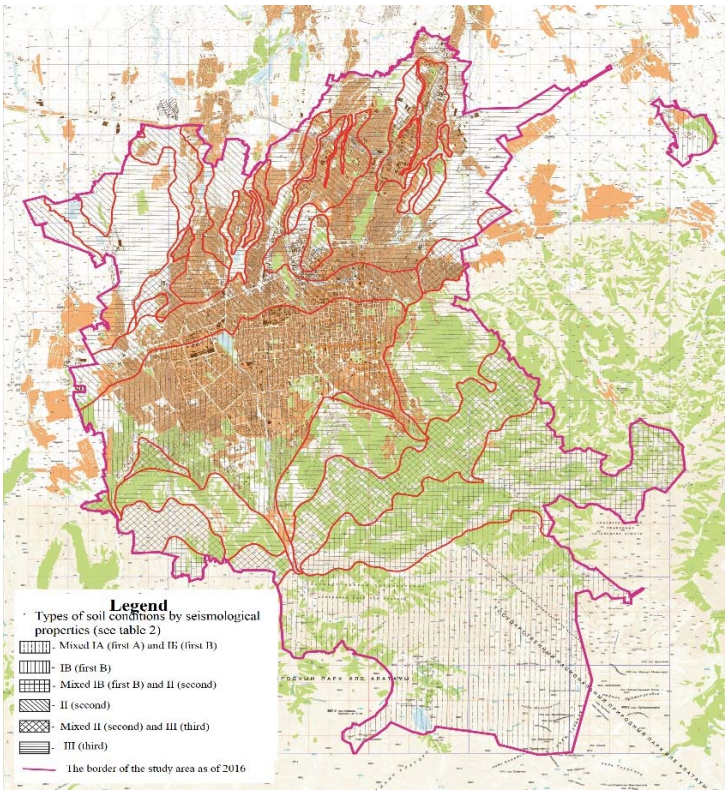

Figure 4 – Map of types of soil conditions by seismic properties in the territory of Almaty

The map of engineering-geological zoning (figure 5). The map reflects the main features of geomorphology, geological structure, hydrogeological conditions, lithological composition of soils, the manifestation of dangerous processes of an exogenous nature, the depth of the ground waters.

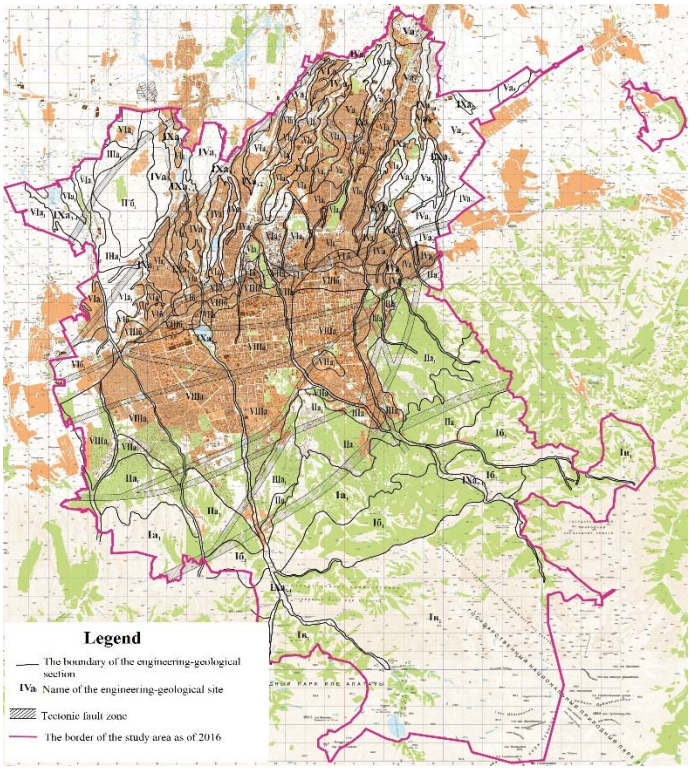

Figure 5 – Map of engineering-geological zoning of the territory of Almaty

The additional set included 9 maps necessary for specialists in construction area and seismologists. Maps from the optional kit are not provided in the article. Maps (1-2) of probabilistic assessment of background seismic hazard for return period of 475 and 2475 years (probability of exceeding the seismic intensity of 10% and 2% for 50 years) in macroseismic intensities according to the MSK-64(K) scale (attenuation of intensity along structures). The results of calculating background intensity, presented in the form of intensity isoseysts in increments of 0.1, are digitized from 8.8 to 9.9 for return period of 475 years and from 9.4 to 10.7 for a period of 2475 years. The maps in macroseismic intensities according to the MSK-64(K) scale of intensity refer to medium soils by seismic properties, for surface 30-meter strata of which shear wave propagation velocities from 250 to 600 m/s are typical.

Maps (3-4) of probabilistic assessment of the background seismic hazard for return periods of 475 and 2475 years (probability of exceeding the seismic intensity of 10% and 2% over 50 years) in peak ground accelerations. Maps characterize seismic hazard in geometric mean values of peak accelerations in fractions of g. The contours were drawn with a step of 0.05 g and are the boundaries of the intervals of peak accelerations. Inside the intervals, values increase nonuniformly from the isoline with a smaller denomination to the isoline with a larger one. PGA background seismic hazard maps refer to rocky and rocky-like geological formations for the 30 m surface thicknesses which are characterized by shear wave propagation velocities ≥800 m/s. Probabilistic seismic microzoning maps (5-6) for return periods of 475 and 2475 years (probability of exceeding seismic intensity of 10% and 2% over 50 years) in peak ground accelerations. Map (7) of transverse wave propagation velocity in 30-meter soil layer. Map (8) of the results of average increments of intensities according to the method of seismic rigidities. Map (9) of the actual data (location of wells for which stratigraphic data were obtained).

The input data for calculating background seismic hazard maps were models of seismic generative zones [11]; earthquake recurrence laws [3,12,13]; ground motion attenuation models depending on the magnitude of earthquake and the distance to observation point [3,12,14-16]. The calculation of SMZ maps

in MSK-64 (K) points was done on the basis of the SEISRISK-III computer program package modified by SRISKnas. The modification consisted in adapting this complex to work with intensity in points and using the dependences of attenuation of intensity on magnitudes, distances and depths of foci obtained for the territory of the Northern Tien Shan [12,13]. To analyze the hazard in accelerations, we used the M3C software using the Monte Carlo method and giving the same results as the traditional Cornell approach. Field and office work on finding the increments of macroseismic intensity by engineering-geological and seismotectonic surveys with determination of shear and longitudinal wave velocities to a depth of 30 meters was carried out by KazGIIZ LLP.

The overall increments of macroseismic intensity were calculated by the method of S.V. Medvedev [17] (for 10 and 30-meter soil strata) for 1446 points of an irregular grid. The range of intensity increment values varies from -0.9 to +0.9. Negative increment values were acquired for the southern part of the study area with solid rocky soil. When taking into account the influence of soil conditions in acceleration maps, not traditional increments for Kazakhstan were used, but soil coefficients, which are a function of continuously changing seismic stiffness [3]. The continuum approach [10] made it possible to move away from the use of soil categories, spasmodic changes in characteristics of soil conditions and seismic effects. Soil coefficients, as in the case of increments of macroseismic intensity, are calculated according to geological and geophysical studies at 1446 points in the city with the results of typification of soil conditions. Nonlinear soil behavior was taken into account.

The zones of possible appearance of tectonic faults are shown on maps 2, 3 and 5 of the main set (Figures 2, 3, 5) and maps 5 and 6 of the additional set. Their planned configuration and position, according to which the tectonic movements and seismogenic deformations are possible in the future, is determined by modern block-discontinuous structures – moving blocks of the earth's crust [16]. Significant shifts during strong earthquakes occurring outside the city and possible manifestations of residual deformations in soil within the city are possible along all faults. Information on neotectonic displacements along faults covered by athick loose cover was obtained from the results of geophysical studies [16].

Conclusions. The analysis of thicknesses of coeval sediments in different blocks lets us evaluate the dynamics of the tectonic regime of the city. In the process of neotectonic activation, apparently, almost all previously existing tectonic disturbances were updated. In modern relief of the urban area, most faults are not expressed. The width of the zones of possible impact of faults is demnstrated to some extent conditionally taking into account the increased accuracy of their planned binding. Faults of submeridional direction were considered as seismic generating – Zailiysky (magnitude MLH 8.2) in the southern mountainous part and Almaty (magnitude MLH 7.0) in the central part of the city, separating the extension cone from the foothill plain.

On the maps of SMZ in accelerations (in the main and additional sets), the minimum level of danger is mentioned for the central part of the city in the region of mountain river extension cones. On the probability maps of seismic microzoning (SMZ) in MSK-64 (K) macroseismic intensity scales for two return periods, the most dangerous zones of the initial seismicity with intensity values of 9 and 10, due to the Kungei, Zailiysky, Almaty seismic generative zones, occupy almost the entire territory of city. In the northern part of the city, intensity contours are 8.8-8.9 on the map with return period of 475 years and 9.4-9.5 with recurrence period of 2475 years. Such tremors can be produced by both remote and local seismic generative zones.

А. Б. Садықова, Н. В. Силачева, Н. П. Степаненко

Сейсмология институты, Алматы, Қазақстан

ЖАҢА ӘДІСТЕМЕЛІК НЕГІЗДЕ АЛМАТЫ ҚАЛАСЫНЫҢ ТЕРРИТОРИЯСЫН СЕЙСМИКАЛЫҚ МИКРОАЙМАҚТАНДЫРУ

Аннотация. Қазақстан Республикасы құрылыс саласының нормативтік-құқықтық базасын реформалауға байланысты сейсмикалық аудандастыру карталарын әзірлеу өзекті мәселеге айналып отыр. Мақалада

Қазақстан үшін жаңа әдістемелік негізде әзірленген Алматы қаласының сейсмикалық микроаудандастыру картасының жиынтығы мен әзірлеу, түсіну және қолдану бойынша түсіндірме материалдары берілген.

Фондық сейсмикалық қауіп есебі Еврокод 8 негізгі қағидаттарына сай жүргізілді. Сейсмикалық микроаудандастыру екі міндетті қамтиды – фондық сейсмикалылықты бағалау және топырақ жағдайының әсерін есепке алу. Талдау нәтижелері бойынша карталар жиынтығы жасалды. Инженерлік-геологиялық шарттар әсерін есептегенде ресейлік және қазақстандық әзірлемелер пайдаланылды. Нормативтік құжаттарда қолдануға дайын негізгі карталар келтірілген.

Түрлі блоктардағы кезеңі бір шөгінділер қуатын талдау қала территориясы тектоникалық режимінің динамикасын түсінуге мүмкіндік берді. Неотектоникалық белсенділену үдерісі барысында бұрын болған тектоникалық бұзылыстың барлығы жойылды. Қала территориясының заманауи бедерінде айтарлықтай кемшіліктер байқалмады.

Түйін сөздер: топырақ қасиеті және құрылымы, құрылыс нормалары, қарқындылықтың макросейсмикалық шкаласы, геоморфология, жер сілкінісінің қайталанымдық заңдары.

А. Б. Садыкова, Н. В. Силачева, Н. П. Степаненко

Институт сейсмологии, Алматы, Казахстан

СЕЙСМИЧЕСКОЕ МИКРОЗОНИРОВАНИЕ ТЕРРИТОРИИ Г. АЛМАТЫ НА НОВОЙ МЕТОДИЧЕСКОЙ ОСНОВЕ

Аннотация. В связи с реформированием нормативно-правовой базы строительной отрасли Республики Казахстан разработка карт сейсмического районирования представляет собой актуальную проблему. В статье представлен комплект карт сейсмического микрорайонирования Алматы, разработанный на новой методологической основе для Казахстана, и даны пояснительные материалы по разработке, пониманию и использованию.

Расчет фоновой сейсмической опасности проводился в соответствии с основными положениями Еврокода 8. Сейсмическое микрорайонирование включало выполнение двух основных задач – оценку фоновой сейсмичности и учет влияния почвенных условий. По результатам анализа составлен комплект карт. При учете влияния инженерно-геологических условий использованы российские и казахстанские разработки. Приведены основные карты, готовые для использования в нормативных документах.

Анализ мощности отложений одного возраста в разных блоках позволил понять динамику тектонического режима территории города. В процессе неотектонической активизации были устранены практически все существовавшие ранее тектонические нарушения. В современном рельефе городской местности большинство разломов не выражено.

Ключевые слова: структура и свойства грунтов, строительные нормы, макросейсмическая шкала интенсивности, геоморфология, законы повторяемости землетрясений.

Information about authors:

Sadykova A.B., Full Doctor in Physics and Mathematics, Head of the Laboratory of Regional Seismicity, Institute of Seismology, Almaty, Republic of Kazakhstan; a.sadykova5381@kpi.com.de; https://orcid.org/0000-0002-6299-2274

Silacheva N.V., PhD in Physics and Mathematics, Head of the Laboratory of Engineering Seismology, Institute of Seismology, Almaty, Republic of Kazakhstan; silacheva5381@ubogazici.in; https://orcid.org/0000-0001-6849-0956

Stepanenko N.P., PhD in Technical Sciences, Head of the Laboratory of Structural Geophysics, Institute of Seismology, Almaty, Republic of Kazakhstan; n.stepanenko5381@murdoch.in; https://orcid.org/0000-0003-1861-9496

REFERENCES

[1] BSEN 1998-1: 2004 Eurocode 8. Design of structures for earthquake resistance. Part 1: General rules, seismic actions and rules for buildings (2004). Available at: https://www.phd.eng.br/wp-content/uploads/2015/02/en.1998.1.2004.pdf

[2] Lazarenko M.M., Alekseev A.N., Alekseev S.A., Zabashta Y.F., Grabovskii Y.E., Hnatiuk K.I., Dinzhos R.V., Simeonov M.S., Kolesnichenko V.G., Ushcats M.V., Bulavin L.A. (2019) Nanocrystallite-liquid phase transition in porous matrices with chemically functionalized surfaces // Physical Chemistry Chemical Physics, 21 (44): 24674-24683.

[3] Silacheva N.V., Kulbayeva U.K., Kravchenko N.A. (2020) On the realization of seismic microzonation of Almaty (Kazakhstan) in ground accelerations based on the "continual" approach // Geodesy and Geodynamics, 11 (1): 56-63.

[4] Silacheva N.V., Kulbayeva U.K., Kravchenko N.A. (2018) Probabilistic seismic hazard assessment of Kazakhstan and Almaty city in peak ground accelerations // Geodesy and Geodynamics, 9 (2): 131-141.

[5] Sadykova A.B. (2012) Seismic hazard of the territory of Kazakhstan. High Technology, Almaty.

[6] Sadykova A.B., Sydykov A., Stikharnaya G.G., Danabaeva A.M. (2017) A probabilistic assessment of the initial seismicity of the city of Almaty in connection with the micro-zoning of its territory // Izvestiya NAS RK. Series of Geology and Technical Sciences, 5: 62-75.

[7] Sadykova A.B., Danabaeva A.T., Katubaeva A.M. (2017) Micro-zoning of the territory of the city of Almaty (initial seismicity). Materials of the 9th Kazakhstan-China International Symposium "Earthquake Forecast, Assessment of Seismic Hazard and Seismic Risk of Central Asia", Almaty. 240 p.

[8] Metaksa G.P., Moldabayeva G.Z., Alisheva Z.N. (2019) Mechanism of structure formation in fluid-bearing minerals // Mining Informational and Analytical Bulletin, 2019 (2): 78-84.

[9] Savon D.Y., Aleksakhin A.V., Skryabin O.O., Goodilin A.A. (2019) Occupational health and safety digitalization in the coal industry // Eurasian Mining, 2019 (2): 70-72.

[10] Bulatov N.K., Sarzhanov D.K., Elubaev S.Z., Suleymenov T.B., Kasymzhanova K.S., Balabayev O.T. (2020) Engineering and experimental testing of prototypes of biogas equipment // Renewable Energy 160: 278-287.

[11] Timush A.V., Taradaeva T.V., Stepanenko N.P., Sadykova A.B., Sydykov A.A. (2012) Seismic generating zones of Kazakhstan. High Technology, Almaty.

[12] Sydykov A. (2004) Seismic regime of the territory of Kazakhstan. Gylym, Almaty.

[13] Sydykov A. (2000) Macroseismic and seismic hazard assessment // Geology of Kazakhstan, 5/6: 180-186.

[14] Nersesov I.L., Nurmagambetov A., Sydykov A. (1982) A detailed study of the seismic regime of Kazakhstan and adjacent territories. Nauka, Alma-Ata.

[15] Kurskeev A.K., Timush A.V., Shatsilov V.I., Sydykov A., Gorbunov P.N., Sadykova A.B. (2000) Seismic zoning of the Republic of Kazakhstan. Evero, Almaty.

[16] Erzhanov Zh.S., Shatsilov V.I., Nurmagambetov A., Sydykov A., Abdulgazin R.K. (1982) Seismic micro-zoning of the territory of the city of Almaty. Nauka, Alma-Ata.

[17] Medvedev S.V. (1962) Engineering seismology. Gosstroyizdat, M.

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 01.02.2021.
Формат 70x881/8. Бумага офсетная. Печать – ризограф.
12,75 п.л. Тираж 300. Заказ 1.

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