

ABSTRACTS

GEOLOGY

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SYSTEM ORGANIZATION OF DISJUNCTIVE TECTONICS IN CONSOLIDATED BASEMENT OF DNIPRO-DONETS PALEORIFT

Formulation of the problem. The article is the second in trilogy, which exposes geological structure and geodynamic evolution of Proterozoic crystalline basement of Dnieper-Donets paleorift. Knowledge of strike-slip tectonics of intraplate geostructures with sedimentary basins belonging to them, such as Dnieper-Donets paleorift with cognominal hydrocarbon bearing basin within it, has important applied significance, owing to structure-forming and structure-controlling role of strike-slip faults, that cause spatial distribution of various tectono-magmatic centers, zones of fold uplifts series, structural-facial zones, salt-folds subbasins, etc., within which oil & gas fields are localised. The subject of the research is structural appearance of strike-slip tectonics in precambrian crystalline basement in the form of secondary deformed structures of rift evolution stage. The subject of studies has been structural-paleotectonic and paleogeodynamic conditions of Dnieper-Donets rift formation.

The purpose of the article. Purpose of the research has been study of structure-forming processes at the rifting stage, for which the following tasks have been resolved:

- study of territory expansion in the ancient rift zones of horizontal strike-slip dislocations;
- reconstruction of tectonical position of paleogeodynamic field's main parameters in paleotensions of rift evolution stage;
- study of typical structural-kinematic paragenesis in identified zones of strike-slip dislocations;
- modelling of Dnieper-Donets rift formation kinematics.

Methods. Methodical approach in researches of rift stage tectonic evolution has been identified by complexing of structural-kinematic and structural-paragenetic methods of tectonophysical analysis for study and diagnostic of morphogenetic type of Precambrian basement dislocation structures. Actual curvilinearity of basement faults has been converted to discrete assemblage of lineaments with overall number of 900 items, which filled output database for tectono-physics analysis of disjunctive systems.

Results. Spatial dislocation, paleotectonic position and paleogeodynamic conditions of ancient riftogenic fault systems formation has been studied. Modelling of rift formation kinematics has been carried-out based on reconstruction of main parameters of earth crust tension-deformation state at the stage of rifting. It has been shown that rifting was occurring in overall plate collision geodynamic environment under interference of local horizontal strike-slip field of paleotensions from tangential componental stretching. Under these geodynamic conditions in zones of dynamic influence of almost all regional systems of disjunctive faults, linear zones of concentration of horizontal strike-slip dislocations, creating within them typical ensembles of secondary deformed strike-slip structural-kinematic paragenesis, were forming. Elastic deformation with divergence of "cold" continental earth crust was grounded by the rifting mechanism. The main role in rifting mechanism was played by transforming faults formed following structural directions of transverse transregional fault systems. They served as unique tectonic "rails" by which opposite margins of megasegments – pull-apart basins were spreading, which consequently joined and tuned into one rift system.

Scientific novelty. The main factor and cause of continental rifting should be considered stretching deformations of earth crust in strike-slip field of geodynamic tensions, owing to that "embryo" subbasins, following mechanism of pull-apart basin was formed. They created "windows" for injection of mantle substance by newly built weaken zones in earth crust, and as a result they formed a steady-state "mantle window" in lithosphere, that served as distributary channel in the rift system of mantle fluids.

Keywords: strike-slip tectonics, linear zone of dislocation, geodynamics stress, kinematic, rifting.

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TRANSFORMATION OF THE IMMOBILE PART OF THE LIGHT PETROLEUM PRODUCTS IN THE GEOLOGICAL ENVIRONMENT

Formulation of the problem. The article is devoted to principles of hydrocarbon pollution cluster formation in geological environments, the part of the contaminant accumulation that consists of immobile oil products, not the lenses of the light oil products. This fluid is retained by soils in aeration and saturated zones, and for many years it has been the source of hydrocarbons that pollutes the aquifer.

The important reason for investigation is the periodic transition of oil products from the mobile to the immobile state and vice versa, depending on the direction of the oscillatory movement of the groundwater levels.

The purpose of the article. Research of the state of the petroleum product pollutant is necessary for the differentiated determination of quantitative indicators and assessment of the threat posed by the individual components of the contamination foci.

Methods. The authors' own achievements, as well as the research results of native and foreign investigators made the methodical basis for the article.

Results. As an example of the need to study the oil product clusters in the geological environment in depth, the results of studies conducted on the territory of the airfield near the city of Mykolaiv (Ukraine) are presented. A layer of mobile kerosene, located on the surface of a perched aquifer was discovered here.

Scientific novelty and practical significance. A feature of oil pollution formation on a special type of aquifer, the so-called perched aquifer is considered.

Additional attention should be paid to identification and evaluation of oil product liquids blocked in the water saturated zone.

Keywords: geological environment, light oil products, immobile oil liquid, perched aquifer, transformation of contaminant cluster.

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PALEONTOLOGICAL CHARACTERISTIC OF TURONIAN DEPOSITS ON THE WESTERN SLOPE OF THE UKRAINIAN SHIELD

Formulation of the problem. Turonian deposits of eastern Volhyn are very wide-spread, a number of mineral raw materials deposits are associated with them. The stratigraphic position is justified insufficiently.

The purpose of the article is to perform a detailed zonation based on the study of the fossil complex, to recreate features of the paleogeography of the Turonian basin.

Results. The results of studying the remains of calcareous nannoplankton, foraminifera, ostracod, and bivalve are presented in the work. In the section near the city of Zdolbuniv nannoplankton and foraminifera zones are established. In the lower Turonian the nannoplankton zone UC6 + UC7 and the Marginotruncana pseudolinneiana zone are highlighted.

In the lower part of the middle Turonian, a break is identified, which corresponds to the UC8 nannoplankton zone. In the upper part of the middle Turonian the Marginotruncana coronata zone, in the upper Turonian the Dicarinea canaliculata zone is discernible. In the middle and upper Turonian we defined nannoplankton zone UC9.

The foraminifera, ostracods and the bivalve have features of the Turonian paleobasin. In the lower Turonian, the complex of nannoplankton and foraminifera is depleted, ostracods are represented by one species, bivalvia are very rare, with a thin wall and small dimensions. This indicates a great depth of the basin.

At the beginning of the middle Turonian a break in sedimentation is observed. It was accompanied by erosion or karst in underwater conditions. Accumulation of precipitation at the end of the middle Turonian occurs in a shallow basin. Over time, the pool is even smaller, the amount of benthos and its diversity are increasing.

Scientific novelty and practical significance. For the first time a detailed zonation of Turonian deposits on a complex of fossils is conducted. Some features of the geological history of the basin have been established.

Keywords: Turonian, Volyn-Podolskaya plate, calcareous nannoplankton, foraminifera, ostracods, bivalve.

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TO THE QUESTION OF CONDITIONS, FACTORS AND CRITERIA OF GEODYNAMIC RISK IN THE BOUNDARIES OF URBAN AREAS

Formulation of the problem Loess deposits are widespread. They are characterized by the singular difficult deformations, therefore, their structure collapses. We have shown in the previous researches that in a zone of influence of the city properties of rocks change over time. Physical condition and gradation of microaggregates change over time as well. As a result, complex changes of physical properties occur. The duration of moistening affects the type and magnitude of the changes. Microaggregates do not disintegrate when the duration of moisture is short. When the duration of moisture is long, disintegration of the microaggregates is accompanied by the re-packaging and increasing of the endurance.

The purpose of the article. The forecast of relative subsidence values and endurance can be performed using statistical analysis and group accounting method arguments. In this paper, we show the possibilities of forecasting using the example of a concrete construction site.

Methods. Statistical method and the method of inductive modeling by group accounting of arguments were used in prognostic researches. In calculation of subsidence in the zone influences and stability analyses we used standard methods.

Results. The object of research is an elementary natural and technical system formed by a projected building. The house will be built in the zone of distribution of loess's (the erosion basin Vstrechnaya, Dnipro). The groundwater level in erosion basin is at a depth of 0.5 to 14.0 m. The magnitude of the increase

of Groundwater level is 1.55 m from the modeling results in the research area. According to the results of multi-year data statistical analysis, close correlation relations between the property indices, regression between indicators of the physical state was found. The forecast values of mechanical properties' indicators are established as the results of inductive modeling with the method of group accounting of arguments. The forecast values of humidity and other indicators of the physical state, the content of individual fractions were set as well. The values were calculated to characterize a moderate and intensive change in soil properties in comparison with the natural state. Deformation calculations in the ground base and stability analysis were performed by standard analytical methods.

Scientific novelty and practical significance. The following variants of events were considered: long-term or short-term humidification, complete or selective change in indicators of the physical condition of soils and microaggregate structure. The loss of strength is most likely to happen in case of emergency soaking of soils when the physical state changes but dispersion do not change.

Keywords: loess, micro-aggregate composition, strength, forecast, group argument method.

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DETERMINATION OF POROSITY IN SEMI-CONSOLIDATED AND LOOSE ROCKS

Formulation of the problem. Due to the fact that the volume of drilling in the shallow horizons of the Mesozoic has recently been increased, the collectors are more often selected in the core with weakly cement-

ed and loose sands and sandstones. Weak consolidation of rocks makes them difficult to study because of the impossibility of using standard, commonly used techniques. As a result, an interest in the methodological part of determining the collecting properties of such rocks became aggravated.

The aim of this work is to choose the most reasonable method of porosity determination of the semi-consolidated and friable rocks and its mastering to the operative complex of researches.

The basic content. The article considers the methods of determining the porosity used in engineering Geology and total porosity of the bulk rocks using the Remniiov's formula. The latter provides pre-compaction of samples under a pressure similar to the effective pressure on the sample and has a few options. The device for pre-consolidation and the method of its application have been developed. Ways to determine the values of effective pressure during compaction have been considered.

Conclusions. On the basis of the work final conclusions have been formulated according to the declared purpose of the work:

1. As long as it is technically possible, within the operational complex for determining porosity of semi-consolidated rocks it is better to use a standard saturation method.

2. In other cases on semi-consolidated and always on friable rocks it is needed to use the method of the direct measuring on a model, under effective pressure, calculation on a formula {3}, where rock pressure is calculation on the formula of $P=\gamma h$. Porosity should be calculated on a formula {2} with the use of quartz specific gravity.

Keywords: researches of stippler, semi-consolidated rocks, friable rocks, research of friable rocks, methodology of porosity, porosity of friable rocks, model.

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MINERAL AND RAW MATERIAL BASE OF AGRONOMICAL ORE IN KHARKIV REGION

The purpose of the article is to analyze the mineral and raw material base of agronomical ore (phosphate, lignum fossil and decay ooze) according to the results of the State Committee of Geology of Ukraine from the 1930s to 2010 in order to arouse interest of the Regional Council to continuing work and providing the region with phosphorous, nitrogen and potassic fertilizers.

Methods of research. After analyzing a number of works in Kharkiv region over the past 90 years by the State Committee of Geology (Kharkiv), the Ukrainian State Geological Surveyance Institute (Simferopol), the Ukrainian Academy of Agrarian Sciences (Kyiv), the National Metallurgical Academy of Ukraine (Dnipro) and O.N. Sokolovsky Institute for Soil Science and Agrochemistry Research (Kharkiv), in the article the condition of mineral and raw material base of agronomical ore (phosphate, lignum fossil and decay ooze) in Kharkiv region is considered and demands of agricultural producers for phosphorous, nitrogen and potassic fertilizers (about 300 thousand tons a year) are identified. The data of previous researches on stock and contents of the mentioned agronomical ore and treatment methods developed by the leading institutes of Ukraine (Ukrainian Geological Surveyance Institutes), and rational use in the national economy are provided in the article. The geological structure of prospective deposits and directions for further work in order to provide Kharkiv region with agronomical ore is considered.

Results. The author of the article reveals the data based on the results of the four-year researches carried out on the fields of Iziium region. They prove efficiency of phosphorite powder from the ores of the Sinichino-Eremovsky and Malokamyshevaha deposits, where effectiveness of phosphorite powder was equal to superphosphate. After treating ores from the deposits, phosphorite powder meets specification requirements U6 14005076.053-99 of the first and second class. In agriculture, it is suitable as a mineral fertilizer for direct soil use.

The article deals with data of using the ore from the Malokamyshevaha deposit as a raw material for ferrophosphorus, which is currently imported. Researchers from the National Metallurgical Academy of Ukraine (Dnipro) developed a magnetic-flotation scheme of treating phosphorite with initial 5.0% of P₂O₅ 5.0% to increase P₂O₅ up to 27.2% in order to use it to smelt iron for alloying.

Because of radionuclides, phosphorites of Iziium region, unlike apatites of the Khibiny mountains and phosphorites of Africa, are ecologically clean and can be used in the national economy.

Hydrogeological conditions of developing the studied deposits are favorable for mining. Aquifers are beneath the bottom layer of phosphorites.

The article shows suitability of strip chalk as associated, meeting the composition requirements of A and B classes for construction lime.

Scientific novelty. The article in detail describes all genetic types of phosphorites (block, nodular in marl and sand) found when carrying out the research, the qualitative and quantitative composition and ways of use are studied. There is a detailed analysis of lignum fossil and decay ooze deposits in the article.

Practical points. The results of the research prove existence and wide distribution of deposits of phosphorites and decay ooze in Kharkiv region. Their further study may eliminate deficit in phosphorous, nitrogen and potassic fertilizers.

Keywords: the Dnieper-Donets basin, deposits, tars, phosphorites, lignum fossil, decay ooze, fertilizers.

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HYDROGEODODYNAMIC PROCESSES IN CARBONATE ROCKS. PART I. SUFFOSION

Problem statement. Groundwater is an active factor in geodynamic processes, giving rise to such phenomena as suffusion and karst of carbonate rocks. These processes pose one of the greatest threats to buildings and structures and occur predominantly under the influence of infiltration waters, the horizons and complexes of which are in the near-surface, broken part of the lithosphere.

Groundwater is characterized by two main types of geological activity - physical (mechanical) and chemical (soluble), which, accordingly, causes the development of such geodynamic processes as suffusion and karst in carbonaceous rocks. Very often both mechanical and chemical groundwater activities occur simultaneously. Therefore, determining the role of each of these processes in the destruction of carbonate rocks requires field observations, laboratory studies and theoretical substantiation.

Object matter of the research. The object matter of the study is the marl and chalk rocks of the Upper Cretaceous, which are exposed in the southern wing of Svyatohirs'k brachyanticline in the form of "Cretaceous boulder". This structure is separated by the zone of the Petrivs'k-Kreminna deep fault, along which flows the river Siversky Donets.

The **subject matter** of the research is the suffusion in the carbonate marl and chalk rocks of the upper chalk.

Presentation of the main material. The geological, hydrogeological and geomorphological features of Svyatohirs'k brachyanticline in connection with the development of suffusion processes are considered. On the basis of the factual material obtained in the course of field studies, it is shown that physical destruction of the rocks, referred to as suffusion, occurs in the carbonate marl and cretaceous strata of the upper chalk. The possibilities of determining the quantitative indicators of "solid runoff" that is formed during the transfer of solid mineral matter by the underground waters are described. It is established that the intensity of suffusion is directly dependent on the volume of infiltration water in different periods of the year and the geomorphological features of the territory.

The most recent and present-day tectonic activation of the Petrivs'k-Kreminna fault promotes the development of suffusion, which causes not only the raising of the southern wing of Svyatohirs'k brachyanticline, but also the disintegration of carbonate marl and cretaceous rocks of the upper chalk. The ascendant tectonic development of the relief is associated with arching slopes, which substantially dominate the "Cretaceous boulder" relief. This is due to an increase in the energy potential of denudation processes and, consequently, an increase in the influence of infiltration water flows on the carbonate rocks of the weathering zone and the intensification of suffusion. It is substantiated that at a certain stage of the development of the suffusion process there is observed a shift from quantitative changes, connected with the ever larger fragmentation of carbonate rock particles, to qualitative - physical (suffusion) processes to the chemical (karst).

Conclusions. It is shown that groundwater is an active factor in geodynamic processes in carbonate rocks, which bring about suffusion and karst. Suffusion is the result of the physical activity of groundwater, in which rocks are mechanically (physically) destroyed with the formation of "solid runoff". The most important indicator of the intensity of suffusion is the module of "solid runoff", which depends on the climatic, geomorphological and geological features of the territory. This process is also correlated with the seasons of the year and the manifestations of modern and modern tectonics, which determines the directions of relief development. The development of suffusion processes is accompanied by increasingly more intense shredding of carbonate rocks (up to suspensions). Under certain physical and chemical conditions, this causes the transition of quantitative changes in the system "carbonate rocks - underground waters" into qualitative - physical (suffusion) processes into the chemical (karst).

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TYPIZATION OF THE REGIONAL URBAN PROCESSES IN UKRAINE

Formulation of the problem. Spread of the urban processes in the world and in Ukraine determines the relevance of this research. Spatial ordering and organization of urban forms change over time, determining peculiarities of regional living conditions, their level and quality. With the general trend of increasing the level of urbanization in Ukraine and its significance, there is important differentiation in terms of regions.

The purpose of the article is to identify the features of urban processes in Ukrainian regions, time and structural features, and find out typical features of regional urban processes in the country.

Results. Regional features of urban processes, their structure (features of regional settlement systems based on the Zipf-Medvedkov's law, the level of real urbanization) as well as temporal features (dynamics of urbanization level and real urbanization, urban population) have been established. This has allowed us to typify regional urban processes in Ukraine and select seven types of them.

The first type is characterized by a high level of official and real urbanization. It has two subtypes: I-a - the settlement system is close to the ideal allocation (Dnipropetrovsk region), and I-b - a monocentric settlement system (Zaporizhya region).

Kharkiv region belongs to the second type. It is highly urbanized with a low level of real urbanization. A sharply monocentric settlement system is typical.

The third category belongs to Kyiv region, which is characterized by an average level of official urbanization and a high level of real urbanization. Urban settlement system is sharply monocentric.

The most numerous is the fourth type of medium-urbanized with the average level of real urbanization. It is divided into four subtypes. The subtype of the IV-a belongs to Khmelnytsk region with a settlement system close to the ideal distribution. Poltava region belongs to the IV-b subgroup with a two-centric settlement system. Cherkassy, Mykolaiv, Sumy regions are characterized by a monocentric settlement system and belong to the sub-type IV-c, Lviv and Odessa regions form a sub-type of IV-d with a sharply monocentric settlement system.

The fifth type is moderately urbanized with a low level of real urbanization. We distinguish it from two subtypes: V-a - the settlement system is close to the ideal distribution (Kirovograd region), V-b - monocentric settlement system (Volyn, Zhytomyr, Vinnitsa, Chernihiv regions).

The sixth type is low-urbanized with a high level of real urbanization. It is characterized by a sharply monocentric settlement system. Chernivtsi region is exactly that.

The seventh type is low-urbanized with an average level of real urbanization, divided into two subtypes. Zakarpattia region has a two-centric urban settlement system (VII-a). Ivano-Frankivsk, Ternopil and Rivne regions have a monocentric settlement system and belong to the subgroup VII-b.

This typification reflects the natural processes of self-organization in space, the formation of a hierarchical system of cities, reflecting the possibilities of their development and functions of interregional and regional significance, influence on the regional development. Coordination of regional policy measures with the influence of the society's territorial organization, which is dynamic and diverse at different stages of development, will allow more efficient use of the urban and regional potential.

Keywords: urbanization, urban processes, regional urban processes, real urbanization, level of urbanization, settlement system, Zipf-Medvedkov's law, typification, population, Ukraine.

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NATURAL RESOURCES MANAGEMENT IN THE COASTAL STRIP OF THE AZOV SEA

The purpose of the article is to characterize features of the natural resource management in the coastal zone of the Sea of Azov taking into consideration natural and anthropogenic factors and to formulate a general vision of its integrated management.

The method is based on the analysis of normative and legislative initiatives of Ukraine in the field of the territory management, in particular coastal marine zones, analysis of planned and introduced economical and conservation projects and their efficiency, analysis of the global experience in the effective management of coastal zones with an attempt to transmit it to the Azov Sea coastline.

Results. During the 20th century, the strategic planning and management of land and water areas was grounded on an economical component. A resource paradigm in science and society has changed since then to environmental one thus requiring the search for new integrated management approaches, including coastal marine areas. The latter are characterized by a high density and variety of natural conditions and resources, being the basis for the formation and development of human economic activity. The conflict in the exploitation of coastal natural resources lies between their excessive use and development of the territory, causing depletion of the resources and disruption of ecological balance in the environment.

A significant diversity of natural conditions and resources of the Azov Sea coastal zone, high dynamism of natural processes, considerable anthropogenic development of the coastal land, high concentration of local

population, and traditional practices of use of natural resources should be taken into account when planning management activities in the coastal marine zone. Analysis of introduced projects and programmes in the Azov Sea coastal zone in most cases has shown their economic and resource efficiency and effectiveness. However, these highly specialized departmental projects did not actually demonstrate an integrated approach.

In our research, we analyzed a global experience in the spatial scale for the implementation of a management system. It is proposed to focus on the natural-economic systems, which take into account both natural, and economic components and all types of interactions between them. In this capacity, the justified boundaries (the watershed line on land and 10 m isobath in the sea) of the Azov Sea paradyamic landscape system are advisable to use.

It is concluded that the legislative framework in Ukraine does not actually provide an integrated management of the coastal marine zones, and in existing reports and documents the information about the coastal zone of the Sea of Azov is virtually absent or sporadic.

It is proposed to introduce a system of legislative and executive initiatives for the regulation of use of natural resources in the Azov Sea coastal zone and for its integrated management.

Scientific novelty: application of the gained global experience in the management of coastal marine zones to land and water areas within the Azov Sea paradyamic landscape system.

Practical value: possibility to implement the global experience in the coastal marine zone management for the Ukrainian part of the Azov Sea region.

Keywords: coastal marine zone, surf zone, paradyamic landscape system, contrast environments, interaction, optimisation and management of natural resources.

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DEMOGRAPHIC DEGRADATION OF SEVERODONETSK-LYSYCHANSK AGGLOMERATION IN THE POST-SOVIET PERIOD

Formulation of the problem. Today Severodonetsk-Lysychansk agglomeration is the main administrative, socio-economic, political center of Luhansk region, where 15.6 % of the region's population lives. This agglomeration is a conurbation and includes 3 city-cores (Severodonetsk, Lysychansk and Rubizhne) and 44 other settlements (5 cities, 10 urban-type settlements and 29 rural settlements). Such a complex structure determines the importance of studying internal differences in the dynamics of population in different settlements of agglomeration.

The purpose of the article. The article deals with the analysis of population dynamics and rates of its growth for Severodonetsk-Lysychansk agglomeration and its individual settlements in the post-Soviet period and justification of the agglomeration depression in terms of population loss.

Results. The post-Soviet period of agglomeration development is characterized by a negative dynamics of the population. For the period 1989–2015, the population of the agglomeration decreased by 22.2 %, in particular by 10.7 % for 1989–2001 and by 12.9 % for 2001–2015. Such extremely negative trends can be explained by its location, on the one hand, in old industrial area, and on the other hand, in the area of the antiterrorist operation. The loss of the population of almost all urban agglomerations is very significant (exceeding 5 % over a decade). According to the indicator of population decline (more than 10 % for the thirty year period) agglomeration is depressed. Among the 18 urban settlements of Severodonetsk-Lysychansk agglomeration, all settlements, except for urban-type settlements belonging to Severodonetsk City Council, are depressed in terms of population loss. This testifies to suburbanization processes in the suburban zone of Severodonetsk. The largest decrease in the population during the years of independence was in settlements in the influence zone of Lysychansk. Negative dynamics of the population in Severodonetsk-Lysychansk agglomeration in the post-Soviet period is primarily accounted for depopulation due to negative indicators of natural growth.

Given the extremely high rates of decline in the population of Severodonetsk-Lysychansk agglomeration over the past decades, aggravation of the demographic situation, negative balance of migration, location in the area of the antiterrorist operation, chronic nature of socio-economic problems, the agglomeration can be considered as crisis.

The geopolitical crisis in the east of Ukraine has both negative and positive impact on the development of agglomeration on the whole and the dynamics of the number of its population, in particular.

Keywords: number of population, population dynamics, population growth rate, dynamics of the population growth rate, demographic problems, depopulation, demographic degradation, depressiveness, old industrial area, area of the antiterrorist operation.

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CONCEPT OF WORLD CITIES: HUMAN-GEOGRAPHICAL APPROACH

Formulation of the problem. The phenomenon of world (global) cities is of considerable interest and is the subject of research of specialists from different spheres. The study of world cities at the present stage of the society's development is complicated by a number of aspects, including complex and dynamic development of the geopolitical and geoeconomic world space, which explains rapid transformation of cities; the

complexity of a statistical base formation for the study of world cities, expressed in a large amount of diverse information and limited access to it; lack of a holistic and unique methodology for studying world cities.

The purpose of the article. The article studies the human-geographical approach to the formation and development of the concept of world (global) cities in the XX–XXI centuries.

Results. In modern scientific literature there are a number of terms describing the phenomenon of world cities, in particular, including «global city», «world center», «world financial center», «cosmopolis», «information city», «media city», «metropolis», «ecumenopolis», «global city region», «capitals of capital», «international city», «globalizing city» «megacity», «interactive city», etc. The variety of terms is an indicator that reflects the ambiguity and complexity of this phenomenon in modern science, as well as the diversity of approaches to its study. Definition of «world cities» concept is based on such aspects as economic development, political influence, social significance.

Formation of the world cities concept has a fairly long history. A significant contribution to its formation and development was made by P. Geddes, P. Hall, C. Doxiadis, F. Braudel, H. Reed, J. Friedmann, G. Wolff, N. Thrift, S. Sassen, M. Castells, C. Abbott, Y. Jao, A. E. Tschoegl, Y. Cassis, P. Taylor, A. Scott, P. Marcuse, R. Van Kempen, E. Isin, D. Clark, N. A. Slucka, S. McQuayer and others. In their research, the world city is, firstly, as a phenomenon unique and singular; secondly, the scope of its influence clearly has a planetary or, ultimately, macro-regional coverage; thirdly, the world city represents a special force concentrator, whether in the field of ideology, religion, military force, innovation economy, etc.; fourthly, it acts as a hegemon, functions as a governing and controlling element within the framework of another, «subordinate» territorial-social system; fifthly, the spatial organization of such a system has a clearly pronounced center-peripheral character; sixthly, the presence of the dominant one-, two-way links that support the system.

Several approaches to identifying the phenomenon of a world city based on different principles can be singled out: geoeconomic, geopolitical, socio-cultural, historical-geographic, geodemographic, information and communication, service, innovation. Human-geographical approach is important as it combines all of the above-mentioned and provides the most comprehensive study of the phenomenon of world cities.

Keywords: global city, world city, world center, world financial center, cosmopolis, information city, media city, metropolis, ecumenopolis, global city region, capital of capital, international city, globalizing city, megacity, interactive city, concept of world cities, human-geographical approach to the concept of world cities.

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SOILS UNDER CONDITION OF CLIMATE CHANGES: ADAPTATION, PREADAPTATION, READAPTATION?

Aim. To cover the current humus state of Ukraine and Podillya, to prove the significance of improving it as a guarantee of increasing their resilience to contemporary and future climate change and productive use in conditions of increasing its extreme.

Methods. The basis of the study was statistical data and materials of special reports and scientific works, its methodological basis – the methods of structural-system analysis and forecasting.

Results. Analysis of statistical data indicates the continuation of dehumidification of soil cover and violation of scientifically grounded crop rotation structures. As a result of annual losses of humus in the coun-

try's soils with 1,07 t/ha and its negative balance of 0,44 t/ha, there is a significant increase of sowing of corn and industrial crops. During the period of 2000-2015, the area under it increased by three times, and sunflower by 1,76. Also, during this period, the area under rape increased by 3,2 times, reaching 2.53%. The sowing of crops of perennial grasses decreased by 2,9 times with a share in crop rotations of 3,8% (with the recommended crop structure in Polissya 5%, in other zones – 10 %).

A similar trend is observed in the Podillya region. The area under corn for the period 2010-2015 increased by 5,5%, sunflower – by 1,2%.

Conclusions. The key to increasing sustainability of soils in conditions of intensifying extreme weather phenomena and their productivity is an urgent application instead of adaptation strategy (gradual adaptation to new climatic conditions) of preventive actions - roar (the restoration of their important components and properties lost) and adaptation (improvement of their agroecological condition). In the current economic climate, this can be achieved by adhering to scientifically sound agricultural development (which is often ignored by land users) with a share of their perennial grasses not less than 10% and introduction of low-cost grain-herbal types that provide a deficit-free humus balance in the soil.

Keywords: climate warming, adaptation, reaptation, preadaptation, humus, crop rotation, cultivating and technical crops, perennial grasses.

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GEOINFORMATION SYSTEMS USE IN THE INVESTIGATION OF REGIONAL POPULATION GROWTH

Formulation of the problem. Use of GIS in socio-geographical studies determines their quality in our time. Due to the ability to display and analyze data, geographic information systems reveal the peculiarities of the spatial interaction of social and geographical objects. Use of GIS in the human geography to study population settlement systems allows us to establish patterns of formation and development in settlements and peculiarities of their distribution across the territory. The use of analytical capabilities of the GIS in the study of settlement systems helps to find out what determines the location of settlements and the link between them. The main stages of GIS analysis should be considered, such as questioning, evaluation of data, selection of the method of analysis, data processing and evaluation of the results.

The purpose of the article. The purpose of this study is to uncover methodical bases for the use of geoinformation systems in the study of resettlement systems of the population in the region on the example of Kharkiv region in such GIS platforms as Map Info, Arc View, Arc Gis.

Methods. The author's own achievements as well as the research results of domestic and foreign investigators made the methodical basis for the article.

Results. The article reveals the role of geoinformation systems in socio-geographical research, defines the main functions of geoinformation systems in the study of settlement systems, and presents an algorithm for conducting GIS analysis. Using geoinformation systems, the analysis of the resale structure of the region was carried out, advantages and disadvantages of methods of constructing population density maps of the region were identified, ways of constructing cartograms were presented. Features of constructing maps of demographic potential are presented in the article. The centographic method is used for mathematical description of the spatial distribution of the population in the region. The topological methods of centrometry are presented. The advantages of using GIS in the research of resale systems are determined.

Scientific novelty and practical significance. The article highlights the fact that when using GIS to construct cartographic images of the resettlement systems development, a combination of the spatial-temporal aspects of the research is important. One of the important advantages of the geoinformation approach in the study of resettlement systems is the operation of the attribute of objects, since a significant part of the derivatives of the geodemographic data given in the work (dynamics, density, percentages) were calculated by means of processing attributive information in GIS systems.

Thus, using the GIS systems in the research of resale systems is explained by the need to establish spatiotemporal interconnections between settlements, to identify the features of the impact of the developed settlements on less developed, to determine the prospects for their further development and evolution of the system as a whole.

Keywords: geographic information systems, GIS analysis, population settlement system, population density map, demographic potential map, isolation, spatial analysis.

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DEFINING OPTIMAL WAYS OF KHARKIV'S SOCIAL-ECONOMIC DEVELOPMENT BY COMPONENT ANALYSIS

Formulation of the problem. Due to active development of the Ukrainian cities a question arises as to the definition of problems and prospects of urban organization, ways of city space optimization. For Kharkiv

city, the second biggest city by population in Ukraine, leading industrial, scientific and cultural center of the country, definition of weaknesses and strengths of social-economic development is quite relevant.

The purpose of the article is to define optimal directions of social and economic development and the organization of Kharkiv's city space on the basis of the component analysis.

Methods. Method of component analysis is used in this article to determine the optimal ways of Kharkiv sociogeosystem development. The essence of this method is the definition of projections in the development vector to multidimensional space with the detailed substantial analysis of their changes. This method allows to move from the general assessment of the conditions and level of SGS's development in an integral form to the assessment of individual components (parameters).

Main results. During 2010-2015 development of Kharkiv SGS of the city was positively influenced by the following factors: an increase in the number of children at preschool and other educational institutions; volumes of the sold industrial output; number of officially registered enterprises; reduction in boiler and oven fuel use; reduction in heat power use.

The decline of population, reduction of educational institutions and students number at higher education institutions by III and III-IV levels; reduction in the number of workers engaged in scientific activity were negative factors for development of Kharkiv's SGS. During all research time Shevchenkivskyi and Kyivskyi districts were the leaders by all indicators. Nemyshlianskyi and Kyivskyi districts were outsiders by dynamics of development. For Novobavarskyi, Slobidskyi, Kholodnohirskyi, Osnovianskyi and Nemyshlianskyi districts it is proposed to introduce programs for improving the demographic situation. For Shevchenkivskyi and Kyivskyi districts it is proposed to increase the number of schools and pre-schools or to renew educational institutions. For Nemyshlianskyi and Osnovianskyi districts it is proposed to support business development.

Scientific novelty and practical significance. By using the method of component analysis in this study, it was possible to identify the main problems of socio-economic and spatial development of the city, as well as to propose recommendations for its improvement.

Keywords: component analysis, socio-economic development, social geographical system, statistical indicators, organization of urban space, city, Kharkiv's administrative districts.

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INNOVATIVE APPROACHES TO SOCIAL GEOGRAPHICAL RESEARCH AND EFFECTIVE USE OF ECONOMIC POTENTIAL OF THE CARPATHIAN REGION

The purpose of this article is to clarify the innovative approaches to social geographical research and effective use of economic potential of the Carpathian region.

Methodical base while writing the article was shaped by general scientific methods such as analysis, synthesis, and generalization, deductive and systemic methods.

Results. In this article the innovative approaches to social geographical research and effective use of economic potential of the Carpathian region have been revealed. Among the main innovative approaches development of economic potential of the Carpathian region on the basis of energy and resource-saving, as well as development of "green economy" have been suggested. Comparative characteristics of "green economy", "green growth" and stable development have been brought on. The key principles of "green economy" have been formulated, among which are: harmonization in relations in the system "nature – human – production"; appropriate coherence of economic, social and environmental priorities; protection of both human and nature from the devastating impact of the production activity conducted by society; provision of favorable living conditions in the current and future periods; guaranteeing the growth of the economic potential of society and its socio-cultural development in the conditions of ecological safety. It has also been led upon terms of political provisions in Association Agreement between Ukraine and EU, which foresee establishment of stable economic development and mechanisms of "green" economy in accordance with the principles of strategy realization on stable development; this strategy was initiated at the UN Summit "Rio+20". The detailed analysis of "green" economy priorities by sectors of economy, such as energy, resourceful, food, social, regional economy, industrial, transport and financial has been carried out. Resource-saving factors of effective use of economic potential of the Carpathian region have been considered, which can be defined as the most popular priorities, leading to the increase in people's welfare and social justice with significant decrease in ecological risks and ecological deficits. The main directions of rational energy, resource and nature use as well as state strategy in rational nature use have been suggested.

Scientific novelty consists in the fact that the prospective ways to improve the market of resource-saving technologies have been suggested, among which are: products and services quality improvement, which are produced by enterprises with adaptation to nature protection requirements, as well as implementation of international standards of resource-saving, development and introduction of new products based on the use of resource-saving technologies, putting into the economy foreign investments on resource-saving production and facilitation of the development of institutions to promote and support resource-saving production.

Practical significance consists in the fact that innovative approaches to social geographical research and effective use of economic potential of the Carpathian region, suggested in this article, can be used in practice for efficient exploitation of economic potential of the Carpathian region.

Keywords: economic potential, energy saving, green economy, infrastructure, the Carpathian region, resource saving, social development.

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SOCIO-DEMOGRAPHIC FACTORS OF THE DEVELOPMENT OF AGRICULTURE IN KHARKIV REGION

Relevance. Agriculture of Kharkiv region is formed by the combination of factors: natural and geographical, economic, socio-demographic, as well as agroclimatic, land, and water resources. Socio-demographic factors are the main ones, with the level of agriculture development.

The purpose of the article. To identify the impact of socio-demographic factors on the development of agriculture in Kharkiv region, to analyze the current demographic situation in the region, the level of social infrastructure and to the ways to increase the level of agricultural development in the region.

Results. Demographic factors include the number and density of the population, its age and sex composition, labor resources, remoteness of settlements from the regional and district centers. The totality of these factors affects the provision of agriculture with labor, as well as the formation of agricultural specialization. In Kharkiv region there is a high proportion of the urban population, a large migration activity of the rural population, especially young people, a fairly large employment in the agrarian sector, the availability of skilled labor resources that could be used in agriculture, an efficient system of resettlement. A negative problem of the current demographic situation in the region is the rural population, since agriculture is an unprivileged area of rural employment. Social factors include the type of land relations, forms of ownership, the level of socio-cultural provision. A huge role in the production of agricultural produce belongs to the farm. A comprehensive socio-geographic analysis of these factors will make it possible to identify agricultural specialization in Kharkiv region, as well as to effectively use land resources.

Scientific novelty. In the article, the factors of agricultural development in Kharkiv region were analyzed for the first time. Socio-demographic factors are decisive, as they affect agricultural specialization, development of suburban forms of agricultural production. A comprehensive study of these factors will increase the economic efficiency of agriculture, solve existing problems in the agricultural sector of Kharkiv region.

Keywords: agriculture, socio-demographic factors, demographic situation, employment of the population, social infrastructure, specialization of agriculture.

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CARTOGRAPHIC SUPPORT FOR TERRITORIAL DEVELOPMENT STRATEGIES: ACTUALITY, PRESENT STATE AND PERSPECTIVES

Formulation of the problem. The authors of the territorial development strategies actively use different means of data visualization (tables, graphs, diagrams, infographics), neglecting maps. For example, only 14 % of the national sustainable development strategies of European countries are provided with maps. The root of the problem is the lack of a basic concept as to creation of strategy maps.

The purpose of the article is to substantiate the relevance of cartographic support for the territorial development strategies, analyze its current state and define prospects.

Main results. Maps are not only vivid and comprehensive means of data visualization, but also material for spatial analysis of the quality in achieving objectives set in the strategies. We consider active use of maps in development strategies relevant for all countries with a high level of geographic literacy and rich cartographic traditions.

The analysis of modern development strategies of various territorial levels (145 documents have been analyzed) allowed us to highlight the following trends in their cartographic support: prevalence of survey maps over thematic ones; dominance of inventory and evaluation analytical maps; schematic character and aesthetic appeal of maps.

At different stages of strategic planning it is appropriate to use various types of maps: at preplanning stage - survey, physical-geographic, socio-economic, ecological maps; when defining goals and objectives - it is expedient to develop at least one map illustrating its contents for each of the objectives set; when choosing the optimal scenario for the territory development - it is recommended to develop forecast maps; at the stage of strategy implementation - it is necessary to reflect the dynamics of indicators set for the objectives.

Conclusions. Creating maps for territorial strategies is a new direction in thematic mapping. Its perspective development requires active involvement of cartographers into the formation of strategies, use of modern cartographic works, in particular web-atlases, and creation of mapping methodology.

Keywords: development strategy, territorial development, strategic planning, cartographic support, a map.

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METHOD OF MATHEMATICAL MODELING IN THE MELIORATIVE GEOGRAPHY AND RECREATION

The actuality of the problem is determined by dependence of agriculture on the natural factors, and in particular, on the weather-climate conditions. All components of natural-agromeliorative systems and in particular hydrometeorological factors take an active part in the formation of agricultural crops. When solving these questions, it is necessary to have an objective estimation of the influence of the different factors including weather and climate on the level of agricultural production. This will allow us to determine contribution of various indicators of agro-meteorological conditions in the estimation of cereal harvest more reasonably. In this connection, the research of the weather-climatic conditions influence on the vegetation of agricultural crops in general and in the conditions of grain farming development in Kharkiv region, in particular.

The method of mathematical modeling was chosen to study the problems formulated in the work. The study of the phenomena of nature and human activity without the use of mathematical methods is considered one-sided, because it does not take into account one of the important aspects of any study - the side of quantitative relationships and appropriateness.

The result of the research is an analysis of statistical indicators of agricultural crops harvest and hydrometeorological conditions in Kharkiv region during the period 1972-2016.

Having analyzed these indicators, we have determined that the quantitative dependence of the crop on the number of dry days is a complex nonlinear multi-parameter. At the same time, close connection between the harvest of corn and sugar beets with weather conditions was very significant, as indicated by the large correlation coefficient between them, which is equal to 0.87-0.90.

We have worked out a hypothesis about the form of functional dependence between these components. Using method of mathematical modeling to analyze the spatio-temporal structure of natural-anthropogenic phenomenon development allows us to unify the hydrometeorological characteristics, and it can be used in different fields of science, in particular, in recreational geography.

It is noted that recreational geography is the newest branch of knowledge, where mathematical methods occupy an important place in scientific research. The model of the natural-recreational system is proposed in the work. This allows us to introduce a complex study of interdisciplinary connections of investigated objects. The feature of the model is in the fact that it allows to cover all levels of the systems development from planning, designing and creating recreational systems, to estimation and forecast of their functioning.

The scientific novelty of the study lies in the fact that the extended concept of the natural-recreational system is formulated, and the principles and methods of research, in particular, the method of mathematical modeling, allow us to consider the system as a holistic natural-anthropology of formation. The methodical approach provides the interdisciplinary level of research of the natural-recreational system. It is possible to study the systemic nature of the system components connections.

The practical value of the work focuses on the agricultural sector. The discovery of quantitative estimation of crops harvest dependence on weather factors allows us to calculate crop yields in each particular case. This technique can form the basis for forecasting crop yields.

Keywords: meliorative geography, natural-agromeliorative systems, recreation, agriculture, weather, climate, hydrometeorological characteristics, mathematical methods, modeling.

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PHYSICAL AND GEOGRAPHICAL PRINCIPLES OF TOURIST CLUSTER'S FORMATION IN KHARKIV REGION

Formulation of the problem. The article considers the main physical and geographical factors (climate, water, forest, relief) forming a tourist cluster on the territory of Kharkiv region. The cluster approach allows us to determine priority directions for the development of tourism, to use natural conditions as much as possible and to carry out nature conservation measures.

The purpose of the article. The purpose of this article is to study natural-geographical criteria for the formation of the tourist cluster in Kharkiv region, their evaluation and generalization.

Methods. The study of climatic parameters has been carried out using a statistical method, analyzing time series of average monthly air temperature, precipitation and solar radiation for the period 2001-2015.

Results. Given the fact that Kharkiv region is in the northeast of Ukraine, it is characterized by a peripheral location. In general, its area is approaching a circle, determining equivalent relations between the regional center and the outskirts.

The relief of Kharkiv region is mostly undulated, it is a plain, cut by river valleys, valley floors and power ravines. The peculiarities of the terrain in the region are emphasized by burial mounds (graves) created by man in ancient times, which increases historical and cultural value of the region under study. Climatic resources of Kharkiv region are favorable for recreation, especially for summer types, such as beach, sports, cognitive recreation.

According to N. Fomenko's methodology of estimating the recreational territory, the climatic resources of the studied region correspond to the indicator "good", as well as to the parameters of optimal climatic

conditions for recreational purposes. The territory of Kharkiv region is located in two landscape zones - the forest-steppe (northern part of the region) and the steppe (southern part). Today steppe vegetation has almost disappeared, which is explained by excessive agricultural activity. Kharkiv region is one of the main centers of balneotherapy on the left bank of Ukraine.

Scientific novelty and practical significance. Today, the tourist cluster is considered an innovative form of the regional economic development, since tourism is one of the territory's socio-economic functioning factors. Tourist and recreational activities are also very important in international economic relations. The formation of the tourist cluster of the territory will make it possible to effectively use all available tourist and recreational resources of the territory. Thus, the main factors determining the organization of tourist and recreational activity on the territory of Kharkiv region are relief, climate, water and vegetation resources. The region under study has sufficient recreational and tourist resources and good potential for their development, primarily of cognitive, river recreational, green and ecological tourism.

Keywords: tourist cluster, tourist market, climatic resources, recreational resources, water resources, relief, physical and geographical factors, Kharkiv region.

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MORPHOMETRIC ANALYSIS OF THE BOTTOM RELIEF OF WATER AREAS USING GIS (ON THE EXAMPLE OF THE AREA IN THE UKRAINIAN ANTARCTIC STATION "ACADEMIC VERNADSKY")

Formulation of the problem. The research of the bottom relief of water areas is one of the measures of the State target scientific and technical program for conducting research in Antarctica for 2011-2020. It is advisable to analyze spatial distribution of benthic groups. Current experience of research on the bottom relief of the water areas on local sites mainly uses the results of acoustic surveys as a source of data, less often - the data of remote sensing of the Earth and available cartographic materials.

The purpose of the article. The purpose of this article is to highlight the methodological approaches to the morphometric analysis of the bottom of the water area by means of GIS (using ArcGIS software complex) tested on the example of the test site of the research. The article also presents the results of modeling and morphometric analysis of the water areas bottom around the Ukrainian Antarctic Station "Academic Vernadsky".

Methods. A digital model of the water area bottom relief was constructed according to the echo sound survey. The means of geographic information systems, in particular the ArcGIS software system, are used. Mostly in research we used ArcGIS 3D Analyst, ArcGIS Spatial Analyst, algebra maps tools and other modules.

Results. On the basis of DMR, a bathymetric map and three-dimensional models were constructed, transverse channel profiles were constructed, angles of the surface of the surface were calculated, and the depth of the bottom relief dissection was calculated, too. Assessment of the potential accumulation of sediments was carried out. The article is illustrated by the fragments of the results obtained within the test site of the research - Meek Channel Strait between islands Galindez, Grotto and Corner (Argentine Islands, Western Antarctica).

Scientific novelty and practical significance. According to inadequate study of the research territory, the detailed relief data of the water area near the Antarctic station "Academic Vernadsky" were obtained and analyzed with GIS for the first time. Results of the development can be used in perspective researches of geochemical links between land and water, for further study of benthic groups.

Keywords: relief, digital model of relief, morphometric analysis, geoinformation systems (GIS), Western Antarctica, Ukrainian Antarctic research.

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SPATIOTEMPORAL VARIABILITY OF ATMOSPHERIC BLOCKING WITHIN NORTHERN HEMISPHERE OF EURO-ATLANTIC SECTOR DURING 1976-2015

Formulation of the problem. The westerly jet and the eastward progression of baric systems are common states of atmosphere in Northern hemisphere's midlatitudes. But this persistence balance is frequently interrupted by long periods of atmospheric blocking, which is a large-scale quasi-stationary extratropical flow regime. As a specific state of circulation it causes major transformation of baric, thermal and wind in

the low and middle troposphere and also affects cyclonic activity in nearby regions. On the local scale blocking can be associated with extreme weather such as droughts in summer and severe cold spells in winter. Also, redistribution of heat and precipitation, caused by blocking events, allows us to consider blocking as a climate factor. However, even now, after decades of study, blocking onset and decay are not well understood, as well as basic blocking theory wasn't formulated either.

The purpose of the article. Complete study of the atmospheric blocking phenomena requires an objective criterion for blocking anticyclones identification. Such criterion is based on preceding identification and tracking of baric systems throughout low and middle troposphere, which allows us to take into account its vertical structure. This approach is far more direct than existing blocking indices which use indirect evidences of atmospheric blocking existence. Defined criterion takes into account anticyclone's lifetime duration, mean latitude and longitudinal displacement.

Methods. The author's own achievements made the methodical basis for the article.

Results. Using a defined criterion, a dataset of atmospheric blocking episodes, occurred during 1976-2015, was created. It contains both detailed and generic characteristics of 210 blocking anticyclones. For case study methods of baric system's parameters evaluating were developed. These parameters include such characteristics as blocking intensity, affected area and accumulated geopotential anomaly. Analysis of these characteristics shows stable regularity of blocking episode's spatiotemporal variability. Spatial analysis shows presence of three major cells of atmospheric blocking in Euro-Atlantic sector: Atlantic, Scandinavian and Caspian. Parameters of blocking anticyclones in each cell show different behavior, but common trend is decrease in blocking activity in the last ten years comparing to the rest of research period.

Scientific novelty and practical significance. New approach to the atmospheric blocking study was realized and regional features of spatial distribution of blocking episodes in Europe were discovered for the first time. These features will be used in detailed study of the atmospheric blocking's effect on regional weather regime and climate.

Keywords: atmospheric blocking, baric system, reanalysis, spatiotemporal variability, method, criteria, anticyclone, characteristics.

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SOLVING THE PROBLEM OF SEARCH FOR A SUITABLE CITY AREA USING SPATIAL ANALYSIS

Formulation of the problem. The article focuses on the algorithm for solving a typical problem to find a suitable area within the city area for a new facility (individual components of the infrastructure). The main tool for achieving the goal is the concept of spatial analysis, which includes modeling of phenomena and processes. It is known that there are some reasons why modern research does not always correspond to the needs of society. This is, first of all, difficulties in collecting primary data. The researchers couldn't use standard sources of primary data, such as statistical collections, since cities do not have a single register of such information. Accordingly, they have to look for alternatives. One of these may be electronic reference books, such as 2GIS. If researchers find ways to properly collect valuable information about the infrastructural features of cities, they will be able to make their work more useful and practical for the society.

The purpose of the article. Consideration of one of the options for solving a typical problem of finding an optimal location for a new object based on a set of factors in the GIS environment (for example, finding a suitable site for building a new school near parks, playgrounds and at a distance from other schools, cemeteries).

Methods. Some parts of the ArcGIS platform and the ArcToolBox toolbar functionality have been used to perform spatial analysis (the Spatial Analyst module in particular). These are Euclidean distance, Reclassifying, Raster calculator and other tools of the Spatial Analyst module.

Results. The algorithm for solving a spatial analytic problem, consisting of five steps (setting the problem, dividing it into separate components, studying the initial data, performing the analysis and verifying the results) has been considered. Special attention is paid to the layout and combination of operations, performed to complicate the logic of the research. The raster calculator provides the ability to compare numerical absolute and relative indicators with indication of weights and specific algebra of maps. As a result, we find an optimal location for a new school within the city of Kharkiv. The remoteness of other schools, cemeteries, the proximity of park areas and playgrounds were taken as weighty factors. For each of the criteria, models of Euclidean distances were constructed in order to rank the territory for 10 categories of proximity/remoteness of objects. This is a practical example of using reclassification to combine the objects proximity/remoteness.

Scientific novelty and practical significance. It has been found out that scientists can do their research more practical, using modern geoprocessing tools and electronic reference books. There has been a typical algorithm for solving the spatial analytic problem, which is relevant for large cities. The instruments themselves are not new, but the conceptual algorithm which uses specific primary information about the infrastructure of the settlement and the functionality of the ArcGIS, has not been previously described.

Keywords: spatial analysis, search for a suitable area, urban research, anthropogenic infrastructure, GIS, ArcGIS, modeling phenomena and processes, the infrastructure of Kharkiv.

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GEOECOLOGICAL ANALYSIS OF SHORT-TERM TRENDS CHANGES IN THE STRUCTURE OF NPP "SLOBOZHANSKIY" TERRITORY BASED ON SATELLITE IMAGERY PLANETSCOPE

Formulation of the problem. The article analyses changes in landscape structure of the territory of National Nature Park "Slobozhanskiy" using satellite imagery for obtaining the actual material of plant communities, work in the field examining facies' contours on the basis of GIS-technology. The research comprises the territory of unique wetlands.

The purpose of the article is to show the results of a single physical-geographical process manifestations on the objects of the protected area through changes observation (monitoring) that can be fixed by decoding remote sensing data.

Methods. The main methods of research are the analysis of remote sensing data and control field landscape surveys, including the innovative online use of portable mobile devices (smartphones) to trace contours and create databases using mobile GIS.

Results. The authors reveal the possibility of using satellite imagery data for landscape monitoring. The study presented the choice of satellite images, methods of their processing. The paper highlights the possibility to use ArcGis tools for decrypting the data of PlanetScope imagery and further overlay analysis based on the data of topography, geological structure, soil cover and vegetation. The authors substantiate the need for large-scale mapping of the study area.

Scientific novelty and practical significance is in the choice of classification and postclassification methods, processing thematic imageries of vegetation. For the study area, the best results were obtained using satellite imageries PlanetScope with a spatial resolution of 3 meters. These processes affect changes in the plant structure, and, consequently, in landscape structure in general. In the study we have found that there are not only seasonal fluctuations but also a gradual decrease in the water surface and swamping. Landscape monitoring using GIS technologies allows you to quickly update information and predict future changes based on the collected data.

Keywords: PlanetScope, landscape monitoring, national park, wetlands.

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GEOLOGICAL AND ECOLOGICAL PRECONDITIONS FOR THE DEVELOPMENT OF HYDROGEOLOGICAL "WINDOWS" (BY EXAMPLE OF CRETACEOUS WATER INTAKES IN EASTERN UKRAINE)

Formulation of the problem. The article describes geological and ecological preconditions for the development of hydrogeological "windows" in the waterproof strata of the marl-chalk aquifer. Hydrogeological "windows", in some cases, can serve as conductors of pollutants in groundwater. This particular feature is one of the main factors that impair the quality of drinking groundwater. The task of hydrogeologists is to determine the location of hydrogeological "windows", establishing the geological preconditions for their development.

The purpose of the article is to define and characterize geological and ecological preconditions of hydrogeological "windows" development in the waterproof strata of the marl-chalk aquifer in cretaceous water intakes in Eastern Ukraine.

Methods. The studies presented in this article were carried out in accordance with the methodology of ecological and hydrogeological study of the territories conditions and the methodology for assessing the ecological status of the territories.

Results. Investigation of geological and ecological preconditions in hydrogeological "windows" development is shown on the example of some of the largest cretaceous water intakes in Eastern Ukraine – Svitlychansky, Zhytlyvsky and on the complex of marl-chalk water intakes in Kharkiv region. The article analyzes geological, hydrogeological, tectonic, geomorphological and paleogeographic features in the structure of the study area. On the basis of these data, geological preconditions of hydrogeological "windows" development on the investigated territory have been established: crossing the river valleys of tectonic structures; presence of local increase sites of groundwater mineralization near zones of tectonic disturbances; development of tectonic disturbances zones with their operating fracture zones; exit of cretaceous to the daytime surface.

Scientific novelty and practical significance. The conditions for hydrogeological "windows" formation are given and grounded. Systematic signs of hydrogeological "windows" existence and practical classification of hydrogeological "windows" is proposed. The environmental consequences of their existence are presented.

Keywords: hydrogeological "window", marl-chalk aquifer, Cretaceous water intakes, undergroundwater protection, waterproof strata, zone of fracture, outcrop, eluvium, river terraces.

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HYDROGEOLOGICAL PROTECTION OF THE BUCHAK-KANIV AQUIFER COMPLEX IN THE CENTRAL PART OF DNIPRO-DONETSK ARTESIAN BASIN FROM POSSIBLE TECHNOLOGICAL CONTAMINATION

Formulation of the problem. Every year, the problem of studying the ecological state of drinking groundwater becomes more and more acute, as the reserves of ecologically clean groundwater is becoming more and more depleted. At the same time, at the time of significant influence of technogenic factors on the quality of drinking groundwater, there is an urgent need for a more detailed assessment of the protection index of aquifer complexes promising for water use purposes.

The purpose of the article. The main purpose of the research is to show the degree of modern hydrogeological protection of one of the strategic reserves of drinking underground water in the region – Buchak-Kaniv aquifer complex – in the area of its greatest distribution and use – the central part of Dnipro-Donetsk artesian basin from possible contamination of water that lie above. Corresponding trends in protection changes during the long period of time (55 years) within the territory of work were also traced.

Methods. Taking into account the hydrogeological and lithological features of aquifer complexes and waterproof rocks in the interior of the subsoil, as well as on the basis of previous research by scientists, a multi-factor, adapted to these conditions, methodology for carrying out the research was developed. The methodology includes the definition of both static and dynamic components of the protection index. Calculations and graphic constructions were made for 2 periods of time – 1960 and 2015.

Results. The peculiarities of the hydrogeological protection of the aquifer complex within the territory of works during these periods were analyzed and relevant trends in changes in the indicator over the 55-year period have been traced. It has been determined that the territories of areas with unprotected and conditionally protected underground water expanded, and protected areas – on the contrary, decreased. The largest

changes occurred in the areas affected by water intakes of large cities in the region. The reasons for these processes are presented, the main of which is an anthropogenic factor.

Scientific novelty and practical significance. This methodology in assessing the protection in this region has been used for the first time. The obtained results of the research should be used to develop recommendations for the ecological protection of drinking groundwater in the region. This method of work can be used to determine a hydrogeological protection index of other pressure aquifer complexes in similar conditions.

Keywords: hydrogeological protection, Buchak-Kaniv aquifer complex, contaminated water, surface pollution, water intake, water table regime, separation layer, ascending stream zones.

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ASSESSMENT OF TECHNOLOGICAL POLLUTION SOURCES INFLUENCE ON UNDERGROUND WATER ON THE TERRITORY OF KHARKIV REGION

Formulation of the problem. To date, a large number of environmental problems remain unsolved. Moreover, their number increases year after year. First of all, this is due to the impact of man on a balanced nature, the expansion of industrial and agricultural production. Kharkiv region, whose industry plays a significant role in Ukraine's production and gives a tenth of all industrial production in the country, was investigated in the article to assess the impact of technogenic sources of groundwater contamination. There are more than 1200 industrial enterprises located here, indicating an extremely high level of industrialization, which results in the formation of significant volumes of industrial waste and negatively affects the environment. Powerful heavy industry enterprises on the territory of Kharkiv region, which have worn-out and technically outdated workshops and production in their structure, produce large volumes of industrial waste, which, in turn, causes an unfavorable environmental condition in the cities of the region, such as chemical pollution of air, soils, groundwater.

The purpose of the article is to assess the impact of technogenic sources of groundwater pollution on the territory of Kharkiv region.

Presenting main material. The article gives a description of the influence of the most significant objects of Kharkiv region, which pose a possible threat to groundwater, and therefore to the water intakes they operate. The sources of concentrated groundwater contamination in the investigated area are mainly large industrial enterprises, which, by their nature, use water in significant volumes and, as a result, have large amounts of waste water. Such sites are on the territory involved in the production cycle. These are septic tanks, sludges, heat exchangers, quarries, access platforms, warehouses, burial sites of various wastes, etc.

Conclusions. Several significant sites are located on the territory of Kharkiv region, which pose a possible threat to underground waters, and therefore to water intakes that operate them. These are, first of all, Zmiiv heat-station, Pervomaisky "Khimprom", Balakliya cement-slate intergated works, "Shebelinka gas-extraction", the point of radioactive waste disposal in the village of Dergachi, Dergachi District Solid Waste Management and some other active industrial enterprises. Based on the data of groundwater aquifers' chemical composition in the zone of influence of technogenic sources for the long period of observations, appropriate conclusions were drawn regarding pollution.

Keywords: man-made sources, pollution, underground waters, Kharkiv region, water intake, ecological problems, environment, geological monitoring.

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AUTHENTIC INFORMATION ON THE NATURAL-TECHNOGENIC GEOLOGICAL ENVIRONMENT AS A FACTOR OF REDUCING ENVIRONMENTAL RISKS

Formulation of the problem. An important component of environmental safety is the state of protection of the natural and man-made geological environment (ESGE) from the influence of dangerous natural and technogenic geological processes.

At present, there are 327 cities in Ukraine that need protection from certain dangerous geological processes (groundwater underflooding, landslide displacement, subsidence of base soils, etc.). [1-4] One consequence of this is the deformations and accidents of housing and utility buildings and industrial structures. Obviously, engineering and technical security of housing, along with other parameters of life safety is the basic human need. The safety of construction, reconstruction, operation of structures, territories protection from hazardous natural and man-caused processes, assessment of the impact of construction and reconstruction facilities on the environment, risk assessment should be based on complete and reliable data on the state and dynamics of ESGE, which is the subject of engineering research [14]. At the same time, there is a group of factors systematically adversely affecting the receipt of reliable information in this area.

This article is devoted to a detailed consideration of this problem.

History of the research of the problem. Problems of engineering geology and hydrogeology of urban areas, changes in the geological environment under the influence of human activity are revealed in the works of F. Kotlova, V. Krutova, V. Osipova, E. Yakovlev and others. A significant specificity of the research of the natural and man-made environment (engineering and technical surveys) is indicated by P. Konovalov, V. Ulitsky, M. Solodukhin, G. Strizhelchik, etc. Problems of engineering research and protection of historical buildings in the construction of new and reconstruction of the existing buildings remain relevant even now, especially for such large cities as Kyiv, Kharkiv, Dnipro, Donetsk, etc.

The purpose of the article is to substantiate the need for a reliable assessment of the state and dynamics of changes in the natural and technical geological environment. Classification of existing factors systematically adversely affecting the receipt of reliable information and determining ways to solve the problem is aimed at reducing geotechnical and environmental risks.

All large cities in Ukraine need protection from the manifestation of certain dangerous geological processes (underflooding by underground waters, landslide displacement, subsidence of base soils, etc.). The safety of construction and operation of facilities, assessment of the level of environmental hazard should be based on reliable information on the state and dynamics of the natural and man-made geological environ-

ment. To determine the severity of the environmental situation, the degree of deviation of an object or environment from a certain norm is usually used. It is important to know how far the object approached the level of destruction of its structure. The criterion for assessment can be the resource of the stability of the geological environment, determined by the permissible impact impulses (water inflow, application of static and dynamic loads, temperature effects, etc.).

Today in Ukraine there is a group of factors systematically adversely affecting the receipt of reliable information on the conditions of construction sites. This can lead to plant accidents or to significant unnecessary security costs, up to and including the abandonment of construction. These factors include:

1. Construction in all free areas with complex engineering and geological conditions in the central parts of cities, with maximum use of underground space;

2. Increasing the weight of reconstruction of existing buildings in the total volume of construction. It should be kept in mind that engineering surveys for reconstruction, having specific features, make them more complex than surveys for new construction sites;

3. A complex of administrative, economic and social factors associated with the systems of attestation of specialists, quality control, work in a market economy, etc.

To create objective conditions that reduce the degree of geotechnical and environmental risks, it is necessary to implement a set of measures at the state level.

Keywords: natural and technogenic geological environment, ecological risk, resource of stability, engineering and technical surveys.

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ECOLOGICAL AND ECONOMIC ASPECTS OF BY-PASS WATER DEPOSITS USE IN THE EASTERN OIL REGION OF UKRAINE

Formulation of the problem. Oil deposits in the eastern region of Ukraine are confined to the upper zone of the lower hydrogeological floor (zone of stagnant regime). This zone lies at depths from 1.5 to 5.5 km, including most of the Paleozoic deposits, is characterized by the development of primary pore sandy-aleuric and cavernous-fractured carbonate reservoirs with high porosity and permeability in which broaching systems of formation, massive-reservoir and massive reservoirs are filled with sedimentogenic brines.

Most of the deposits are depleted or are being developed in the final stages, in which, along with oil, there is also by-pass water in the extracted fluid.

Factors affecting the environment during oil production are considered. The schemes of by-pass water impact on the environment are given.

Results. In the article we show the urgency of stratal water use as hydromineral materials. Bromine, iodine, lithium are the main chemical components whose content defines water as a valuable raw material. Practical use of stratal water in Ukraine will increase the mineral resource base and reduce the impact on the environment.

The authors analyze stages of the field development in terms of the extracted fluid water content. The water coefficient in produced fluid extracted on the oil field is the main element that increases the cost of oil. In the article the theory using stratal water is presented, which allows the transfer of these waters expenditure component in revenue.

The authors describe theoretically "perfect" conditions in which the oil companies developing oil fields will work with profit. There are basic parameters that influence the overall profit of the company in terms of water production formation and considers in detail the income and expense components.

Scientific novelty and practical significance. The article compares profitable work of the oil company without implementing related-field water as raw hydromineral. The authors graphically expressed how oil companies can increase their profits by using stratal water and keeping on development period. The paper determines that concentration of chemical components in water is the main indicator showing possible industrial development and building price on hydro- raw materials.

Keywords: eastern region of Ukraine, oil deposit, mining enterprise, oil, by-pass water, coefficient of watering, production cost, expenditure and income components, hydromineral raw materials, realization, profit of an enterprise.

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