3rd Students International Geological Conference

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ABSTRACTS

Lviv, Ukraine
April 27-30, 2012

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The book contains the abstracts of presentation from the Students International Geological Conference devoted to the regional geology of Europe and related topics. — 3rd Students' International Geological Conference (April 27–30, 2012, Lviv, Ukraine).

The presentation are devoted to actual problems of recent regional geology and show the opinion expressed by representatives of researches from number of schools, universities and institutes from all around Europe.

Книга вміщує тези доповідей з 3-ї Міжнародної студентської геологічної конференції, присвячені регіональній геології Європи та спорідненим темам. — 3-я Міжнародна студентська геологічна конференція (квітень 27–30, 2012, Львів, Україна).

Доповіді висвітлюють актуальні проблеми регіональної геології та демонструють погляди, висловлені представниками різних шкіл, університетів та інститутів з усієї Європи.

This collection presents abstracts of the Third Students International Geological Conference. Researches concern many aspects of modern geology. Among other it is necessary to outline the problem which applies to useful minerals prospecting. First of all this refer to energetic resources. Exploration of shale gas in topical in Europe and elsewhere now. The latest techniques and technologies are used here. Widespread usage of methods of geophysical sounding are also a common method.

In a number of reports various aspects of using GIS in geology and environmental protection are presented. Today geology benefits from the latest achievements of information technology. In particular, this applies to geographic information systems and their usage at all stages of geological research ranging from data collection to their processing and presentation in various forms.

Modern geology is at the stage of development, which should provide not only the exploration of useful components, but their rational usage and recycling. Therefore, many abstracts concern problems of environmental protection and rational usage of natural resources.

Traditionally, students pay much attention to the study of mineralogy and petrography of sedimentary and igneous formations of different ages.

Another "classical" branch of geology, i.e. structural geology is also enjoying the development. Usage of new methods and approaches provide a new information flow which scrutinizes progressive investigation of various crust structural elements. This is shown in a series of reports.

Both small territories and large basins located on different continents are concerned by students from the geographical point of view.

Editorial Board

В цьому збірнику представлені доповіді учасників 3-ї Міжнародної студентської геологічної конференції. Дослідження стосуються багатьох аспектів сучасної геології. Серед інших необхідно відмітити проблеми пов'язані з пошуками корисних копалин. Насамперед це стосується енергетичних ресурсів. На передньому плані в Європі та в інших частинах світу стоять пошуки покладів сланцевого газу. При цьому використовують новітні методи та технології. Широке застосування знаходять методи геофізичних зондувань.

В низці доповідей представлені різноманітні аспекти використання ГІС технологій в геології та охороні довкілля. В першу чергу це стосується геоінформаційних систем, та їх використання на всіх стадіях геологічних досліджень — від збору даних, їх опрацювання та представлення в тих чи інших формах.

Сучасна геологія знаходиться на такому етапі розвитку, що повинна забезпечити не тільки виявлення корисних компонентів, але й їх раціональне використання, та утилізацію відходів цього використання. Тому значна частина доповідей стосується проблем охорони довкілля та раціональному використанню природних ресурсів.

Традиційно багато уваги студенти приділяють вивченню мінералогії, петрографії як осадових так і магматичних різновікових утворень.

Інша "класична" галузь геології структурна геологія також переживає підйом. Використання нових методів та підходів дає новий потік інформації про розвиток різноманітних структурних елементів земної кори. Це продемонстровано в серії доповідей.

В географічному охопленні студентами розглядаються як невеликі території, так і цілі басейни, що розміщені на різних континентах.

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The Geoecological State Analysis of Brody District

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Nowadays the problem of the environment geoecological degradation has been increasing. Intensive development of industry and agriculture, irrational and uncontrolled use of natural resources, increase anthropogenic pressure on the environment cause adverse changes of it's state. This in turn affects the social and demographic processes in society, health, general stress geoecological situation territory.

The object of investigation is a territory Brody district, subject — geoecological state components of the environment. Since the absence of large industrial plants and the dominant effect of agriculture attention is paid to its impact on the geosystems. This territory belongs to the small Polisya. Unique habitats of plant species formed on this territory. 13 nature-protective areas are the ekostabilizing factor in this area.

Using ArcGis software by ESRI in the research process, were designed and created the geodata base and cartographic models, that formed the basis for Brody district geoecological analysis. During research it was used stock, cartographic, statistical materials of the State department of natural environment, Main department of statistics, land resource, water management, forest management, sanitary and epidemiological service.

Investigated territory modern geosystem is the complex of natural and anthropogenic components, their correlation indicates stability or instability of geoecological state. A method that takes quantitative and qualitative characteristics of the environment components into account is used to determine the environmental stability of the territory and the level of anthropogenic pressure. This is determined by calculating the coefficients — K_{ee} and K_{an}, that characterize the impact of economic activity magnitude. The environmental properties coefficients of different types of land were considered in the first case, in the second — scoring the degree of anthropogenic load a particular type of land on the investigated area.

The coefficient of ecological stability areas (CES) is calculated as:

$$K_{ee} = \frac{\sum_{i=1}^{n} S_i K_i}{\sum_{i=1}^{n} S_i}$$

where K_i — ratio of environmental characteristics and land-type, S_i — area of landuse and species, n — number of indicators.

Coefficient of anthropogenic pressure on land resources K_{an} define it by the formula:

$$K_{an} = \frac{\sum_{i=1}^{n} S_i B_i}{\sum_{i=1}^{n} S_i}$$

where S_1–S_n — square of the land with some level of anthropogenic pressure B_1–B_n — relevant land's evaluation points [7]. Defining the coefficient of ecological stability areas and analyzed its distribution within the Brody district, it follows, that most of its area is ecologically stable (0.7–0.8 points) and stable medium (0.5–0.6points). Analyzing the distribution ratios of the anthropogenic pressure we can see that the vast majority of the study area has increased (3.1–4 points) and medium (2.1–3 points) level of this indicator impact.

Another aspect of geoecological state research are the heavy metals and other pollutants spatial distribution modeling in the environment components. For example, let's consider the distribution of pollutant content in the soil resulting from the application in agriculture amendments, fertilizers, pesticides, and using polluted domestic and industrial wastewater in irrigation. It should be noted that Brody district area is characterized by developed transport network. On its territory there are such important transport communications as "Lviv-Zdolbuniv" electrified railway, national significance trackroad "Kyiv–Chop", "Druzhba" Main Oil Pipelines. That is why along major highways zinc content exceeds the value of maximum permissible concentrations. Distribution of heavy metals in geosystems area research caused by the density of transport network. This direction was established cartographic models, reflecting the spread of content of cobalt, copper and zinc in soils in the Brody district. Analyzing the spatial distribution of these elements in the territory of the study, we conclude that the cobalt and copper reached a high level (70–80% of the total area), and zinc content is low (20–30% of the total area).

Based on the analysis of the ecological state of the Brody district we can draw the following conclusions that most of the study area is covered with forests, and the fact that its territory no very big factories contributes to stable environmental situation. The main directions for improving the ecological situation in the region and nature use optimization must predict measures to preserve and enhance biodiversity, forest regeneration, optimizing the structure of land structure river's watersheds, reducing the anthropogenic impact (emissions and discharges of harmful substances into the environment) by adhering to the principles of sustainable development area. Within the framework of such events "North Podilla" National Park in 2009 was created.

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"Lviv Citadel" Historic-Cultural Complex GIS Modeling of Nature-Economic Systems

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During centuries Carpathian region of Ukraine had a strategic value and gained well developed military infrastructure by different purposes facilities. Many of them lost strategic importance and were eliminated or abandoned. Some postmilitary objects even today have a particular value in landscape, architectural, historical and cultural aspects. Lviv Citadel is one of the examples of postmilitary objects. This fortification complex is a key area in our research. Lviv Citadel is a unique historic-cultural natural-economic complex that represents basic fortification tendencies in the middle of XIX-th century. The research area GIS modeling gives opportunities for complex estimation of nature-economic system antropogenic transformation degree and military activity consequences over the environment.

During creation of Lviv Citadel GIS model the following topographic plans were used: "Plan of Red Rus Capital City Lviv and Neighborhoods" of 1770, (*Plan La Ville de Leopole Capitale de la Russi Rouge avec les Feauxbourgs*), "Plan of Lviv City and Neighborhoods",of 1828, (*Plan der stadt Lemberg sammt ihren Vorstadten*), "Lviv and Neighborhoods" of 1844, (*Lemberg mit seinen Vorstadten im Jahre 1844*), map series "Plan of Lviv the Royal capital city" (*Plan królewskiego stołecznego miasta Lwowa*) of 1890, 1894, 1901, 1910 yy., a 1 : 2 000 modern topographic plan of Lviv, remote sensing data.

As main GIS software for spatial analysis ArcGIS 9.0 (ESRI) was chosen. Models structure was designed with appropriate geodatabase, where each item had own separate layer. After scanning and georectifying the vectorization of topographic plans (izolines, elevation points, hydrography, roads network and buildings, etc.) was held. Than, using *Topo To Raster* (*3D Analyst*) instrument the digital terrain model DEM of the investigated territory was created, that is well suited for relief displaying of postmilitary objects bordering localities. Using the *Georeferencing* tool the investigated area images were rectified to Quickbird-02 imagery. Layers that represent plateau leveled localities and fluvial forms were given a special masks, created by using *Spatial Analyst* tool and its *Extract By Mask* function. Slope complex morphometric analysis and relief models were created with *Slope* and *Aspect* functions from *3D Analyst* tool [2]. To correct deficiencies of resulting slope model the raster image was generated and small areas were filtered of by using *Majority Filter* (*Spatial Analyst*) function that allowed averaging and filtering of small areas [1]. A series of thematic layers with appropriate attribute base for complexes natural boundaries were created, where each natural-economic component had own classificator.

During the modeling process thematic models of slope shape, exposure, length, soil and vegetation cover, and modern land use structure were created. Morphometric parameters analysis using diverse models made it possible to distinguish natural, transformed and artificial landforms. Therewith three main genetic types of relief were singled out: monadnock (aligned watershed areas), slope and fluvial (stream valleys, wetlands and ravine network). As the Lviv Citadel relief is strongly dissected, nine classes of slopes were selected for the slopes shape model. Within the limits of Lviv Citadel landscape complex there are flat leveled areas (slope's shape 0−3º), and abrupt slopes (shape 40−50º) at the north-west and southern parts of the hills. Northern, northeast, southwest and south-east slope exposure prevails around the monadnock hills. Five main soil types are allocated: reactivated, sod-podzol, washed of ravine's and gullies

soils, rocks exits to the surface, gray podzoliated ashed light loamy soils. Deciduous and shrub planting is dominating within the complex, the bulk of vegetation is concentrated in the northern and south-western hills.

Using GIS technology has allowed to analyze the main morphometric parameters, to study the structure of land use, interpolate features of soil and vegetation cover formation. This was the basis for studying of historic-cultural complex "Lviv Citadel" natural-economic systems anthropogenic transformation degree. The research area has significant transformations as a result of military activities: relief become more complicated, exogenous processes activated, hydrographic objects disappeared, soil and vegetation cover transformed.

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Description of Dangerous Hydrological Processes in the Basin of DnisterRiverUpperPart Flow

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The north-eastern slope of the Carpathian folded region within the middle mountain landscapes of Scole, Turca and Drohobych districts of the Lviv region is a main columbine area of the Dniester River upper part flow and it's the biggest tributary which is the Striy River. Flow speed in the Carpathians during flood periods achieves 3–4 m/s and more. Under such conditions the landslides, mud flows, slope and lateral erosion are activating in the mountain part of the basin of Dniester River upper part flow. An oil pipeline "Friendship" is laid down in the basin of Striy River from the river mouth to Nyzhne Sinevidne and further along river-beds of the Opir, the Boutivlya, the Oryava, the Brimivka, the Climchanka, and also are laying the Scole branch of the arterial gas pipeline "Ivannyky-Poucenichi" and the product pipeline Drohobych — Kalush (VAT "Oriana"). In case of activation of above mentioned dangerous hydrological processes there exists the possibility of appearance of emergency situations and decompression of ecologically dangerous objects with incoming of oil products to the soil surface, underground and superficial waters.

The biggest danger of appearing of regional scale extraordinary situations exists for the Kam'yanka river-bed in the place of its crossing with the arterial oil pipeline. Hydrological and engineering-geological conditions of the Kam'yanka valley practically eliminate the possibility of prevention of landslide processes. Seismotectonic processes, unfavorable climatic phenomena, subsequent technogenic violation of the ground array, and especially total action of these factors can be a reason for activation. A basic danger at the worst scenario of events development would be created by the volley emissions of petroleum if the oil pipeline which goes across Kam'yanka River is damaged, and it can reach the columbine area of the Striy underground waters deposit in 6 hours.

Forest biogenesis of the Carpathians mountains is the main water keeping factor, which recently occupied about 90 % of territory. In recent years forestation decreased to 60–50%, especially within the Turka and Starosambir districts. Therefore protection and restoration of forest ecosystems are of great importance in the hydrological regime improvement of the upper flow of Dniester River.

Downstream from the Carpathians sierra to the Pre-Carpathian plain an average consumption of water substantially grows, namely from 40–50 m^3/sec during the mean water period to about 800–900 m^3/sec during the flood periods. Periodic catastrophic floods (in 1927, 1955, 1969 and 2008 respectively) substantially affected the state of the engineering buildings and coastal strengthening, as a result the settlements, agricultural lands, industrial objects were flooded, a transport infrastructure collapsed, and people died. The most dangerous area of flooding during periods of high water is area stretching from Sambir to Novyj Rozdil. At rainfall intensification some settlements can incur losses.

An idea of arrangement of anti-high water processes at the end of XX century dtcfuse of ecological caution and economic problems was not realized. Therefore within the Precarpahtian plain of the basin of Dnister River upper part flow the main threat for ecological safety is caused by the problems of against-flood protection.

The Loess Landslide Massif Energy

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The majority of Ukraine territory is covered with such specific soils as loess. Mid-Pridneprovie is not an exception. As it is known, these soils possess specific subsidence properties when get wet or torn, e.g. if the groundwater level rises (this phenomenon is influenced by many factors, such as leakage from the water communications, mass construction — on cities, construction of hydraulic structures, the violation of the hydrogeological conditions of the area, etc.). It is therefore important to predict the behavior of loess under different conditions, especially on the slopes of the landslide. This research focuses on loess power.

It is known that there are two approaches to assess the stability of slopes — mechanical and energy. The goal was to combine the models given to more adequately describe the processes occurring in the loess soils.

The article deals with the quantitative interpretation of a boundary where the bond energy of the loess soil is not sufficient to provide the slope stability. The latter is estimated by combining the energetical and mechanical approaches.

The research consisted of a series of triaxial tests carried out for loess soils under different loading conditions. Samples were taken from the actual landslide sites (beam Tunnel, construction pit on Karl Liebknecht street). Strength and deformation properties of soils were evaluated based on the results of testing accounting for the natural conditions and physical state. It is established that the loading mode can change the deformation modulus value for the same soil up to one order.

The developed computational scheme accounts for a combination of natural, geological and geodynamic factors using the complex energetical and mechanistic models. The new term named as the slope activation potential has been proposed as result of analyzing the field of physical gradients obtained by modeling. It is established that the deformation dynamics of a loess slope is formed under the impact of natural geological genesis of deposits and varying geodynamic factors. The proposed technique for modeling the loess soils stability accounts for this combination of finite element discretization of a slope by the equations of deformation continuity and gravity field where man-made and genetic components have been introduced.

The proposed concept of loessial slope activation and its ranges enables to distinguish the different phases of landslides processes. The developed approach has been applied to the site located on the slope of Tunnelna clough in the city of Dnipropetrovs'k.

The models of a slope were also created using the finite element method. The simulation results, as it was expected, confirmed the hypothesis. A combined model has also shown more accurate results data.

A Comprehensive Approach to Settling Problems of Coal Concentration Waste, Industrial and Everyday Waste in Lviv Region Using Alternative Kinds of Fuel at Mykolaiv Cement Works

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OJSC "Mykolaiv Cement Works" is one of the largest industrial enterprises in Lviv region, which after the decline of industrial production in the early 1990s began to improve its economic status and started to increase production. It is promoted by a profitable geographical location near deposits of cement raw materials: Dobryanskyi and Rozvadivskyi limestone deposits, Kahuivskyi clay deposit and Piskyvskyi gypsum deposit. The enterprise is situated near the main railway line Lviv–Uzhgorod and international highway Kyiv–Chop.

Within the current economic conditions the company tries to solve two major problems. The first problem is to reduce pollutant emission under the conditions the production level being raised and to solve environmental problems with increasing anthropogenic impact on the environment. The second problem is to find alternative types of fuel under conditions of sudden rising of prices on energy sources, especially natural gas. That's because "Mykolaiv Cement Works" is the biggest industrial producer and it is the largest consumer of natural gas in Lviv region with the exception of heat-generating organizations. To produce one ton of cement by wet method they spent on average 178 m^3 of natural gas. According to the current market estimations, the price for natural gas is $ 400 per 1 000 m^3, and only energy takes $ 70 (560 hryvnias) in the total price per 1 ton of cement. High prices for natural gas imported from Russia and the instability of its supply cement plants including OJSC "Mykolaiv Cement Works" to cope with alternative kinds of fuel.

These alternative types of fuel also include those, that create a series of environmental problems in Lviv region. They are coal concentration waste, combustible industrial waste, solid waste, depreciated tyres. On the other hand the introduction of alternative energy is accompanied by a negative impact on the environment and the increase of hazardous emissions. That's why it is very important to conduct environmental and economic evaluation of these alternatives and to determine their prospects both in terms of environmental impact and economic benefits.

Using of fine-dispersed concentrated coal waste from Chervonohrad mining industrial area on the north of Lviv region may be the most cost-effective solution under the condition of minimizing cost for transportation to "Mykolaiv Cement Works". It is explained by the fact that before transportation these waste materials are crushed and sorted and there is no need to spend any energy or money for doing this again. Furthermore, the use of concentrated coal waste will reduce technological impact on the environment because waste will not form dumps, which have a tendency to spontaneous ignition in time.

While using depreciated tyres and other energy content components (they can be found in solid waste like plastic, wood, paper and other types of biomass) as an alternative fuel, the major problems arising here are sorting and environmentally safe burial.

The annual savings of natural gas can reach up to more than 100 millions m^3 by realization of a comprehensive approach. If we realize such scenarios for solving environmental problems, it will improve the ecological situation in Lviv region essentially.

Testing the Material Kuznets Curve Hypothesis for Copper: Evidence from Rich Countries

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The paper tests the Material Kuznets Curve (MKC) hypothesis with regard to copper consumption for 17 high-income countries over the period from 1966 to 2010. The test is based on the suggestion of Narayan and Narayan (2010). Various generations of panel data unit root and cointegration tests are applied. The copper and GDP series are found to be integrated of order one and cointegrated especially after controlling for cross-sectional dependence. Moreover, the Blundell-Bond system generalized methods-of-moments (GMM) is employed to conduct a panel causality test in a vector error-correction mechanism (VECM) setting. Unidirectional causality running from real per capita GDP to copper intensity is uncovered in the long-run. A 1 per cent increase in per capita GDP generates an increase of 0.47 per cent in metal intensity in the short-run and a fall of 0.84 per cent in the long-run for the panel. These results therefore provide evidence supporting the MKC hypothesis.

Flood Water Tributaries of 2007-2009 in Submerged Podorozhnensky Sulphuric Quarry, Their Influence on Lake Water Quality and Condition of Coastal Landscape

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Since 90s extraction of sulphuric ore in the Podorozhnensky quarry (Zhydachiv district of Lviv region) has become unprofitable because of economic and political reasons. According to the project of recultivation of the Podorozhnensky quarry as well as other sulphuric mines of the Carpathian is submerged without preliminary pouring out of clayey shield, a deep lake is formed on its place. Submersion of the cavity is caused mainly by atmospheric precipitation and low-mineralized water of the river Krehivka which is plunged into the quarry in 2004. There is a series of complex ecological and hydrochemical processes in a lake and there is an essential influence of flood water tributaries on it.

The passage of flood waters in Podorozhnensky quarry during the period of its submersion was recorded three times — in 2007, 2008 and 2009. These high-floods were caused by exorbitant precipitation during a short period of time and the precipitation was up to 2–3 monthly quotas per day during intensive downpours in July 2008. Herewith the orifice of streams after high-floods looked like the deep ravines up to 30 m and canyons. The above mentioned flood streams on their way from the upper more gently sloping areas to lower more rapid sloping ones eroded the river-bed intensively, hollowed its bottom and banks, formed rapids, rifts, waterfalls and carried significant amounts of clay material. Herewith the difference in intensity of erosion processes increases with the growth of slope rapidity but only to certain limits. The intensity of slope erosion on small inclinations is less in several times than on rapid slopes. Transporting capacity of flows and the quantity of their solid flow depend on the nature of connection of sections of different rapid slopes. There is an increase in flowing down water mass and speed of its flowing on the water way from upper more plane slopes to lower more rapid ones and it facilitates the intensification of erosion and increase in suspended fractions from 2–3 g/l to 20–30 g/l. With such concentration of suspended fractions the stirred high-flooded stream is characterized by low mineralization and the significance of density is higher than in the most mineralized waters in the bottom water thickness of the lake.

Under such conditions high-flooded stream entering the lake spreads in two directions. First direction — its “light” fraction with a small amount of suspended clayey parts is spread over the surface of the lake. Second direction — more “heavy” one — intensively stirred fraction “dives” into lower water thickness and mixes with one part of highly mineralized water displacing the other into hypsometric higher plots releasing from sediment and water proofing the bottom of the lake. Such scheme of interaction of stirred high-flooded streams that fell into the lake of Podorozhnensky in 2007–2009 is confirmed by the results of monitoring hydrochemical tests. Detailed analysis of an abnormal flood in July, 2008 that led to entering the quarry cavity as per theoretical calculations from 12 to 20 million m^3 of water from streams of the river Krehivka, showed a significant decrease of mineralization in bottom and near-surface layers and its growth in the depth interval of 20–30 m. On the basis of the researches we can conclude that stirred high-flooded streams, that contain ultra-fresh river water, play one of the leading roles in demineralization of hydrochemical structure with interaction of water layers of the Podorozhnensky Lake.

Modern Geo-Ecological State of Derelict Landscapes in the Area of Pre-Carpathian Potash Deposits Influence

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The part of the Pre-Carpathian region, located in the area of Stebnyk and Kalush-Holynskyi potash deposits influence, is characterized by a threatening ecological state. The main problem of this region is the violation of geo-ecological state of landscapes due to the deformation of the surface over the mine goaf, the activation of karst-suffosion processes, the salinization of groundwaters at the sources of mineralized waters in salt-barrows and tailing dams, the potential contamination of soil, water and air pollution caused by industrial waste storage.

Two salt-barrows are located in the area of Kalush-Holynskyi deposit influence to the south-east of Dombrovskyi open-pit mine. These are the salt-barrow No.1 with an area of 48 ha and the saliferous rock capacity of 11.3 million m^3 and the salt-barrow No.4 with an area of 38.4 hectares and the capacity of 7.4 million m^3, which contain more than 40 million tons of overburden saliferous rocks. Also there are three tailing dams in the area, which contain more than 30 million tons of flotation tailings. The tailing dam No. 1 has the surface area of 54.3 ha and the capacity of 15 million m^3. The tailing dam No. 2 with the volume of liquid phase of 1.8 million m3 and the volume of solid phase of 8 million m^3 is the most problematic man-made object in the study area due to the excessive precipitation, which may result in the dam break. The uncontrolled flooding of Dombrovskyi open-pit mine, which was operated from 1967 to 2005, makes the problem more complicated. The flooding accelerated sharply during the July catastrophic flood of 2008. Resumption of the open-pit mine operation was impossible, since salt-brine discharge into a drainage system is ecologically unacceptable. Calculation shows that the flooding on the level of the Quaternary sediments aquifer will take place in 2–3 years, and the total flooding will take place approximately in 8–10 years.

In the area of Stebnyk deposit influence the salt-barrows are localized near the mine shafts of small size — the main bulk of substandard ores and enclosing rocks was used for mine goaf filling. The tailing dam of Stebnyk enterprise is located in the basin of the Solonytsya river and consists of two sections with the total area of about 125 ha. The area of the first section is 69 hectares, where about 20 million tons of solid phase — salt-clay waste of flotation concentration- is stowed. The second section is filled with brine and is divided with a dike into two areas — the northern and southern, with the area of 28.9 and 26.9 ha respectively. The total volume of brine in two sections is over 3 million m^3 with the mineralization from 400 g/L at the bottom to 100 g/L. The process of self-flooding of mine roadways has been ongoing in the area of Stebnyk deposit influence since 1978. According to the estimates a complete self-flooding will take place in 15–16 years.

Meanwhile, under the current technological Pre-Carpathian potash deposits influence two mechanisms of water salinization of the Quaternary aquifer are possible — the overflow of highly-mineralized salt brine from the flooded mine roadways through the channels of hydrodynamic communication (mine shafts, karst swallow hole) to the level of daylight surface and the discharging of secondary salt brine from salt-barrows and tailing dams directly into the drainage system and groundwater. After the direct effluxion of salt-brine from mine roadways, tailing dams and the effluxion of leaching infiltrates from salt-barrows, they undergo the dilution with atmospheric and ground waters and the overflowing into the river system and the

Quaternary aquifer. As a result, the salinization of salt-brine and leaching infiltrates takes place with the areas spreading over dozens of hectares.

More than hundred years' potash ores mining within the Kalush-Holynskyi and Stebnyk deposits, their enrichment and the storage of waste have led to a sharp deterioration of the environment. The problem of soil and natural water salinization is first and foremost considered to be one of the most critical problems in the areas of influence of these deposits and the adjacent territories.

Burrowed Siliceous Chalk of Kytaygorod Outcrops, Like a Filter Element in the Systems of Cleaning Drinking Water

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A famous in Ukraine expert on problems of drinkingwater and ways of its cleaning, academician V.V. Honcharuk pointed out in 2011, — that the main problem of all widely known water filters is their insufficient resource. When the polluted water is goes through afilter, the latter quickly becomesball up. Especially it concerns the filtrationof bacteria's and micro water plants. When a filteris used for several times — itstarts to be a supplier of toxins and pathogenic organism's colonies.

The renovation of the work ofa filter could be done by the replacement or regenerationof the working cartridge. Renovation is performed by using chemically-active solutions (like acids, salts, some synthetic aspects), which could very often destroy the filter element. The most stable filters are natural massive material mainly of siliceous composition. These areburrowed siliceous chalk and rotten-stones.

The filter effect of siliceous materialsis connected not only with their chemical composition, but also with penetration and porosity.

We have studied the filter ability of burrowed siliceous chalk in the village of Kytaygorod, Khmelnitsky region. Havingstudied observations in petrographic slides, it was determined, that the high porosity of rock is stipulated by partial dissolution of microfauna skeletons, — mainly foraminifers and sponges.

It was found out that drinking water from Lviv water pipe having being slowly filtrated, through crushed up to 4–5 mm burrowed siliceous chalk, does not change itconcentrations of dissolved salts, but oxi-water potential is lowerup to 137–120 mV after filtration. Such change points out the improvement of water quality. Water parameters were defined with the help of "HANNA" technologies equipment.

If rocks are treated with 10–15% dilute hydrochloric acid till 10–15%, it increases the porosity up to 20–25%.

On an idea the burrowed siliceous chalk from Kytaygorod could be used, as filler forthe filter cartridges, for better — purification of drinking water. To increase the speed of water passing through a filter and to disinfect it a processing of a cartridge with diluted hydrochloric acid could be done.

The Recultivation of Landscape within the Affected Area of Yavoriv State Mining and Chemical Enterprise "Sirka" (The Affected Area of Sulfur Extraction by the Method of Underground Smelting on Yaziv Deposit)

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The production of sulfur and development of sulfur deposits as well as other natural resources is followed by unfavorable influence on environment, particularly soil cover is being disrupted. With the development of scientific and technical progress this influence is increasing and expanding. Therefore, this issue should be paid close attention.

The application of the method of sulfur underground smelting which was suggested by Herman Frash in 1891 seemed to be more environmentally friendly and economically appropriate at that time than open production of sulfur as it enabled to get relatively pure sulfur on the first stage of production which later needed only refining.

The first experimental station of underground smelting of sulfur (USS) was established in 1969 and existed till 1973. The expediency and possibility of application of the method in conditions of the Precarpathian sulfur deposits (Ukraine) were proved as a result of research work. In June 1971 the launching of a new station was held in the centre of the Northern part of Yaziv deposit. Industrial station was being planned simultaneously with conducting of research work.

Despite the advantages of the USS method over the open production of brimstone sulfur, there are some factors that affect the environment. The exploitation of Yaziv deposit by underground smelting has led to reduction of land resources for agricultural and forestry purposes as a result of the disruption of the fertile soil layer.

The USS method has some positive and negative aspects. Especially it concerns while choosing the method of recultivation of affected land.

Mining and technical recultivation of the affected land is complicated due to the fact that a large area is passed through by numerous mining wells (6 wells on 1 hectare of land) which is the main obstacle for the development of the territory. Considering the difficult situation, the staff of the Scientific Research Project Institute suggested a new method of mining and technical recultivation. The essence of the method is to dig pits 40 cm deep over the mouth of mining wells after they have been closed down. In these pits the casing columns are cut and then filled up with the removed soil. As in the process of the USS method the surface of mining site gets salted by sulfur and polluted by worked highly mineralized cooler, the chemical melioration must be carried out. This provides reducing of the soil acidity. Rozdil lime sulfur fertilizers (RLSF) can be used as a chemical ameliorant (80–85% — $CaCo_3$, 6–8% — S, 1.6–2.5 — P, 0.2–1.8 — K, as well as little amount of Na, Si and Mn). After the chemical melioration the soil and vegetation cover (50–60 cm thick) is put on the mining production site.

The biological stage of recultivation, that is the agricultural use of land is made difficult by the considerable soil acidity, minor presence of the mobile forms of N, P and K, which is the important factor of the agrochemical properties of soil, necessary for growing of agricultural plants.

Field studies were conducted for 10 years in order to reduce the soil acidity. These field studies were based on the liming of acid soils at the rate of 100 tons per hectare and using of

organic mineral fertilizers. However, despite relatively large quantities of fertilizers and potassium carbonates in the form of the RLSF, they failed to improve the agrochemical properties of soil and as a result they could not ensure the crop productivity.

Therefore, the agricultural recultivation of affected land immediately after the completion of USS is not advisable. The only way to restore the soil fertility and achieve the crop productivity is chemical melioration, use of organic mineral fertilizers. Equally important is to grow one year plants (*Equisetum, Plantágo, Rumex*) and perennial forage crops (*Wheat, Beet Root, Cabbage*) in following years.

Bioturbation Structures in Recent Alluvial Sediments on the Dunajec River, SE Poland

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Distribution of bioturbation structures in the Holocene alluvia in the lower reach of the Dunajec River, the Carpathian Foredeep have been explored. The described burrows occur in non-vegetated or poorly vegetated fine- or medium-grained sandy and muddy substrates, which occur locally in patches on the Holocene redzina terrace or in scarps of the Dunajec River channel. The most frequently observed burrowers in the alluvium include European mole (Talpa europaea), common earthworm (Lumbricus terrestris), a few species of ground beetles (Carabidae) and solitary bees (Ammophila). In the surface layers of soil, burrows are spread mainly horizontally. Vertical burrows of large earthworms reaches far to 2 m and deeper into the soil profile.

Water-level fluctuations, causing floods or droughts, are the main factors disturbing channel-bank burrowing biota and controlling their diversity and abundance. Generally, the highest biodiversity of this fauna, especially beetles, occurs under moderate level of disturbances. A large majority of the small organisms inhabiting the alluvial deposits are not adapted to survive floods. On the contrary, European mole and bank swallow (Riparia riparia) build their burrows beyond the range of flood waters. Burrows of the latter are long enough to enable nesting during the progressive erosion of the banks. A long flooding in the spring 2010 killed the majority of the burrowing organisms on the channel banks and their populations, especially those of the ground beetles, did not restore that year. On the contrary, the solitary bees quickly restored their burrows in place of the destroyed ones.

Laboratory observations were carried out and aimed at understanding the behavior of earthworm species *Lumbricus terrestris*. Four glass terrariums were made and filled with alluvia in various layouts. The experiment explained some aspects of the behavior of earthworms in the profiles, as well as little fertile sediments and other stressful conditions. It should be noted that the conditions in the terrariums varied significantly, which strongly reflect the activity of earthworms. The largest increase in the quantity of burrows followed in the first days after the changes in the number of earthworms, or after delivery of the terrariums of water or plant roots.

In order of observe morphology of the burrows, they were sectioned in the vertical plane and cast by means of plaster-of-Paris. The burrows were composed of a simple or branched shaft and a terminal chamber. Two morphological variants A and B were recognized.

Type A. The shaft is oblique or subvertical on the alluvial plain. In the scarps, it is approximately perpendicular to the plain of the scarp, up to rare horizontal orientation in the vertical scarps. The shaft is slightly bend down and more rapidly bent before an entrance to the chamber, where its inclination decreases remarkably. It is circular in cross section, 45–95 mm long, 6–11 mm in diameter, without any sign of constructed wall or lining. In most burrows, a side, horizontal blind gallery comes out from the lower, bent portion of the shaft. The chamber is elongated, turbinate, 14 mm long, 10 mm wide and 9 mm high. Its longer axis is horizontal or subhorizontal.

Type B. The overall morphology is similar as in type A, but the chamber is less distinct because of its smaller size. It is 8 mm long, 7 mm wide and 8 mm high. Moreover, the side gallery occurs rarer than in type B.

Dimension and Morphology of Wreckages of Lithotripsically-Destroyed Urolites

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Shock-waving lithotripsy is one of the most effective methods of medical treatment of urolithiasis, which is widely used in the clinical practice and allows to grind down the concrements directly in kidneys, urinary tract and bladder without surgery. Lithotripsy is based on mechanism of urolites destruction by dynamic influence of a shock wave. An efficiency of the lithotripsy influence depends upon technical parameters and quality of lithotripter: parameters of focusing, pressure in focus, impulse duration, methods of mechanical influence control. The most effective lithotripsy procedure is to crush urolite to thin dispersing state, and injuring of surrounding urolite tissues is minimum, or there is no injuring under ideal conditions.

Biomineralogical characteristics of urolites as well as the technical and medical prerequisites are of great importance for efficiency of crushing: mineral composition, morphology, size, structure, density, homogeneity, plasticity, fragility, microhardness, durability on the compression and break, deformation characteristics (module of resiliency, coefficient of Poisson), and firmness. Process of urolites destruction is determined by the limits of their durability in conditions of definite a shock wave energy. The integral biomineralogical indices of the destructive influence consequences are the dimension and morphology of lithotripsically destroyed urolites wreckages. Mineral composition of lithotripsically destroyed urolites have been determined by X-ray analysis (DRON-3,0, Cu-radiation). Size and morphology of wreckages have been photodocumented and studied visually and microscopically.

The analysis of destroyed urolites wreckages dimension shows that the oxalate stones (built especially mainly by whewellite) are the most resistant to the influence of a lithotripter shock wave. If the stones of such composition have spherolitic structure in the centre and dendritic one in peripheral part, the main breaks are on the contact between one-water and two-water calcium oxalate, and also through the kernel of spherolite and by periphery of dendrites branches. Fragments are not numerous after the destruction of oxalate stones but they are of maximal size. The visual analysis of destruction products shows that oxalate wreckages are the most ragged and have the roughest surface. Morphology of whewellite fragments depends upon the power and rhythm of layers, and also upon the neighbouring spherolites character of growth.

The urate stones are characterized by lithotripsically destroyed wreckages of middle and small size, by their asymmetry under the conditions of layer destruction. The fragmentation of urate stones takes place mostly in direction from the surface to the kernel. At the same time stepped split off and throw out are observed in areas with complicated unclearly expressed layered structure.

Destruction of phosphate stones of apatite composition which have the heterogeneous internal structure and formed by styaginnyami of small and middle sized globules and excretions of glassy hydroxylapatite takes place after violation of peripheral shell firmness. The least firm to influence of lithotripter shock are small phosphate stones presented by struvite or brushite. Their wreckages are characterized by the least size and the most expressed isometry. Gradual layering is inherent for the phosphate stones during destruction, and as the result thin scales like wreckages appear.

Environmental Risks of Contamination of Fresh and Mineral Underground Water at a Shale Gas within the Olesko Area

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Today the question about the shale gas within the Olesko area is controversial. Indeed, on the one hand, the investigated area is considered to be promising for gas production. On the other hand a number of problems exist concerning the operation of this site. The U.S. Geological Agency estimates that reserves of shale gas in Ukraine is set approximately between 1.5 and 2.5 trillion m^3. Olesko area covers the territory of Lviv, Ivano-Frankivsk and Ternopil regions with a total area of 6.213 km^2. For gas production from the Silurian deposits, which lie at a depth of more than 1.3 km, from wich such giant gas sector, as Chevron, Shell, Exxon-Mobil, Total are taken. Potential investments in the Olesko area are measured in multibillion.

The faults which were detected during the Seismic, Magnetic and Electrical surveys were unalysed by us and other methods. Besides these faults are present in almost all the territory of Lviv region.

The method of shale deposits operation lies in the use so-called "hydrogaps". First of all- as in conventional fields, a hole is drilled to a depth of several kilometers. After that, the same hole is drilled will continue to drill a horizontal plane of the shale rock. Later, explosions are carried out in this borehole — for the slates to have cracks. Then under high-pressure the substance with a mixture of 98–99.5% water and sand and 0.5–2% of chemicals (surfactants, KCl solution, gel, corrosion inhibitor, acidity regulator, the regulator of iron, lubricants, salt acid, etc.) is pumped into the hole. The mixture opens "pores" in the rock through which and through a great variety of traps the gas is released. The presence of disrupted damages and the related to them areas of fractured rocks of all the sedimentary strata is naturally a negative factor of a real threat to the quality of water in water intakes of drining and mineral undergrounds waters. The work beimg carried out on water on hydrogaps layer proofs that water may be contaminated by the chemical reagents, which will be uploaded in the layer, and the chemical elements will migrate into the aquifers.

A lot of water intakes are situated here, they are used for water supply to big cities. Also, the area is densely populated, so the threat will touch the wells. Surface waters will also be under the threat as the hydrogap presupposes the use of a great quantity of water which after the hidrogap being conducted partially releases to the surface. This water can be insufficiently purified and enriched with different components which are located at a depth where the gas is mined.Apart from this, nearly all the territory of Lviv region is located in the third zone of sanitary protection of water intakes of drinking underground waters.

In addition, nearly the territory of Lviv region is in the third zone of sanitary protection zone of drinking water intakes of groundwater. The legal regime on the territory of ZSP is regulated by the Cabinet of Ministers of Ukraine dated December 18, 1998 N2024. "On the legal regime of sanitary protection of zones of water bodies." According to this Regulation "Within the third zone ZSP for underground water sources the following is prohibited: pumping of waste waters in underground water horizons with the aim of their protection, underground storage of solid wastes and the development bowels of the earth, which can lead to contamination of the aquifer." So, before starting a full-scale work at the shale gas, previous comprehensive studies must be carried out in order to learn all the aspects of the impact of the shale gas technology of production on the environment.

Anthropogenic and Natural Factors of Quality Formation of Natural Waters within the First and the Second Floodplain Terraces of the Middle Stream of the River Dnister

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Drinking qualitative water is one of the most important points nowadays. Therefore, the scanning of the water-producing areas is a very important task.

We examined the "Chernetsya" and Zhydachiv water-producing areas, which are located respectively, in the first and in the second floodplain terraces of the middle stream of the river Dnister.

The geological area section of the stream line "Chernetsya" is represented by alluvial sediments of the upper neopleystotsen with the capacity up to 17.6 m (loam and sand at the depth of 9.0 m and pebble with sand and clay filler at a depth of 17.6 m), and at a depth of 20.0 m lie dark-loden clay of the Upper-Dashavsk highlights of the lower Sarmatian stages. The aquifer of the alluvial deposits of the first floodplain terrace of the Dnister River upper neopleystotsen lies in the range of 9.0–17.6 meters.

The geological area section of Zhydachiv stream line is close to 0.0–5.0 m — loam; 5.0–10.0 m — loam with gravel (20%) 10.0–20.0 m — gravel and pebble; 20.0–31.0 m — valunno-pebble, clay lies below the dark-loden Kosiv suite of the upper-Baden. The aquifer of the alluvial deposits of the second floodplain terrace of the Dniester River upper neopleystotsen lies in the range of 10.0–31.0 meters.

The chemical composition of the underground waters of the stream line "Chernetsya" is the following: fresh water, the salinity level is 0.6 g/dm^3, calcium-hydrocarbonated, the composition of hydro carbonates is 341.7 mg/dm^3, sulfates — 57.6 mg/dm^3, chlorides — 42.0 mg/dm^3, with predominant calcium cations, its composition is 110.2 mg/dm^3, magnesium — 21.9 mg/dm^3, sodium — 14.3 mg/dm^3, ammonium — 0.5 mg/dm^3. The total hardness of water is 7.3 mh-ekv/dm^3, iron total — 1.52 mg/dm^3 (rate — 0.2). In the main indicators of chemical water composition corresponds with the State Sanitation Station standards 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption" except for iron.

The water of Zhydachiv stream line is calcium-hydrocarbonated, fresh, mineralization level is 0.5–0.7 g/dm^3. The composition of hydrocarbons is 237.9 mg/dm^3, sulfates — 33.7 mg/dm^3, chlorides — 23.4 mg/dm^3 with calcium cations prevails — 84.2 mg/dm^3. The total hardness of water is 6.0–7.2 mg-eqv/dm^3. The total composition of iron in water is 16.0–18.0 mg/dm^3 (rate — 0.2), ammonium — 1.3–1.75 mg/dm^3 (standard — $\leq$ 0.5, in some cases, in agreement with chief sanitary doctor of the appropriate administrative territory — 1.6). According to the main indicators of its chemical composition, water meets the State Sanitation Station standards 2.2.4-171-10, except for iron and ammonium.

The main natural reason for the high iron composition in the above mentioned water streams, in our opinion, lies in leaching iron out of minerals (glauconite, pyrite), rocks that locate the aquifer (dark-loden Neogene clays) and in the least, out of alluvial loam of the upper neopleystotsen.

Concerning the high composition of ammonia in Zhydachiv water stream, we should emphasize the following: the direction of the underground water movement in the alluvial deposits floodplain terraces of the middle stream of the river Dnister of the upper

neopleystotsen is subparallel to the watercourse of the river Stryi. The landfill → the water intake → the residential area of the town Zhydachiv are located according to the line of the underground water stream from the top to the bottom.

The area for the waste disposal of the town of Zhydachiv and the waste of Zhydachivsky Pulp and Paper Mill is located in an abandoned quarry for the extraction of loam. The surface of the quarry is revealed, the drainage of the ground water has created a number of surface basins. Ammonium together with water infiltrates into the aquifer, which is operated by Zhydachiv water intake. The location of this landfill contradicts to the environmentally safe water intake function. Thus, the presence of high ammonia in the water composition of Zhydachiv water intake is caused by the anthropogenic factors.

Influence of Natural and Anthropogenic Factors on the Quality of Spring Water of the Ninth above the Floodplain Terrace of the Dniester River (Between the Rivers Stryi and Svicha)

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Research of springs are important at this time due to the need for the provision of quality drinking water. Objects of study are Morshyn and Strilky deposits. These two deposits are located within the terrace of the Dniester River and characterized by a close chemical composition, but different conditions of formation.

Geological section of deposits is represented by: eluvial and aeolian-deluvial sediments of lower and middle Neopleystotsene capacity to 11.0 metre (clay with layers of sand), alluvial sediments of Eopleystotsene to the depth of 30.0 metre (sand and clay). Aquifer is in alluvial sediments above the floodplain terrace of the Dnister River Eopleystotsene lies in the range of 11.0–30.0 metre.

The chemical composition of water in Morshyn deposit is as follows: calcium (16.0–23.0 mg/dm^3) and sodium (14.5–24.6 mg/dm^3), hydrocarbons (91.5–109.8 mg/dm^3) and less dependent on the content of magnesium ions (2.4–5.5 mg/dm^3), sulfates (8.6–14.4 mg/dm^3) and chlorine (10.7–16.0 mg/dm^3). The content of nitrates ranges within 2.6–8.9 mg/dm^3 that meets standards. The water of Strilky deposit is characterized by the following indicators: the content of hydrocarbons is 48.8–158.6 mg/dm^3, sulfates — 13.2–66.7 mg/dm^3; chloride — 12.0–40.0 mg/dm^3, nitrates — 7.8–37.7 mg/dm^3, calcium — 24.0–48.1 mg/dm^3; 3.6—12.2 mg/dm^3 magnesium, sodium — 3.7–26.9 mg/dm^3, potassium — 0.7–2.1 mg/dm^3. The total mineralization of water in Morshyn and Strilky deposits depends on rainfall and ranges from 137.5 to 238 mg/dm^3.

Morshyn deposit is located among forests and clean water is not contaminated. The formation of its composition is influenced only by natural factors. According to the main indicators the water meets the requirements. High quality of water due to the fact that the whole area is located in the forest, where there are no water pollutants. “Morshynska” water has a curative effect on the human’s body. This is confirmed by many years experience of using of such water at the Morshyn resort and by relevant researches.

Strilky deposit is less environmentally friendly than Morshyn deposit because of the location near the settlement. The presence of high nitrate content in these springs is due to the anthropogenic factors. This is because the springs are located in one stream and therefore polluting components are spread across all springs. It should be noted that the maximum nitrate content is observed in the water of the spring 3 (37.7 mg/dm^3), which is located 0.3 km to the northeast of the village of Strilky down by the water flow and the minimum — in the water of the spring 9 (7.8 mg/dm^3) — at the distance of 1.6 km to the northeast of the village. Although these indicators are great, but meet the standards.

Peculiarities of Heavy Metals and Selenium Distribution in the North of the Crimean Peninsula

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Researchers have become more and more interested in selenium recently. Once considered as a toxical element, selenium, as the result of numerous investigations, has appeared to be vitally essential for human's body. Lack of selenium in the organism leads to progress of many diseases. That is why for treatment of selenium deficiency a great number of drugs and food additives have been developed. Selenium comes to the body with products of animal and plant origin. Exceeded amount of selenium occurs in our organisms as the result of human-induced environment pollution.

The objective of this work is to investigate the composition and distribution of heavy metals and selenium in soils of the north of the Crimean peninsula.

According to scientific sources and results of our own investigations ambient selenium for southern regions of Ukraine is within 0.2 kg per dm^3.

The region under research is located on the plain lowland of the Black Sea Depression within the boundaries of the Crimea. It is presented with one land sculpture — the Southern Trans-Syvash accumulative flat land — with quite a thick layer of glacier continental deposits.

As for distribution of selenium content in different sedimentary rocks, one can notice a regularity of its increase in the following layers: dolomites, limestone — sandstone — clay deposits, slate (from 0.03 to 0.6 mg/kg).

Monitoring of seasonal aggregation of transition forms of heavy metals with application of absorbents has been carried out. It has been determined that artificial phosphate-cellulose absorbent can determine such elements as V, Cr, Zn, Y, Pb, Se contained in the soil in different seasons.

The most favorable for determination of chemical elements lateral migration out of three seasons under investigation has appeared to be early spring.

The aggregate rate of Zc pollution of the southern region of Ukraine, in particular Krasnoperekopsk town, has been figured out by the results of laboratory examinations of soil samples taken in the investigation area and nearby villages.

Studies have shown the occurrence of selenium at all surveyed places with the concentration exceeding the average one for soils. Places with intensive man-caused impact evidence ambient concentration exceeding the average one by 5–10 times, sometimes 12 times.

The following analytical methods have been implemented during the studies: spectrochemical analysis for determination of microelement composition of soils, atomic absorption method for determination of transitional forms of heavy metals. To determine the level of pollution of areas under research, the indices of chemical elements content in the soil and a number of coefficients have been applied.

The area under research, Krasnoperekopsk and Armiansk towns, are mainly industrial with significant man-induced impact.

It has been determined that the biggest concentration of heavy metals is observed near industrial enterprises Brome Production Plant Brom, LLC and Technical Soda Ash Manufacturer Crimean Soda Plant, LLC. Here the results of soil examination showed exceeding concentration of Cu by 1.5–2 times, Pb by 3–5 times, Ti by 2–3 times, Mo by 5–6.5

times, Li by 3–4 times and Se by 5–10 times (in comparison with ambient concentration for this area).

Thus, due to environment pollution with chemicals and radionuclides, selenium deficiency in food products, increase of diseases caused by selenium status disorder in human bodies, implementation of selenium preventive measures and selenium treatment of Ukrainian population is a very topical issue.

The Regime of an Infiltration Flux in Unsaturated Zone to Groundwater at Chernobyl "Red Forest" Radioactive Waste Site

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The methodology and results of regime analyses of infiltration flux to unconfined aquifer are presented. Research of infiltration flux in the unsaturated zone of "Red Forest" radioactive waste dump site (2 km away from the Chernobyl nuclear power plant) is the highly urgent task. Infiltration of pore solutions from the pollution source (radioactive polluted soils situated in the unsaturated zone) represents main factor of radionuclide migration out of waste dump to geological environment and ground waters.

The unsaturated zone and the unconfined aquifer of the site are made up from aeolian genesis quaternary fine quartz sands (saturated hydraulic conductivity — 3–5 m/day). Depth to the water table fluctuated from 2.3 to 3.9 under the unsaturated zone monitoring station.

The uniquely detailed data set was collected with a help of the automated unsaturated zone monitoring station "Pit" during 2000–2004. Station "Pit" measured volumetric moisture content and suction pressure with 1-day time step through the basement soil profile to 2.5 depth. Regular meteorological observations were also performed by the automatic weather station. The data set allowed us to apply a new technical approach for in situ estimation of hydrophysical soil characteristics (dependence between moisture content and suction pressure in soil, unsaturated hydraulic conductivity) and for regular observations data interpretation with application of Darcy equation for unsaturated conditions.

Estimation of unsaturated hydraulic conductivity of sandy soils was based on the analysis of automated observations of moisture content of soil profile after rains. The following dependence is obtained for unsaturated hydraulic conductivity K (m/day) from soil suction pressure ψ (cm of wat. column): $K(\psi) = 3{,}8 \exp(-0{,}13\,\psi)$. The advantage of the method is that unsaturated hydraulic conductivity is determined in conditions of undisturbed soil profile in the range of suction pressure values, which is characteristic for natural regime of unsaturated zone.

The results of infiltration flux regime estimation for the depth of 1.5 m of the unsaturated zone are shown in Table 1. It should be mentioned, that within the area of the unsaturated zone monitoring station vegetation was absent.

Table 1

The results of estimation of infiltration flux to groundwater in Chernobyl "Red Forest" site using Darcy equation for unsaturated conditions

Year	Infiltration flux, mm					Inf. flux, % of precip.	Precipi-tation
	Winter	Spring	Summer	Autumn	Annual		
2001	108	131	23	4	265	40	668
2003	24	82	26	107	240	45	533
2004	115	126	108	80	429	64	675
Average					311	49	625

The obtained results are in good agreement with the results of alternative methods of recharge rate estimation (such as water table fluctuation method and isotope dating of

groundwater age). The values of annual infiltration fluxes and their regime throughout the years were specific for each one, depending on weather conditions. Certain meteorological events (like a spring snowmelt, winter thaws and intensive rains) result in huge intensification of infiltration flux. The maximal value of daily infiltration flux was 8 mm (during the snowmelt in February 2004). During dry periods, its value decreased to 0.1 mm/day and less.

Applying GIS to the Study Process of Groundwater Salinisation in Kherson region

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The present abstract deals with the consideration of the problem of groundwater salinisation. Special attention is paid to the application of GIS technology. The methodological approach was proposed to build digital surface of water salinity field. Spatial features of salinity process in the Neogen aquifer complex were defined.

Groundwater is an important source of water to supply human needs. In the last few years, there has been a tendency for drinking groundwater quality to deteriorate, which resulted from increasing anthropogenic impact on the environment. Morris, B.L. et al. (2003) suggest some global trends affect all of Earth's freshwater reserves. Perhaps the three most far-reaching in terms of resource sustainability are those of salinisation, trends in withdrawals and climate change.

Salinity is the major threat to aquifer sustainability because it can rarely be reduced in a natural way. Salinisation can occur as a result of poor irrigation practice in agricultural areas, and as a result of over-abstraction inducing saline intrusion.

Salinisation problems in Kherson region reveal causal relationship between the irrigation practice, aquifer overexploitation and a complex of natural conditions. First of all, the process of salinisation occurred in the upper unconfined aquifers. Nowadays, the deeper aquifers are affected by salinisation as well. Consequently, the Neogen aquifer complex, as the main source of drinking water in this region, tends to reduce resources of fresh groundwater.

To understand the aquifer behaviour and the effects of groundwater use conventional approaches are being used in Ukraine. They involve statistical processing of hydrogeological monitoring data and qualitative comparison of groundwater regime parameters by individual wells. Such approaches couldn't provide spatial orientation of the salinisation process.

Thus, interest is growing for applying GIS technology to study spatially oriented hydrogeological processes.

Digital surface of salinity field has been built using ArcView GIS 3.2a, for the Neogen aquifer complex. The input data for modelling were spatial objects such as borehole. Attribute values of objects were the number of a borehole and its coordinates, the salinity of groundwater within two periods. The method of interpolation was used to determine the value of water salinity throughout the area of the water-bearing complex distribution.

To ensure high accuracy of the final result, the interpolation was carried out according to the following model: point → lines → vector model → raster model. Digital maps correspond to 70% of the actual data. In the raster model each cell is restricted to a single value of water salinity. Thus, the aquifer throughout the area of distribution was characterized by the value of water salinity.

The comparison of raster models within different periods gives an opportunity to determine the direction and scope of the salinisation process.

In summary, the area of distribution of saline groundwater is increasing in Kherson region. Groundwater for drinking water supply is only available in southern and some northern parts of the region. The rest of the region is being heavily affected by the process of groundwater salinisation.

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Hydroecological Estimation of the State of River-Bed and Floodplain Complex

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At the last decade the question of water supplying of Ukraine is very urgent. This issue concerns both qualitative and quantitative indicators. The sources of fresh water in our state is mainly the water from rivers and their tributaries, but the formation of the flow begins from the most sensitive elements of hydrographical net — small rivers, the state of which mostly depends on the state of their basin. The state of the river-bed and floodplain complex the most completely reflects the processes in river basin, consequently its research is very important for water protection task.

The object of this research is the river-bed and floodplain complex of the river Bereznytsya. This river is the right-bank branch of the river Dnister and flows through the territory of Ivano-Frankivsk (Dolyna district) region and Lviv (Stryj and Zhydachiv districts) region.

The basis of research was laid by the method proposed by R.V. Himko, O.I. Merezhko and R.V. Babko. The research object was divided into 12 experimental parts approximately equal in length and with similar conditions based on cartographic processing, archival, literary and reserve sources. Each piece held f certificat which included general information, the visual assessment of the river-bed and floodplain as well as conclusions that include the final assessment of the river. This assessment was gathered on the basis of visual examination. At the end certificat contained recommendation of the proposals to improve hydroecologycal state.

Visual assessment of the river-bed and floodplain complex consists of three blocks. The first of them includes the estimation of parameters such as the river flow velocity, state of the river-bed, its overregulation, grade and silting of the river, the characteristics of river water and species diversity of hydrobionts, the state of the banks and bank protection zone. The second block is determined by the ratio of natural elements to the transformed ones, the degree of violation and degradation, the level of recreational load and rate of the bank protection zone, the presence of residential buildings in the valley, direct industrial or domestic water waste, also the intensity and of the economics use of the floodplain is estimated. The third block provides some information on the depth and nature of the changes that have occurred in the recent decades.

The area of exploration received three assessments of the river, "excellent", "good" and "satisfactory". These assessments are distributed downstream. "Unsatisfactory" and "catastrophic" state of the river is not currently observable, although close in value to the poor condition of the river is the explored area within the village of Dashava. The best situation is at the first studied area, as here there is minimized anthropogenic influence and preserved natural vegetation. Moving further to the downstream we trace a tendency to deterioration because of the increasing of human pressure on the pool. The presence of large forest areas somewhat weakens the impact, and thus on these areas close to the middle of the river the state of the river-bed and floodplain complex is "good". Farther the value of such an important natural barrier as forest is redused and anthropogenic pressure on the river, which is manifested in intensive agricultural mastered and building floodplains increases.

On the one part of the river the degradation processes are actively developing, on the other — there are negative changes. Only studied area, located near the outflow is in a state approximate to optimal. The complex measure for stopping the destructive process of the river and its ecosystem also measures to rehabilitation, protection and conservation should be carried out instant.

The priority measures to improve rivers state should be as follows: cleaning the stream channel and the coastal protection zone from existing domestic and natural debris; compliance use of the coastal protective strip and establishing its boundaries; fixing the river banks; banks soils extraction limitation; domestic animals watering places arrangement; better waste waters purification by municipal wastewater treatment plants, industrial wastewater by their reconstruction; reduce the possibility of getting water contaminated by toxic waste, and to ensure adequate protection of pipeline that runs beneath the river-bed, reduce the degree of regularized as most of ponds are eutrophication, reduction in agricultural use of floodplains.

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Radiological Safety of Banded Quartz-Feldspathic Schists of Niemcza – Kamieniec Metamorphic Unit

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Banded quartz-feldspathic schists with graphite of the Niemcza – Kamieniec Metamorphic Unit has been described as helleflinta-metamorphosed rhyolitc tuffs by Dziedzicowa (1966). Their normative mineral composition is 53.8 % of quartz, 42.5 % of orthoclase, 3.2 % of albite. Potasium content according to standard chemical analyses is of order 6 %. According to Puziewicz et al. (2002) the presence of albite and silica-magnesium-iron rich white mica suggests that the quartz-feldspathic schists were formed under low-grade metamorphic conditions. Solecki (2000) described them as a source of radiometric potasium anomaly.

In the present study K, U and Th content of schist was measured by means of portable RS230 gamma spectrometer. Measured activity of ^{40}K was recalculated into total K (%) content. Measured activities of ^{214}Bi and ^{208}Tl were recalculated into equivalent uranium (eU) and thorium (eTh) concentrations (ppm). Obtained results were analysed in terms of F1 and F2 indices according to Polish Law.

Summary of obtained results is presented in the table below (Table 1).

Table 1.
Results of gamma spectrometric measurements

	K (%)	eU (ppm)	eTh (ppm)	F1 (Bq/kg)	F2 (Bq/kg)
quartz-feldspathic schist					
max.	8.7	7.9	19.8	1.5	98
min.	5.5	3.5	13.4	1.0	43
mean	6.6	5.1	15.7	1.2	63
quartz-feldspathic schist with graphite					
max.	9.0	14.9	25.5	2.0	185
min.	5.9	6.0	16.6	1.2	74
mean	7.0	9.7	20.3	1.52	120

Taking into account the fact that safety limit is F1 = 1 and F2 = 200 even with acceptable 20 % excess, the graphitic type of schist should not be used for building construction.

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The Groundwater Vulnerability Assessment Using DRASTIC Method in Drawa National Park with Border Area

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The groundwater vulnerability assessment using DRASTIC method was created in the United States of America in 1984 by Linda Aller et al. This method lets us estimate in a simple way the relative groundwater vulnerability to pollution that comes from the terrain surface. Creating map of DRASTIC index requires maps of 7 factors included in method. The first letters of these factors create acronym DRASTIC and they are as follows: D — Depth to groundwater, R — Recharge net, A — Aquifer media, S — Soil media, T — Topography (slope inclination), I — Impact of vadose zone, C — Conductivity. Each map must be reclassified, so each assignation on the map must be bound with numerical value from 1 to 10. The low values mean that groundwater is resistant to pollution; the high values predefine groundwater as vulnerable to contamination. Also each factor has its own weight which mathematically describes how much important each factor is. All used maps should be digitized to make it possible to carry out mathematical operation in rasters. The map of DRASTIC index is created by summarizing in each raster all the reclassified assignations multiplied by the weight of each factor. The high values of DRASTIC index define area as vulnerable to pollution, and he low values mean that area is resistant to pollution.

The map of groundwater vulnerability assessment using DRASTIC method in Drawa National Park is prepared in two *simultaneously* prepared Master theses which concern the western and the eastern parts of the aforesaid national park. Input data is derived from military maps of the area surface, hydrogeological maps of Poland, geological map of Poland and maps of soils. Preparation of data consisted of scanning paper maps and vectorization of scanned maps. After that the input maps assignations were reclassified and all maps were digitized. As a result 7 reclassified maps were created. These maps were used to create the map of groundwater vulnerability to pollution — map of DRASIC index.

Karst-Suffosion Processes in the Area of Influence of Drainage-Mine Working within the Solotvyno Salt Deposit

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The Solotvyno deposite of salt has been used from the surface since ancient times and by mine working starting from the Middle Ages. Balance storage of salt equals to 30 million tons, though general amount of salt dome is about 2 billion tons. First mine works showed difficulty of hydrogeological conditions of salt excavation and activation of development of salt karst under condition of water coming into mines. Salt mines in western part were established in XVIII-XIX centuries — Mykolaj, Albert, Chrystyna, #7 and others were operated for more than a century. Now all these mines are filled with water, and there are lakes over them. It's a pity, but the same thing happened to both mines which have recently been in operation: mine #8, built in 1886 and mine #9, opened in 1975.

As a result of more than several centuries of mines having been put in operation the natural geological environment in Solotvyno region has considerably changed, first of all it concerns karsting and dip formation. Significant process of mine-geological conditions getting worse is, connected with filling mines with water, development of salt karst and getting low of surface. These conditions made exploitation and mine working more difficult. These excavations were established as self-flowing for getting of water of quarter watergiving horizon in order not to let them get into salt mines in the source in periphery of salt dome in high level of clay upsalt layers: Pivnichna, Nova Tysa, Tysa-mine, and also water leaving bore pits (#1–18).

Mine working significantly limited the development of salt karst. Troubles in its operating during last 15–20 years led to disaster consequences. Which are observed at the source now. In hollows and bore-pits crumbling-rock, which blocked blowing of excavated water were often fixed. These crumbling-rocks weren't taken away in time because of lack of financing. Artificial dam, which provided intensity of upper salt water and its quicker filtration into slat massive on weak zones, first of all in the area of Chornyj Mochar, where deformation of the surface is determined by developing of salt karst and it was the most dynamical last years.

As details of geological survey showed areas of intensive water coming into karst hollows, over mine working sufosius processes are developed the actively in the density of iregular coarse deposits. Growing of size both karst and sufosius hollows result in getting low, or more often sudden falling of ground. These fallings usually happen in spring time. It is conditioned by the circumstance that alongside with karst forming in salt and sufosius process, internal abrasion and fixing parts together reduces which makes faster its mechanical flowing.

Given data witness the modern crisis and disaster condition of geological environment in the area caused by mine working within the area of Solotvyno salt deposit. First of all it is connected with intensive development of salt karst and mechanical sufosia during last years. Breaking of stagnant in geological time natural rhythm of upper salt water led to activation of assimilation of salt. Existence of zone of underground unloading extended zone of active water exchange to easy assimilated salt and became the main reason of intensive karsting and deformation of area.

Geochemistry of Mine Waters in Chervonograd Mining Region

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The problem of mine waters has been topical since the beginning of the mining company operation. Mine waters are characterized by various chemical and corrosive features, thus having a negative influence both on the equipment used in mining works and environment. It is necessary to investigate the elemental composition of mine waters as well as determine interdependence of their elements. Information obtained can be used for optimization of mine waters purification and for predicting changes in the environment caused by the influence of such waters.

Mine waters are underground waters that enter in the excavation during the deposit opening and exploitation. Mine waters constitute the main part (74–76 %) of the sewage of coal mining industry in the region.

Underground waters of Carboniferous hydrostratigraphic complex greatly influence the formation of mine waters in Chervonograd mining region. The composition and some characteristics of mine waters differ from that of underground natural water of this complex. Mine waters start to form on the first stage of the roadway development. In this case the role of second working is of great importance. At the time of work, landslip cracks appear and spread on neighboring aquifers and even hydrostratigraphic complexes. Waters circulating in landslip cracks mix with waters from the mined coal bed and wall rocks thus get exposed to the oxidizing environment and in such metamorphosed form go to mine opening.

Within the mine environment mine waters undergo substantial change during the second stage of excavation development.

Changes in the content and new features of mine waters are caused by they having been enriched with the coal and rock destruction materials containing sulfides when mine waters concentrate in drift base and used lava scope and when move towards the central water scoop. Sulfates accumulation as well as an increase of alkali-earth elements in mine waters are caused by this process. Besides, while flowing in the used lava scope mine waters are enriched with mortars of mineral and mechanic origin and suspended solids.

Through the mine drainage system mine waters evacuated from the excavation usually concentrate in settling ponds and often flow into the river Zahidnyy Bug during the floods.

Complex analysis using methods of multivariate statistics of geochemical data has been carried out to identify the elements distribution in mine waters from Chervonograd mining region. We used data taken for the period of 5 years (2005–2009).

According to the results of regression analysis of mine waters composition we have driven to the following conclusions:

- in composition of the mine waters among anions there is $C1^-$ predominance, among cations — Na^+;
- increasing in mineralization is caused by increasing of content of Cl^- and Na^+ ions;
- concentration of Ca^{2+} and Mg^{2+} cations is low;
- common types of mine waters (according to K. Pyt'yova) are $Cl^- > S0_4^{2-} > HCO_3^-$, $Na^+ > Ca^{2+} > Mg^{2+}$;
- in spring-and-autumn period changes of the mine waters type are typical.

Factor analysis was carried out for mine waters of Chervonograd mining region. For nine mines eight variables and all variables (14) taken for the period of five years have been analyzed. Data from the all mines, as well as from every separate mine has also been analyzed.

Results of the factor analysis have shown that formation of component content of the mine waters is determined by the first main factor (58,4 %). The second factor is subordinate (14,8 %). While interpretation of the factor analysis data it has been showed that the first factor affected mine waters component content formation due to water inflow of the coal water-bearing complex. This factor controls Cl^-, Na^+, Ca^{2+} concentration and such features as mineralization and solid residue (underground water from the Carboniferous water-bearing complex contains hydrocarbonate – chloride, calcium – sodium content). The second factor controls the mine waters composition as a result of waters demineralization by mixing with underground water from Senonian water-bearing complex. This factor controls Ca^{2+}, Mg^{2+} and HCO_3^-, concentration and such feature as water hardness (underground water from the Senonian water-bearing complex contains hydrocarbonate calcium content).

Based on the data of factor analysis and maps of the factor value changes trend two relative mine blocks are distinguished. The first "block" is mine 1 BM, 3 BM, 7 BM and 9 BM. In mine waters formation of this block the first factor has the main influence (typical Cl^-, Na^+, Ca^{2+} content, mineralization, solid residue). The second "block" is 2 ЧГ, 10 BM, 4 BM, 6 BM, 8 BM. In this case the second factor is main (typical Ca^{2+}, Mg^{2+}, HCO_3^- content, water hardness).

Monitoring of Ecology Condition of Groundwater at Mokrotyn Water Intake

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Nowadays, the countries are ensuring the conditions for preservation, protection and rational use of water; that is why international documents are being taken and different programs are being launched.

Since 1970, people have started realizing the problems which concern the providence of really nutritious drinkable water. As a result, the UNO has proclaimed the decade between 1981 and 1990 as the International decade of water supply systems and sewerage, however, these measures were not suffice.

According to the data collected by the UNO two thirds of the population in the world or in other words 5.5 billion of people will suffer from the lack of drinking water by 2025.

The problem of drinking water supply still exists in Ukraine.

During the last decades the essential problems of water supply do exist in Lviv. “Water problems” found their channel and were even used in the political life of the city and as well they were topical during the elections.

One of the water suppliers of the northern part of the city is Mockrotyn water intake which has been exploited since 1962. It is situated in Zhovkva district of Lviv region. The relief on the most parts of the territory looks more mature with the developed stooped flat residual arrays, ridges and mounds which are divided by saddle-like decreases. Within the Mockrotyn area in accordance with the geological structure relative horizons are spread in the Quatemary, the Upper Chalk deposits.

According to their chemical composition, the waters of the Upper Chalk horizon are of hydrocarbon-calcium and hydrocarbon potassium-sodium types.

The mineralization of water fluctuates from 450 up to 780 mg/dm^3. The general solidity of waters alters from 3.58 up to 7.2 mg-ekv/dm^3. The contents of nitrates in waters deviates from the total absence in the majority of samples up to 5.12 mg/dm^3, nitrites are absent or present in the form of traces.

The great influence on the condition of waters has the transportation of water by water pipes to the water intake of the city which has the direct influence on the water supply for the residents.

Geochemical Modelling of Processes Controlling Heavy Metals and Sulphur Mobility in the Copperbelt, Zambia

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The Copperbelt known as sediment-hosted stratiform copper-cobalt province and covers an area of 31,328 km^2 in Zambia, representing the largest mining region in Africa. Mining activities in open-mine pits or underground mines and ore processing both connected with active and old tailing impoundments affect water and soil quality as well as sulphur emissions in the region.

Surface water of the Kafue river network and related soils were found to be contaminated by heavy metals and sulphur, associated with acid mine drainage (AMD). The fresh water contained up to 1.644 ppb of Cu, 29.528 — Co, 7.836 — Fe, 17,093 — Mn, 1.776 — Ni, 317 ppb — Pb, 37.8 ppb — Se, 1.741 ppb — Zn and 3.672 ppm of sulphate.

Processes affecting heavy metals and sulphur mobility have been studied using data obtained by Czech Geological Survey in years from 2002 to 2008 (e.g. Kříbek, Nyambe et al., 2002). Geochemical modelling in Geochemist's Workbench® ver. 8 and distribution diagrams prepared in Surfer® ver. 8 have been used for explanation of the observed dependencies.

The mobility (and also toxicity) of heavy metals is strongly influenced by redox potential (Eh), clay mineral and organic matter content, water content, pH (Herms and Brümmer, 1984), soil properties, and root residues. The mobility also depends on total concentration of metal, its specific chemical form, its binding state and the metal properties (Nyamangara, 1998).

Processes such as chemical precipitation, attenuation and sorption-desorption seem to control heavy metal and sulphur mobility through remobilisation and stabilisation. Admittedly, according to the data, the most important contaminants copper and cobalt are less mobile and are stabilised relatively rapidly compared to sulphur and other elements. Moreover, sulphur concentration in surface water on some places seems to be controlled by dissolution of gypsum ($CaSO_4$). Conversely, sudden drop of pH and Eh caused by AMD can remobilise heavy metals fixed in sorption complexes or stabilised in precipitated phases.

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The Forms of Preservation of Natural Landscape and Ecological Units in Beskid Sadecki, the Outer Carpathians

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Beskid Sądecki is orographically and geologically distinctive group in the Outer Carpathians. In majority of these mountains are in Poland and they have three ranges — the Radziejowa range, the Jaworzyna Krynicka range and the smallest — the Leluchow mountains. The first one belongs to two countries — Poland and Slovakia. The highest peak is Radziejowa (1262 meters above the sea level). Beskid Sądecki begins in the southern part of the biggest town in the region — Nowy Sącz. This town is also the lowest point in the region (272 meters above the sea level). The main river is the Poprad, which separates the Radziejowa range and the Jaworzyna Krynicka range. We can find more rivers in Beskid Sądecki. The biggest one is the Dunajec, which is a border of the region from the west and the north. The Kamienica Nawojowska is a border from east.

The Carpathian Mountains were formed during the Alpine orogeny in the Mesozoic and Tertiary. The mountains take the form of a fold and thrust belt with generally north vergence in the western segment. Beskid Sądecki, as majority of the Outer Carpathians is built of the Flysh belt. It should be mentioned here the types of lithology we can find in Beskid Sądecki. The most widespreadpopular are siltstones, sandstones and the most interesting — varicoloured clays. Geological structure is connected to many landslips.

To describe the region not only rocks and geological units should be mentioned. Many unique examples of flora and fauna have their habitats in this region. Forests are under control. In Beskid Sądecki there are a lot of standpoints of Fagetum carpaticum. To protect the last reminders of Fagetum carpaticum many forms of prevention measures have been taken. Today we have 14 natural reserves, one of the biggest landscape parks in Poland and 80 natural monuments. They do not only protect trees, but also rock exposures, forest lakes and — what is unique — landslips.

Beskid Sądecki is not only nature. There live a lot of people; it is densely populated region. There we can find many ethnographic groups, which today continue their tradition. So, cultural landscape is also important as natural landscape.

Geoinformatics and Geophysics

Electromagnetic and Radiometric Prospecting at Ancient Fortification Area in Riga, Latvia

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A geophysical investigation was undertaken at ancient fortification building area in Tornakalns, in the Riga City, at left side of the River Daugava. The archaeological and geological studies in Tornaklans were realized within the project "Archaeological and geological research at the University of Latvia Academic Centre of Sciences building area in Tornakalns". In the nearest future, at the historic territory a construction of UL Science Centre is planned. During the last centuries the area of fortifications was rebuilt several times, and at present on the surface of the ancient buildings remains are not recognizable and exact building remains are missed.

The aim of the study was to obtain essential information about the ancient fortification building locations and geological structure of the site.

The survey was performed using two geophysical methods — electromagnetic and radiometric. Electromagnetic and radiometric measurements were taken in grids within the limits of covering area aprox. 6000 m^2, aiming to identify geophysical anomalies of potential interest for archaeological studies in details.

Geophysical data 2D visualization reviled the series of anomalies, mainly charactering the soil physical properties, but some of anomalies could be attributed to possible buried historical structures. The archaeological remains occur under anthropogenic transformed multi-layered geological media and the alternating geological heterogeneity of the research area didn't allow to easily interpret geophysical data, therefore a number the geological drilling were made to verify results.

The geophysical survey in Tornakalns proved that the applications of the electromagnetic and radiometric methods are appropriate and effective in archaeological research.

Complexity and Changing Pattern of Tectonics in Hydrocarbon Bearing Basin of South East Asia

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East and South-East Asia is a giant 'jigsaw puzzle' of allochthonous continental lithospheric blocks and fragments (terranes) that are bounded by suture zones or by geological discontinuities such as major strike-slip faults. The complex assemblage of south-eastern Asian continental terranes, accretionary complexes, ophiolites, volcanic arcs, and marginal ocean basins occurs in the zone of convergence between the Eurasian, Indo-Australian, and Pacific plates. In this region, two important biogeographical boundaries are recognized, namely the extant Wallace's Line and the Late Palaeozoic Gondwana–Cathaysia Divide. Both of these biogeographical boundaries are the result of convergent plate-tectonic processes bringing together allochthonous continental lithospheric terranes on which contrasting faunas and floras had developed owing to their prior geographical separation, different palaeoclimates, and biogeographical isolation. Multidisciplinary data shows that in the Early Palaeozoic all of the principal east and south-east Asian continental terranes were located on the margin of the eastern Gondwana, where they formed the Indo-Australian 'Greater' Gondwana. The regional geology of South-East Asia is thus characterized by Gondwana dispersion and Asian accretion of terranes and the subsequent collisions of India and Australia with these terranes following the breakup of Gondwana and their northwards drift. A variety of multidisciplinary-data is used to constrain the origins of the terranes, their times of rifting and separation from the parent cratons, the timing, directions, and amount of drift, and the timing of suturing (collision and welding) of the terranes to each other. Significant oil and gas accumulations occur widely in East and South-East Asia, generally in Cenozoic rocks. Sedimentary basins and these have markedly contributed to the economies of the South-East Asian countries. The oil and gas accumulations are commonly associated with the rocks of the Middle and Upper Miocene age, with locally significant Oligocene and Pliocene occurrences. This work focuses mainly on the complexity and changing pattern of Gondwanaland of the south-east Asian continent and the hydrocarbon bearing basins of the region.

Regional Seismo-Geological Models of Jurassic and Neocomian Deposits of the Central Part of the West Siberian Petroleum Province on the Basis of Regional Seismic Sections (XIII, XVI, CII, CIV) and Well Log Data Interpretation

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Construction of the regional seismological models of Jurassic and Neocomian deposits in the "transition zone" from predominantly oil-bearing regions of the Ob' region to mainly gas area of the northern parts of the West Siberian petroleum province was the main objective of this research paper.

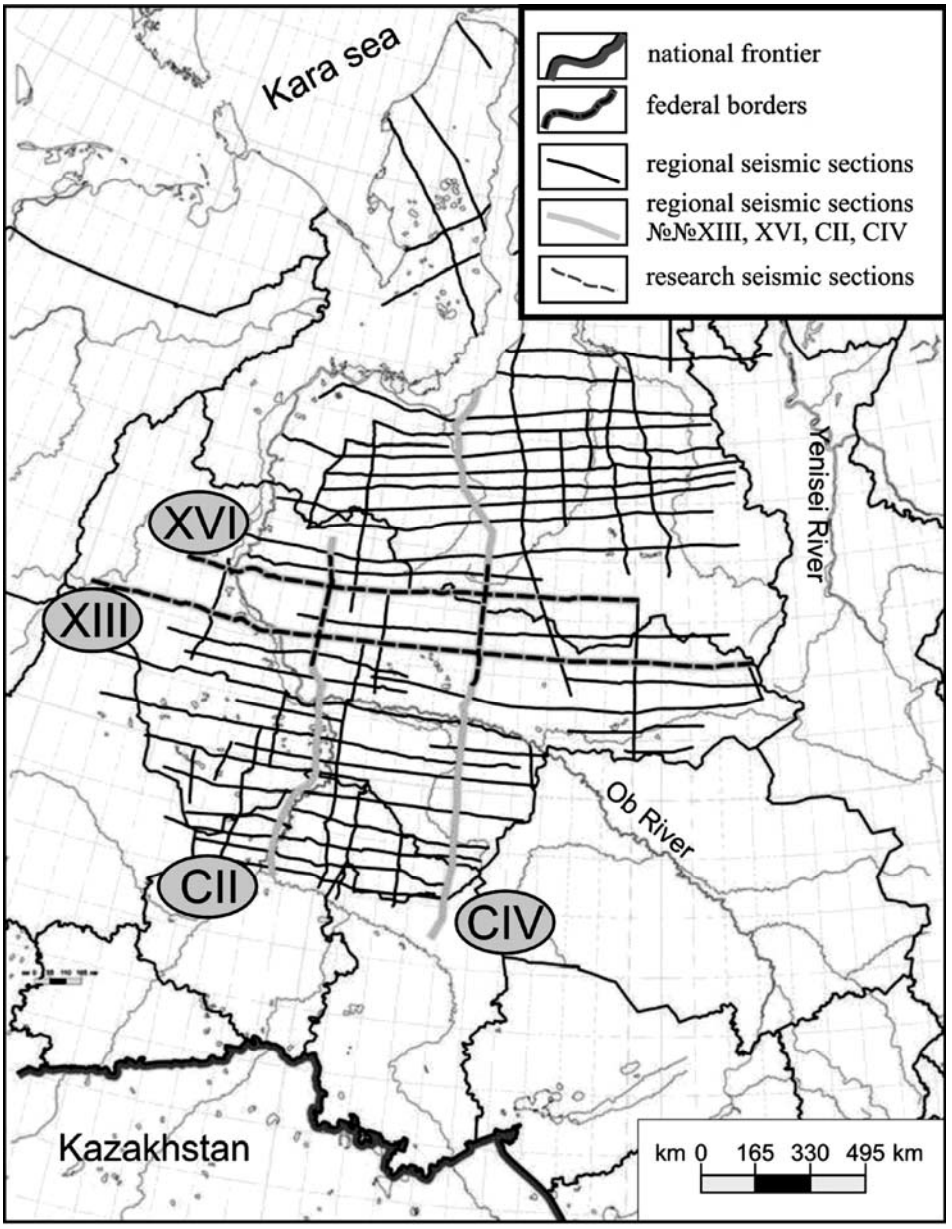
At present the entire territory of the West Siberian basin is covered by a regional seismic grid. Sublatitudinal seismic sections XIII and XVI, as well as fragments of submeridional — CII and CIV were used in these investigations. Geographically, the regional section XIII, the western part of the XVI seismic profile and parts of the CII and CIV seismic sections are located in the Khanty-Mansiysk Autonomous Region, Russia. The eastern part of the XVI section crosses the southern part of the Yamalo-Nenets Autonomous Region, Russia. Both seismic sections XIII and XVI cross the whole territory of the West Siberian sedimentary basin in the latitudinal direction from the eastern part of the Ural Mountains in the west to the Yenisei River in the east. Also logging data of 181 wells were used in this work.

The geological section along regional seismic profiles is presented by rocks of the Middle and Upper Paleozoic, the Triassic volcanic-sedimentary varieties and the Mesozoic-Cenozoic sedimentary cover. Thickness of the Mesozoic and Cenozoic sediments varies from 0 m to the western and eastern ends of latitudinal profiles to about 4.600–4.700 m in the center.

There are five most intensive reflecting seismic horizons in the Mesozoic-Cenozoic section of central region of the West Siberia presented by unconformity surfaces or clay packs with stable thickness formed in the transgression periods and spread over large areas. They are as follows: seismic horizon 'A' — confined to the bottom of the platform cover and corresponds to the unconformable surface between the pre-Jurassic basement and the Mesozoic-Cenozoic sedimentary cover, seismic horizon 'B' (K_1, the Berriasian) — associated with the top of the Bazhenov formation (its equivalents), seismic horizon 'M' (K_1, the Aptian) — confined to the Koshay pack of the Alym Formation (its equivalents), seismic horizon 'G' (K_2, the Turonian) — timed to the Kuznetsov Formation, seismic horizon 'E' (E_1, the Danian) coincide with the top of the Talitsk Formation (its equivalents).

Based on interpretation of seismic sections and built correlation patterns along these profiles (XIII and XVI) construction of regional seismo-geological models of the Jurassic and the Berriasian-early Aptian deposits were made. It is shown that the Jurassic deposits are developed in varying volumes throughout the study area, but thickness of this complex increases in the direction from the basin sides to the area of the Koltogory-Urengoi rift. The Neocomian complex has a clinoform structure. On the sublatitudinal seismic sections XIII and XVI clinoforms with both west and east dip were marked. The area, where clinoforms with the opposite dip meet, coincide with the axial part of the Neocomian paleobasin, which is significantly shifted to the west from the Koltogory-Urengoi rift and intercrossed by the profiles XIII and XVI between 65° and 70° meridians.

The paleotectonic analysis was made on the basis of constructed set of seismic paleosections which were created by the alignment of each regional seismic section to the level of reflection horizons B, M and G. The results of this analysis demonstrate the history of tectonic development of the research area in the Mesozoic and Cenozoic and show the relationship between the regional tectonic movements and oil-and-gas content.



The Numerical Model of the Aquifer. The Methods of Construction and the Possibilities of the Usage in Hydrogeology

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The contemporary methods of the numerical modeling allow the cheaper and effective environmental management and the dynamic imaging of geological and hydrogeological conditions. Instead of paper maps and sections, we can make the interactive, numerical spatial models, on which it is possible to perform a huge amount of calculations using the 3D and 4D technology (taking into account changes in time). Such models can be easily and quickly updated. One of the programs which gives many possibilities in the field of construction of the numerical scheme of hydrogeological conditions is the program by ESRI — "ArcGIS". In this program, there is the Map Algebra and many interpolation tools (IDW, Natural Neighbor, Kriging, Spline), which allow very complicated operations on data and the whole maps. In "ArcGIS" it is also possible to visualize the scheme in 3D.

To present the method, the area located to the east of Zegrze Lake was chosen. It is an artificial reservoir created by building the dam on the Narew River in Dębe. The lake is used as a reservoir of potable water for Warsaw. In the future the new water intake for the capital city will be built there. It will be an infiltration intake, located under the bottom of a lake. In order to determine the optimal investment location, a considerable amount of geological, hydrogeological and geophysical studies were done. As a result there is a lot of data from wells and geophysical researches as per the area located to the east of the lake, which allow the construction of a quite detailed numerical model of the first quaternary aquifer.

The boundaries of the model were based on the rivers. The top surface of the model is the land surface, and the bottom is the top of the impermeable Pliocene silt or the younger, quaternary clays lying straight on the silt. Between them there are fluvioglacial and river sands with levels of clays and silt from the glaciations. To model the bottom surface geophysical data were used and several well profiles which reached the Pliocene sediments.

A resulting model can be used in future to make the very complicated flow models.

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Comparative Geological Studies of Sub-Basalt Basin of Western Continental Margin of India for Delineating Hydrocarbon Prospect in Sub-Basalt Reservoir

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Extruded basalt flows overlying sedimentary sequences present a challenge to hydrocarbon exploration and there are still large prospective areas of the world sedimentary basin that remain under-explored beneath flood basalt. Flood basalt shows a high level of heterogeneity and it is clear from geological observation that basalt cannot be thought of as a single homogeneous layer or not it can be considered as a series of homogeneous layers separated by simple interfaces. Internal and interface heterogeneity are believed to be the major causes of low quality geophysical data in basaltic areas. A basalt layer often contains high-velocity layers This paper emphasizes the need of comparative geological studies of the South American continent sub-basalt basins in relation to the western continental margin of India considering factors such as expected reserve, reserve calculated, quantity of exploratory wells, maximum drilling depth, sub-basalt stratigraphy, logging, petroleum system identification, structural geology of the area, fracture system, play fairway, source rock maturation, and stress applied in potential area etc. Paper will discuss the detailed stratigraphic modeling of basalt flood in the basin for proper visualization of the existence of petroleum system beneath the basalt cover. In order to combine the appropriate technology and maintain the workflow in drilling potential sub-basalt hydrocarbon prospect we need several phases of identification like integrated multi-measurement, data acquisition, processing, imaging, modeling, inversion and simulation. Seismic time or seismic depth imaging and its accurate interpretation are the key in the guiding comparative geology to envisage the sub-basalt reservoir. This rational approach to the sub-basalt basin of South America with India involves comparative geology coupled with modern geophysical technology as an effective means in the quest to delineate drillable oil and gas prospect in these highly complex areas.

Integrated Study of Hydrocarbon Prospective Sub-Basaltic Sediments and Tectonic Significance of Cretaceous Volcanism, in Western India

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The western continental margin of India has awoken much interest because of its prospective hydrocarbon potential. The basin lies to the South of the Bombay offshore basin, the major hydrocarbon producer of India and is adjacent to the Cauvery-manar basin. The south west continental margin of India is characterized as a complex volcanic passive margin. Tectonic reconstructions show that the western continental margin of India owes its origin to the Mesoproterozoic extensions of the Columbia supercontinent that was responsible for the Mahanadi and Pranhita-Godavari rifts. Gravity modeling of the southern India shield and offshore area shows thicker magmatic crust in that area and increasing of effective elastic thickness towards the South indicates that the volcanism decreases to the South. The aforesaid fact indicates that this margin had already been in a well advanced stage of the rifting by the Middle Cretaceous. Cretaceous volcanic rocks, which consist mainly of the basalt flows and pyroclastic rocks occur in the western part of India. Volcanic rocks are associated with each of four regional transgressive–regressive cycles that makes the Cretaceous clastic succession. This paper will discuss the comprehensive understanding of the regional tectonics setup developed by integrating regional, seismic, wells information and plate tectonics studies to provide the best analysis of hydrocarbon prospectivity in sub-basalt sediments. In this area the hydrocarbon is mostly considered to be in the gas window because it is evident from high basalt heat flow and process of rifting. This paper concerns the imaging of the sub-basalt strata and its prospectivity. Tectonics synthesis of the western India margin basin developed by the integrating of the regional seismic, wells information and plate tectonics reconstruction studies indicate the multi episodic rift, providing a high possibility for the presence of the Mesozoic source rock along the south western continental margin of India and the fact that can be the powerful source of hydrocarbon accumulation in these sub-basalt sediments.

Prediction and Significance of Entropy and Anisotropy in Lithological and Reservoir Characterization of a Sedimentary Formation Using GIS

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The study of geological system and GIS, from the view point of homogeneity or heterogeneity of their complex structure may be carried out with an aid of the theory of the information. The entropy is the special index in the theory of information and is employed a criterion for the identification of the system. GIS gives us the clear-view fact of the different parameters of a reservoir changing with respect to entropy and anisotropy. GIS presents information on porosity, permeability, etc., thus making it possible this information to be interpreted through the different types of software. The concept of entropy is borrowed from the thermodynamics and statistical physics and it is a basic concept in the defining the lithological characteristics of a particular formation. Magnitude of entropy, which expresses the degree of heterogeneity or identification, may be used in geological studies and graphic representation of heterogeneity of various geologic systems and can be analyzed using the GIS. Generally, for the determination of lithological and reservoir characteristic entropy has different values like that for sand, silt and shale the relative entropy value is 0.45 and unsorted rocks have the relative entropy of 0.83 to 0.85. The concept of entropy may prove to be useful not only in the fields of lithology and petrography but also in the field of geochemistry and in the hydrochemistry. Another parameter for the characterization of a reservoir is anisotropy of rocks. The fluid motion in various directions is subjected to a considerable anisotropy because permeability of the stratified rocks is dependent on the direction of a flow and anisotropy is determined on the basis of the anisotropy coefficient of different types of rocks. Anisotropy coefficient is dimensionless; it is dependent upon the ratio of permeability. So, anisotropy coefficient determines the sequence of thickness of the beds by which we analyze the rock type, matrix, stratigraphy, cyclicity and fluid migration through the rocks.

New Method of Magnetic Scanning of the Precambrian Basement (Case Studies of the Ukrainian Shield)

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Geological magnetic investigations are carried out by selection of rock samples and laboratory analysis. Observation of the magnetic fields are used standard aero-ore cur- survey method. Detail magnetic investigation used for archaeology or ore resources. The most part of magnetic investigations includes selection process "in situ" (on the field) and laboratory researches — there are two separate operations.

The understanding of geological structure of region with differentiated basement structure requires detailed studies of small geological bodies. Their size might be too small to be resolved by standard geological survey, but these bodies are magnetic markers of geological structure. In this work the new method of petromagnetic investigations is described. Method of magnetic scanning (MS) let use a new possibilities of mapping for high-differenciated sectors of the Precambrian basement. Scanning of magnetic field by new method gives the chance to use the high-frequency fluctuations of curves T (rejected earlier as "noise") for the analysis of distribution of magnetic minerals in the surface layer of exposure. χ-metric and laboratory studying specify a picture and real character of behaviour of magnetic fraction in rock. The resulting of MS in new geointhormation system be used. Also, the method of comparative magnetic analysis is developed. It consists in comparison of several profiles of geophysic areas by visual and magnetic characteristics.

In case of high similarity by form of fragments of detailed T-curves one can intuitive accept the structural-geological similarity of corresponding domen (in area of scanned profiles). This thesis is argumented in next way: detalization of T-curve individualize him and his form can identificate structural-geological formation of rock in scanned area.

Successful exploitation of method MS is related to territory among village Samchinzi and village Raygorod on the left coast of the river. Here, the curve *T* has obviously similar IK and I'K' fragments on both coasts of river (fig. 1). This similarity causes similarity of corresponding geological bodies. But this fact does not correlate with traditional geological map of investigated territory. The similarity has a "parallel" type (fragments IK = I'K' by parallel transfer), i.e. profile of T-scanning cuts two geological bodies with parallel-similar structure in fragments IK and I'K'.

Perpendicularly to their cuts on the maps of abnormal magnetic field there are prolongated anomalies >700 nTl (fig. 2). Two of their areas, pint by nord-west prolongated izo-lines of magnetic field, are ≈ parallel one to one. Presentated analysis of T-map and similarity of forms and items of *T* in fragments IK and I'K' lets conclude: in the Pre-Cambrian basement two geo-bodies that are very similar by magnetic structure prolongated in nord-west orientation are formed (fig. 1b).

Due to detalization of measurements and synchronization of χ- and T-scanning, the possibility of real imagination of magnetic field sources appears. The complex computerizing analysis of in situ and laboratoric magnetometry let investigate the magnetic markers for next analysis of problem geological zones and correction of geological maps.

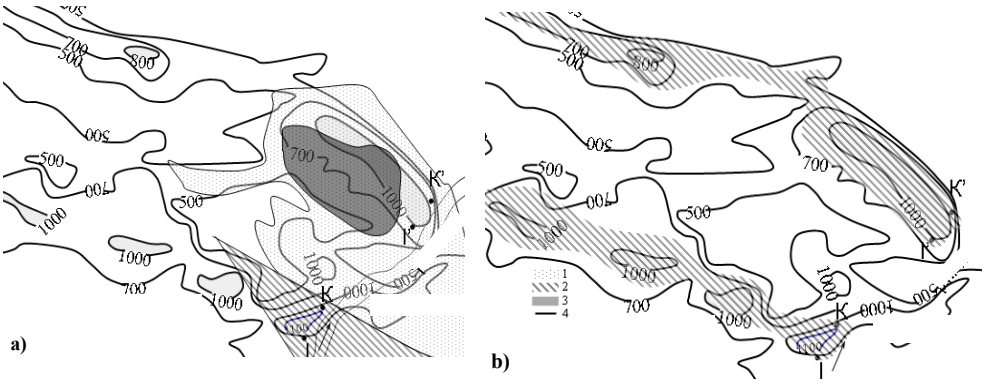

Fig. 1. Detailed geological map, 1 : 25 000 with isolines of ΔT (the Southern Bug v. Samchyntsi, v. Rayhorod): a) for the MS and b) after the MS. Legend: a) 1 — granodiorites, 2 — migmatites, 3 — diorite, 4 — baseline ΔT (nT).

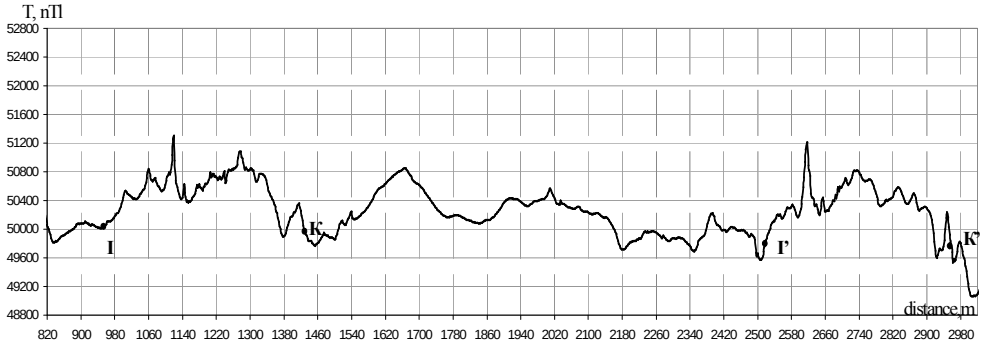

Fig. 2. Fragment of T-curve along the river South Bough (verbs are corresponding to route of scanning).

Geological and Tectonic Feature of Neoproterozoic Flood Basalts Field of the Volhyn Region

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The providing prospection within the Volhyn region, where around 300 boreholes were drilled, was chosen for defining its geological and tectonic patterns. This research was mainly dirested at defining geological position of the Neoproterozoic (early Vendian) flood basalts the Ratno Beds. The methods of analyses in ArcGIS were used

The Precambrian basement in investigation area are covered by Neoproterozoic (the Polesie, and the Volhynian Series) deposits. The Volhynian Series is divided into (from bottom to top) the Brody Beds (~ 40 m), the Gorbashi Beds (to 50 m), the Zabolottya Beds (to 85 m), the Babino Beds (to 200 m) and the Ratno Beds.

The Ratno Beds is consist basaltic flows, lavabreccias and tuffs beds between them. The basaltic flows differ from each other in rockforming minerals quantities, alteration degree, structural and textured features, and also presence of amygdales, veins and vesicles.

Map of study area was digitized and linked to the grid. The location of wells, faults (highlighted during geological research) and the borders of geological units were placed on the map.

The Attributive table, which contains information on the number of wells, the absolute mark, deep wells, stratigraphic unit boundaries and boundaries of flows and tuffs beds, was made based on the description of wells, which were accumulated over the years. The surfaces of flow boundaries were built in ArcMap using the Spline. The model of flow surfaces were created in ArcScene.

These all allowed to draw next conclusions and assumptions. It was verified the Ratno Beds is southwest dip. The assumptions about Neoproterozoic (early Vendian) character Chartorysk rupture zone formation can be made based on the building surface of the Babyno Beds (or base of the Ratno Beds), where displacement can be seen. Such feature wasn't found on the roof surface of the Ratno Beds first flow.

Ground-Penetrating Radar Studies of the Archaeological Sites in Estonia

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GPR (ground-penetrating radar) is one of the geophysical techniques that permits, with a help of electromagnetic waves, to study the structure of the ground by identifying layers and objects of interest on the base of a contrast in their electrical properties. This method is widely used in geology and engineering. Its application in archaeology allows to determine structure and lateral extent of the cultural layers without destroying them in course of excavations. However, in Estonian archaeology, especially in research of the Stone Age, using GPR is not a long tradition.

The Veibri archaeological site is situated in southern Estonia on a flood plane on the left coast of the River Suur Emajõgi. As a result of previous research it was suggested that a larger Late Mesolithic (8500...7000 BP) cemetery was located in Veibri. With an aim to establish the extent and structure of the cemetery the GPR survey was conducted in June, 2010. Identification of graves according to the radar profiles did not succeed due to their location in the so-called upper shadow zone of the electromagnetic waves some decimetres from the surface. However, GPR enabled to define the type of the sediment as crossbedded river sands. With an aim and hope to make further research in the area, the repeated GPR survey was performed in November, 2011. As distinct from applied in 2010 antenna of 500 MHz, new equipment of higher frequency (900 MHz), with the smaller upper shadow zone was used.

The Kudruküla archaeological site is situated in north-eastern Estonia and is presented by cultural layer, outcropping on the right coast of the Kudruküla stream (discharges into the Narva River). The position and age (5600...5700 cal. BP – Middle Neolithic) of the layer does not fit into the regional sea-level scheme: it outcrops 3.8 m below the Litorina Sea level that makes its origin unclear. With an aim to specify geological structure of the area and extent of the cultural layer, the GPR survey was undertaken in July, 2010. According to the radar profiles the layer is located within cross-bedded river sands that are clearly younger than contiguous marine beach ridges. The areal extent of the layer reaches ~900 m^2. All proposed reasons for such a low position, such as water-indused displacement of the archaeological material, landslide, compaction of underlying organic sediments, some inaccuracy of the regional sea-level curve, did not find their confirmation. However, the study is still in the course.

The Jägala archaeological site is situated in the northern Estonia on the right coast of the Jägala River mouthing into the Baltic Sea. The Jägala-Jõesuu hill fort and dozen settlements of different age were previously discovered and studied in Jägala. In the course of rescue excavations in summer 2011 a large complex of field remains, presented by two buried within aeolian sands chronologically different layers, was detected. Performed in July, 2011 GPR fieldworks aimed to establish extent of the field remains.

3D Models of the Karadag Massive

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The Karadag is a mountain range on the Black Sea coast of the Crimea, which is located between the Otuzskoyu valley and Koktebel Basin. Its main elements are the Coast Range, located along the coast, and the dome massive of Holy Mountain. The top of this mountain is the highest point of elevation in the areas and reaches up to 577 meters.

Karadag is translated from the Turkish as "Black Mountain". It is considered to be remnants of an ancient volcano that was active about 150 million years ago and is referred to the manifestations of mid-Jurassic volcanism. It is these volcanic rocks that formed the massive. Different and unusual shapes of modern relief Karadag array is the result of prolonged denudation processes that occur today. It is a unique geological reserve and of great global significance.

The basis for constructing 3D models of the Karadag massive and possible landslides served a variety of published topographic and geological maps of the area. This work was carried out using software ArcGis, which is a combination of technical, software and information tools that provide input, storage, processing, mathematical modeling, mapping and integrated figurative representation of geographic and related attribute data to solve problems of territorial planning and management.

The first stage of work includedbinding data maps to the real geographical coordinates. For geological maps the so-called method of "dragging of coordinates", which involves the use of geographic coordinates of pre-tied topographic base was used. The next stage was to create a separate module using ArcCatalog. Different types of shape files in which we entered the necessary attribute data.

Then we built the TIN (Triangelated Irregular Network) model, which is the most widely used vector polygonal model of spatial data. It is constructed by combining the known point values in a series of triangles by Delone's triangulation algorithm. Using this model enables us to present the massive surface as a set of related three-dimensional (3D) triangular faces that do not overlap. Having picked up the colors and set the spacing between them, we can easily diagnose a particular terrain and visually estimate the absolute excess. Compared to raster graphics, this method is more accurate and compact.

To display surface of the massif more precisely the program Move has been applied. By means of this program a 3D model of relief was built. Also this aforesaid program was used to develop a 3D model which highlighted areas of possible landslides. These hazardous areas are observed in the eastern mountains Syuryu-Kai, less likely is their appearance on the slopes of Holy mountain, and the most dangerous landslide area is in the south-eastern part of the Karadag's massive. It forms the sea cliff with a great angle of inclination of the surface towards the sea. Imposing the geological map on the 3D model and taking into consideration the possibility of landslides it comes obvious that these slopes are principally composed of solid homogeneous volcanic rocks such as dacites, andesite-basalts and other volcanites.

So, as we can see, using software ArcGis and Move allowed to build rather accurate and visually sensitive three-dimensional model of the massif. After analyzing the features of its topography and geological structure landslide-hazardous areas were determined, and they need to be considered while laying ecological paths for tourists in the reserve.

Also, this 3D model can be used for visualization of geomorphological features of the relief of volcanic origin and during various excursions.

Geology of Mineral Deposits

Perspectives of Shale Gas Exploitation in Poland

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Poland has potentially rich resources of shale gas and this appears to be a not-to-be-missed chance.

We can divide natural gas into conventional gas reserves (natural gas) and deposits of unconventional natural gas (tight gas, shale gas, coal seam gas and gas hydrates).

Shale gas occurs in shale rock. The gas forms a closed forms and the volume of each slots is much smaller than in conventional gas fields.

Fig. 1. State at shale gas deposits in Poland

Shale deposits in Poland include the lower Silurian, Ordovician and Cambrian shale formation which range from north-central to south-eastern Poland. In Poland, the foreseen extensive stratum of shale extends from the Baltic Sea coast (from Słupsk to Gdańsk) and spreads northbound beneath Warsaw to Lublin and Zamość in southeast Poland (fig.1). The country faces a great opportunity to build a strong energy sector, becoming independent of energy import.

Shale gas extraction is a very special technique, which was developed in the US. Horizontal drilling technique consists of drilling the initial vertical borehole. Then, when it reaches the appropriate depth, there is gradual transition to a horizontal section of the target and drilled rock stratum. Then follows a process of rock "opening", called hydraulic fracture. This process consists in pumping water under pressure up to 600 atmospheres and then fine sand, which is pressed into the cracks formed in the rock, which prevents them from reclosing. The whole creates a closed circuit.

Stages of shale gas exploitation could be observed on the example of the U.S. The operation is not only a drilling and hydraulic fracturing, but involves also a number of other activities, such as acquisition of rights to explore and exploit hydrocarbons on the territory, obtaining work permits for exploration and production and deposit management. All these steps will be discussed on the example of the schedule for shale gas exploitation in the United States.

The important issue is the impact of gas exploitation to the environment. Due to the development of horizontal drilling technology, the impact of extraction the gas of shale rocks on the terrestrial mining in the region is much smaller than in the case of conventional gas extraction. The process of extracting shale gas may have an impact on the landscape, air pollution, soil pollution, water pollution and its excessive consumption.

Geological Structure and Gold-bearing Perspective of the Vyshkovo Ore Field (Transcarpathian, Ukraine)

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Vyshkovo ore field is situated in the south-east part of the Transcarpathian region (north-east part of the Vuhorlat-Hutyn volcanic ridge). Geologic section consists of the basis rocks (limestones (J_{2-3}), clastic rocks (K_2)) and Neogen cover rocks (clastic-carbonate rocks, rarely volcanic-sedimentary rocks). Geologic section of the Beregove ore region is similar.

Vyshkovo ore field is a part of the Prypanonian deep fault which separates Transcarpathian deep and Panonian middle massif (Merlich, 1971). That's way Vyshkovo ore field is interpreted as a part of the single ore zone which crosses Bihan, Beregove and Vushkovo ore field and Baia-Mare ore region. O. Kolodiy compared a tectonic map of Vyshkovo ore field with related territory in Romania. This map of Vushkovo ore field was composed by Kolodiy (1988) using photointerpretation. Kolodiy discovered different structural elements (radial, ring and linear fault) within Vushkovo ore field. Gold bearing ore formation could be connected with these structural elements. Vyshkovo ore field has mosaic-bloc structure. Such structure is typical for many ore-bearing regions.

Deposits in Romania (near Vyshkovo ore field) have the similar ore bearing rocks and secondary changes, mineral associations. This can indicate that ore generation processes were similar for these deposits. Hydrothermal-metasomatic changes in rocks (argillization, silicification, qarts- hydromica metasomatite, adularitization, sulfidization, alunite ore) are widespread within Vyshkovo ore field too.

Matkovskiy (1992) marked out few perspective gold bearing mineral association types at Vyshkovo ore field: gold-pyrite-galena type, gold-quarts-adularia type, and gold-barite-galena-blende type. Intrusive dome structures, ring, cone, radial faults, exo and endo contact zones of intrusive body, explosive breccias are ore controlling.

At the previously evolved gold ore occurrence (Zagadkovij, Novij, Banja etc.) ore bodies forms are as follows: veins, jack ore, silicification zone (mostly connected with faulting), irregular shape body.

Often occurrence of gold in ore is associated with silicificated explosive breccias. Pyrite, blende, galena, calcite, barite associated with gold. Sulphide content is not more than 2% (volcanogenic-hydrothermal class by Smirnov). That's why type of this ore is hydrothermal-veins with complicated ore body morphology. Striped and brecciated textures are characteristic for the veins structure.

Research conducted in the Transcarpathian GPP Vyshkovo ore field was mainly devoted to mercury mineralization (Velukiy Shayan and Borkut deposits) that's why it is very important to investigate gold-bearing mineralization at Vyshkovo ore field.

Hydrogeological Safety of Induced Hydraulic Fracturing

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Hydraulic fracturing is the propagation of fractures in a rock layer caused by the presence of a pressurized fluid. Hydraulic fractures form naturally, as in the case of veins or dikes, and are the only one means by which gas and petroleum from source rocks may migrate to reservoir rocks. Energy companies attempt to accelerate this process in order to release petroleum, natural gas or other substances for extraction, via a technique called induced hydraulic fracturing. The fluid injected into the rock by drilling companies is typically a slurry of water, proppants, and chemical additives.

Operations related to fracturing can result in a number of potential impacts to the environment, including:

- Stress on surface water and ground water supplies from the withdrawal of large volumes of water used in drilling and hydraulic fracturing;
- Contamination of underground sources of drinking water and surface waters resulting from spills, faulty well construction, etc.;
- Adverse impacts from discharges into surface waters or from emergency disposal into underground injection wells.

Hydraulic fracturing combined with horizontal drilling has turned previously unproductive organic-rich shales into the largest natural gas fields in the world. Because of that natural gas development is increasing rapidly in many regions, prudent steps to reduce these impacts are essential now even as further research to understand potential risks continues.

Sequestration of CO_2 Emitted from Fossil Fuel Combustion — Storage in Geologic Formations or the Use of Mineral Carbonation Processes

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The growth of CO_2 emission as a by-product of fossil fuel combustion is one of the most important problems modern world has to deal with in terms of environmental protection. According to many climate scientists, carbon dioxide, a main greenhouse gas, is the most immediate global warming cause. For this reason many countries have already taken up some actions to reduce emission of CO_2. The technology of carbon capture and storage (CCS) is well known as CO_2 sequestration.

Increasing interest in CCS around the world has generated the development of different methods of CO_2 sequestration, which can be classified into three basic groups: chemical, physical and biological one. Mineral sequestration belongs to chemical methods and it is based upon natural processes which in geological history have always played the most significant role in reducing carbon dioxide concentration in the atmosphere. Mineral CO_2 sequestration consists in the reaction of combining CO_2 chemically with abundant raw materials such as olivine and serpentine. Products of this reaction are Mg-carbonate minerals, which are thermodynamically stable and environmentally neutral. Mineral sequestration can be conducted by means of direct and indirect methods. Second group of CO_2 sequestration constitute physical methods. In this case carbon dioxide is injected into deep geological formations or deep-sea, where it is stored and fixed. Candidate sites for geologic storage include deep saline aquifers, depleted oil and gas reservoirs and deep unmineable coal seams. Injected into deep rock formations, CO_2 can form supercritical fluid, which characteristic features are used in methods of enhance oil or gas recovery. The United Nations Intergovernmental Panel on Climate Change (IPCC) estimates that the world's potential capacity of geological formation is big enough to sequestrate CO_2 emitted from industry over the next hundreds of years.

Mineralogy, Petrology and Geochemistry

Inclusions of CO_2 of the Homogeneous Origin Used for the Reconstruction of Conditions of the REE-U-Th Dibrova Deposit (Ukrainian Shield)

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We have found the initial inclusions of CO_2 liquid solution (Fig. 1) that "stick" to needle formations of sillimanite in quartz of secondary quartzite of Dibrova deposits (borehole 74, depth 171.3 m) [6]. Their densities vary from 0.82 to 0.85 g/cm^3. These values correspond to the density of pure CO_2 at a temperature of homogenization of +19.8°C and +16.5°C of inclusions in the liquid phase (Anhus [5]). Due to the small size of inclusions the triple point temperature of the contents was identified approximately with an error of 0.5°C and in total comprised 57.3°C. The X-ray microanalysis confirmed the presence of sillimanite inclusions in quartz [3].

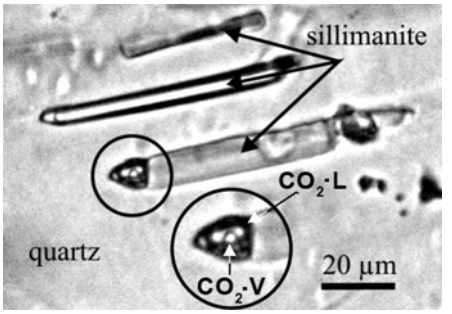

Fig.1. Initial inclusions of liquid solution of CO_2 (circled) that "sticking" to needle formations of sillimanite in quartz.

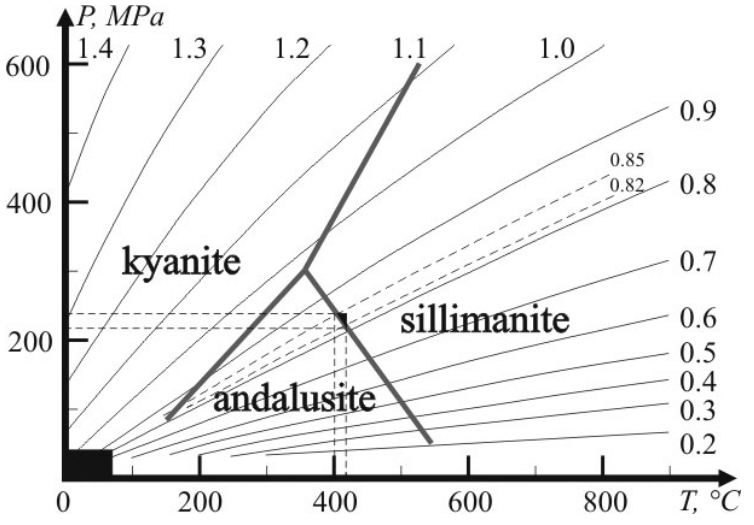

Fig. 2. Intersection of chart of "andalusite-sillimanite-kyanite" phase changing with isochors of CO_2 density.

Reconstructing PT-path of inclusions conservation formed by means of the homogeneous system of mineral-forming fluids is very complicated [2]. To solve this problem we need to find a point on the chart, where PT-parameters would correspond to the conditions of conservation of inclusion [5]. Some other solutions for solving this problem are discussed separately [1].

PT-conditions of the sillimanite crystals growth in quartz of secondary quartzite of Dibrova deposits are equal to or greater than the parameters of CO_2 points of intersection; density isochores are of 0.85 and 0.82 g/cm^3 with a limit of sillimanite field in the chart of "andalusite-sillimanite-kyanite", that is ≥ 400–420°C, 220–240 MPa (Fig. 2).

CO_2 fluids that participated in the formation of Dibrova deposits, are related to magma products degassing of basic/ultrabasic composition. Initial inclusions of liquid solution of CO_2 characterized by the high density have been found in the minerals of deep-seated basic and ultrabasic rocks only [5]. Glass inclusions in olivines and pyroxenes of these rocks contain the largest amount of CO_2 (1.029–2.4 % by mass) [4].

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Complex Investigations of Carbonate Rocks and Related Weathered Materials in Rila-Rhodopean Massif, Southern Bulgaria

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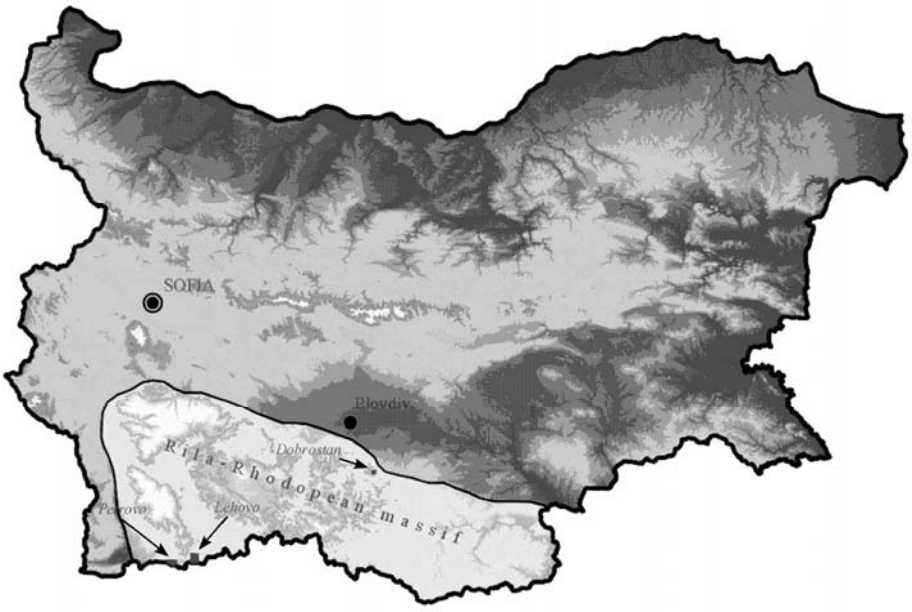
The presented material is a review of 3-years project, financed by the Bulgarian Science Fund, and covers three research polygons on the territory of the Southern Bulgaria - Dobrostan (central-northern part of Rila-Rhodopean massif, Rhodopa mountain), Lehovo and Petrovo (south-western part of Rila-Rhodopean massif, Slaviyanka mountain). The research areas are named after the villages located nearby. The aim of the study is complex investigation of the ***bedrock-relief-soil formation*** system and existed intersystem relations in the context of the land-use in territories with carbonate terrains in the Rila-Rhodopean massif.



The combination of geological and geomorphological premises forms conditions for formation of specific weathering products and soils upon carbonate type of rocks. In that study we try to determine the mechanisms for their genetic relations and distribution. These weathering products, carbonate rocks related, are the only soil source in these areas, defined as "unfavored regions", due to the programs for development of the EU.

To achieve the main goal, the following tasks are planned:

- geomorphological investigation of the research polygons;
- investigation of the mineralogical, petrological and geochemical characteristics of the bedrocks;

- complex investigation of the weathering products;
- implementation of monitoring activities of the dynamics of the geo-system bedrock-relief-soil and climate changes.

Categorization and estimation of different types of soils and estimation of their suitability for agricultural land-use and improving of the qualities of the agriculture fields is an expected practical result from the study, as well as foundation of database for the research polygons.

The expected scientific results from the project are connected with characterization, correlation and interpretation of the relations in the system bedrock-relief-soil on defined terrains.

Carboniferous Granites in Juniku (Kosovo)

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The outcrop of Juniku (Kosovo) granites is located to the south of the Trokuzi Massif (Gashi Zone-Albania, fig. 1).

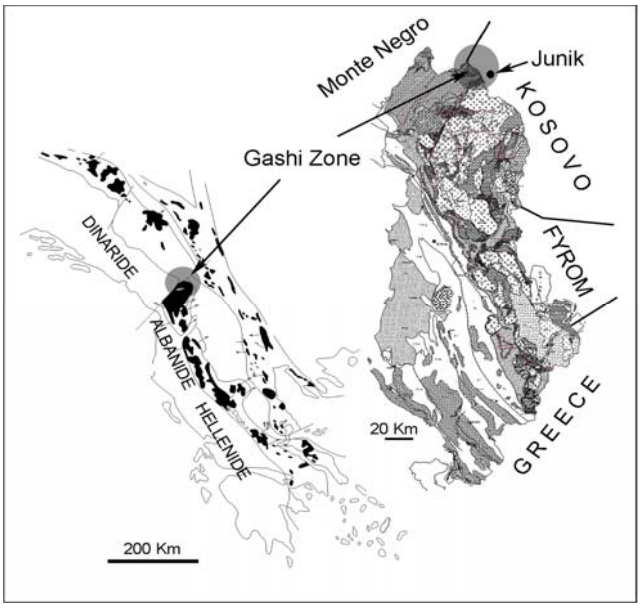

Fig. 1. Structural sketch showing the position of the Gashi Zone

This paper reports the results of the analysis of major and trace elements, rare earth elements (REE) and isotopic dating of the Carboniferous granites of Juniku in Kosovo by U-Pb method in zircons. The isotopic dating is completed in the laboratory of Istem, CC 066, University Montpellier II, France. The trace elements analyses are carried out in the laboratories of CRPG, Nancy, France by ICP-MS.

The age of this massif is determined as the Carboniferous, 329.6 ± 2.1 Ma. Carboniferous granites, until now, are known only in this small outcrop in Juniku region (Kosovo), not on the territory of Albania and as far as we know, neither in the area of the Durmitor Zone. A similar case is described in the central Sudeten (Kryza R, 2011) where, within the Devonian ophiolitic fragments are found the tectonized granite dykes aged 338 ± 2–3 Ma. These granites represent a relatively new phase of granitoid magmatism of the Variscan orogenesis. In the western part of Macedonia (Hrvatović and Pamić, 2005), in the Ordovician metasediments the granitoides of Ordovician age are intruded (461–465 Ma).

This outcrop of Juniku (Kosovo) granites localized between the formations that according to Dimitrijevic, 1992 represents an ophiolitic melange, and according to Elezaj, 2009 the Triassic-Jurassic ophiolites. They may be the representatives of the Palaeozoic basement, (fig. 2).

Concerning the type of granitoides, they can be classified as of the type I, but with more careful examination, all of them belong to a variety of I type, namely type A 1.

The chondrite-normalized REE compositions show a relative depletion in heavy REE and absence of the negative anomaly of Eu (Eu / Eu*= 0.9) (fig. 3).

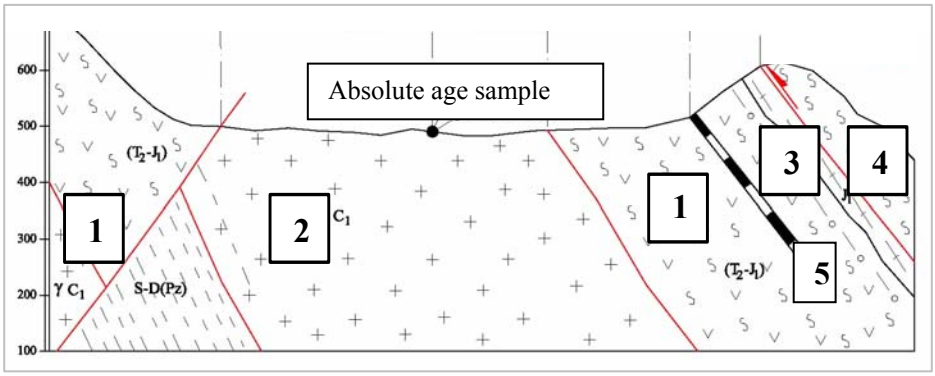

Fig. 2. Schematic cross section. 1 — Volcanic-sedimentary series; 2 — Granites; 3 — Amphibolites; 4 — Serpentinites; 5 — Radiolarites.

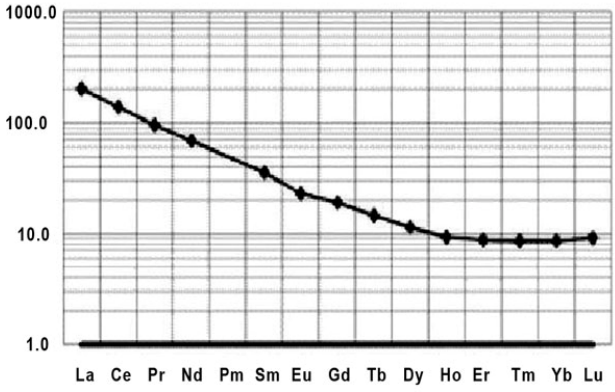

Fig. 3. Chondrite-normalized REE compositions (normalization values after Sun and McDonough, 1989).

They are enriched in Ni and Cr. These geochemical features indicate that magma which has crystallized these granites is generated in the mantle at great depth, leaving a garnet peridotite as the residue. The high content of the elements such as Ba, U, Th and Sr suggests an enrichment of magma with continental crustal material. These features can be explained by the formation of such granites in the continental rifting conditions or within continental plate as suggests their classification to be of A1 type granites.

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Changes of Chemical Composition of Precipitation Water in Aeolian Sand Dune Massive, Ropažu District, Latvia

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Groundwater recharge is one of the most complex processes in hydrology. The understanding of this process provides possibility to make more precise models of hydrological systems and geochemical cycling of the elements. Analysis of the groundwater and precipitation water composition is a possible approach to address this problem.

Research was conducted repeatedly collecting groundwater samples from eight boreholes located in different parts of dune massive in Ropažu district, Latvia near the village Tumšupe. Chemical composition of groundwater samples were analyzed and compared with precipitation chemical composition using mathematical calculations. The chemical composition of precipitation was taken from meteorological observation station Zosēni.

The main tasks of the research were:

- Identify suitable research area and obtain all available information about geological and hydrogeological settlement and processes of the study area;
- Collect representative groundwater samples;
- Calculate amount of groundwater recharge using environmental chloride method (Seiler&Gat, 2007);
- Interpret and evaluate the results.

The research covers area of 3.49 km^2 large dune field formed in proximity of Baltic ice lake during the last deglaciation. Dunes composed of well sorted sand overlay glacial till deposits, which work as an aquitard for unconfined groundwater. The relative height of dunes ranges from 5 to 18 meters.

Groundwater samples were collected in hand drilled monitoring wells, using small submersible pump and monitoring such parameters as temperature, electrical conductivity and oxygen contents.

To determine groundwater recharge from precipitation environmental chloride method was used (Seiler&Gat, 2007). It is based on assumption that there is no other chloride source in the research area and no anthropogenic inputs occur. The chloride concentrations in precipitation and groundwater was known or analyzed in collected samples.

The results show that there are two major groundwater types in one aquifer. After determining amount of groundwater recharge from precipitation, chemical composition changes in groundwater were calculated. It is found that there is an increase of Ca^{2+} and SO_4^{2-} ions, and much smaller increase of Mg^{2-}, Na^+ and K^+ concentrations in the groundwater compared to the precipitation.

This paper is partly supported by the ESF project no. 2009/0212/1DP/1.1.1.2.0/09/APIA/ VIAA/060.

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The Zechstein Polymetallic Mineralization in the Fore-Sudetic Monocline in the Region Ślubów (SW Poland)

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The Fore-Sudeten Monocline is located in the southwest of Poland and is a part of the Permo-Mezozoic structural floor. In the Permian rocks, on the boundary between terrestrial deposits of the Rotliegend and marine deposits from the Zechstein (cyclothem I), we found Kupferschiefer facies. Polimetalic mineralization were found in three lithological types: sandstones, shales, and carbonate deposits (Piestrzyński 2007). The core samples were collected in the northeast of the village Ślubów, and were made during the exploitation of the Kupferschiefer deposits. The mineralization of this area is located at the depths ranging from 1,380 m to 1,520 m below the surface, depending on core location. In the face of progress in the world exploitation of metal ores, we encounter the possibility of deep-surface exploitation. The Ślubów region is prospective to Zechstein copper ore deposits (Speczik, Oszczepalski 2011).

All photographic documentation was done at the geology department, at the University of Warsaw, via reflected, as well as plain and cross-polarized light microscopy, using a Nikon microscope, with a connected Nikon Sight DS.-5Mc. The mineral composition and ore minerals, in the sandstones, shale, and carbonate rocks were determined by the above mentioned microscopy. The predominant ore mineralization is represented by several Cu-S and Cu-Fe-S minerals: chalcocite, digenite, covellite, bornite, and chalcopyrite being Cu-S minerals, and galena, sphalerite, pyrite, being Cu-Fe-S minerals. Furthermore, we can find fossils that have been incrusted by sulfides (Foraminifera Fig. 1, Gastropoda, Ostracoda).

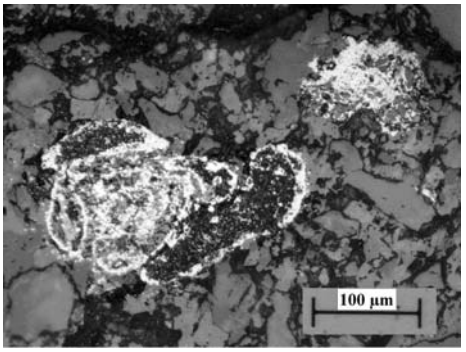

Fig.1. Foraminifera incrusted by sulfides.

There are many theories describing ore mineralization. Most geologists believe mineralization was created by geothermal processes in the Mesozoic. The source of transition metals were the underlying Carboniferous Molasse Basin sediments and Rotliegend deposits. There exist six ore mineralization stages (Piestrzyński 2007). These mineralization stages created zoning, lateral and horizontal, illustrate the movement of the mineralization front. The stages are oxidation, transition and reduction (Cu-bearing, Zn-Pb-bearing, pyrite-bearing). In each of the zones we can find different mineral parageneses (Oszczepalski 1999).

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Magmatic Crystallization and Structure Formation of Basalt Lavas of the Volhynian Trap Formation

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The structure of lava flows as well as variations in the composition of basalts determine the distribution of native copper in the Volhynian Trap Formation. The role of the magmatic process in the formation of native copper can be defined by a detailed study of the relations between minerals or by simulating the crystallization of the basaltic melt, which will help to confirm or refute the "magmatic" hypothesis of copper origin.

Here we report the results of the analysis of basalt crystallization processes in the upper beds of the Volhynian Series (Luchychi and Yakyshi horizons of Ratno beds).

In our research, we studied the structure of the basalts, the sequence of mineral crystallization, and the variations of the mineral composition of rocks and minerals, and emloyed the computer simulation analysis. The simulation analysis of the magmatic crystallization was performed using COMAGMAT 3.59 and PELE 8.0 software and was based on calculating the phase equilibria during the crystallization of basaltic magma.

Petrochemical trends of the basalts of the Luchychi and Yakyshi layers indicate different degrees of magmatic differentiation and mixing of magmas, which are reflected in different sequences of mineral crystallization. Initially, the magma of the Luchychi horizon contained a small amount of phenocrysts, and so it could be characterized as overheat. This can be explained by the magmatic mixing of the differentiated magma with new portions of magma from the deep. The crystallization sequence of the Luchychi magma was the following: augite ± pigeonite + magnetite → augite ± pigeonite + magnetite + plagioclase.

The magma of the Yakyshi layer is partly heterogeneous. The Yakyshi layer marks a new stage of magmatic activity. The sequence of crystallization of the Yakyshi magma: olivine → olivine + plagioclase → plagioclase + pigeonite → plagioclase + pigeonite + magnetite → plagioclase + pigeonite + magnetite + augite → plagioclase + pigeonite + magnetite + augite + ilmenite → plagioclase + augite + ilmenite. The different sequence of the magmatic crystallization has been verified by computer simulation.

Different petrochemical trends can be explained by the intrachamber differentiation of the initial olivine basaltic magma. The magma differentiation processes of the Ratno time were intermediate between the equilibrium and the fractional crystallization. Oxygen fugacity conditions approximately correspond to the QFM buffer.

The simulation of the process of copper fractioning during the magma differentiation has demonstrated that, given the initial content of Cu at 100 ppm, the maximum concentration of copper did not exceed 300 ppm, which was not enough for the crystallization of native copper.

We also simulated the behaviour of gases in the process of the lava flow formation, including the correlation between the gase phase and the patterns of lava crystallization. Fluidal patterns caused the formation of chainlets of gas cavities along the stripe texture. The network of cavities controlled the extraction of copper from glass in the peripheral parts of the flow and the sedimentation of native copper in the central zones.

Current Status of Fluid Regime Peculiarities Study of Lower Vendian Volyn-Podolian Flood Basalt Complexes

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Lower Vendian flood basalt complexes in Volyn region, which are perspective on copper deposits, are known as the Volyn series and are lower structural tier of Volyn-Podolsk monocline platform cover with Polissian series (Pryhodko, Kosovsky, 1993). In spite of the fact that scientists began to study flood basalt complexes two centuries ago, the physical and chemical nature of space–time variability of the rocks and parametric characteristics of fluids (Naumko, 2006) have been studied fragmentary.

S. Martynova (1955) was one of the first who began to research fluid inclusions. Single-phase low-temperature liquid and solid inclusions of ore minerals (hematite and goethite) have been found in amethyst crystals of vugs and tonsils in Volynian basalts crust of weathering. Results of the current thermobarogeochemical studying of Volynian basalts are presented in the works of I. Bakumenko, M. Bezugla, K. Derevska, Yu. Fedoryshyn, I. Kvasnytsya, I. Lugova, V. Melnychuk, L. Shumlyanskyi, O. Yemets et al.

I. Bakumenko and Yu. Fedoryshyn (2005) determined the temperature of Ratne basalt formation, with no signs of postmagmatic changes. Finely crystallize melt inclusions in plagioclase from basalts, selected in career of Janov Valley, have been investigated. According to the research melt inclusions in vivo Volyn basalt melt was completely crystallize and lose the ability to move at temperature above 800–840 °C, but below 950 °C. The melt that is poured out in lava flows remained fluidity at the temperature of 1 110–1 120 °C. Crystallization of plagioclase micro-impregnates was occurred at even higher temperature — 1 200–1 135 °C.

I. Kvasnytsya (2006) studied gas-liquid inclusions in minerals connected with copper (quartz, calcite) and found out *PT*-parameters of mineral paragenetic association crystallization. It was determined that there are three types of copper in basalts: magmatic copper-I, magmatic copper-II and hydrothermal copper.

K. Derevska and M. Bezugla (2002) measured the homogenization temperature of gas-liquid inclusions (GLI) in transparent minerals (quartz, analcime, vayrakit, calcite), and found out that there were four stages of mineral-forming process: histeromagmatic, avtometasomatic, parahydrotermal and hydrothermal. Results of chlorite-like minerals research in the rocks of the Volyn Neoproterozoic trap formation presents in the article (Derevska, Shumlyansky, 1999).

Quartz and calcite from tonsils in association with chlorite-like minerals in the first type of chlorite-like minerals do not contain GLI, and in opinion of the authors are low-temperature (up to 100 °C). Homogenization temperatures of GLI from calcite veins in the second type of chlorite-like mineral is 233 °C. The temperature of homogenization GLI in calcite veins compile of ranges from 135 to 227 °C, in barite — 157–214 °C.

In our opinion, further attention should focus on goal-oriented of the fluid veinlet-impregnated mineralization research (Svoren, Naumko, 2005) as a direct indicator of migration processes and product of cracks healing, which in this context in the region has not been studied at all. Quartz, zeolites (analtsym), calcite and other minerals are well suited for thermobarogeochemical studying.

Mineralogical Composition and Internal Structure of Alunite-Kaolinite Zones of Metasomatic Epithermal Deposits in Berehovo-Bihan' ore region

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Beregovo-Began' ore region (Beregovo, Muzhiyevo, Bigan' deposits and Kvasovo ore occurrence) is an example of the Sarmatian epithermal system (14.12 My), combining in its structure two geochemical types (Hayba et al., 1985): low sulfur (LS) and high sulfur (HS). Each of these types shows a different nature of epithermal processes and mineral composition changes. Hydrothermal systems of diathremes were related with catastrophic rhyolitic eruptions (Beregovo, Muzhiyevo, Kvasovo) or and in eruption-related fracture zones (Began′ is situated in the Kvasovo crater framework). Rhyolitic tuffs and ignimbrites which undergone LS and HS hydrothermal alteration, comprise upper and lower parts of this deposits. These levels are bounded by a clay member. Characteristic for lower level are sericite-adularia-smectite epithermal changes with carbonate-sphalerite-galena-chalcopyrite-quartz composition of Au–Ag veins. The upper part undergone alunite-kaolinite metasomatic alteration with gold veinliets.

The structure of hydrothermal system is determined by the filtration inhomogeneity of the formation and this led to the formation of active filtration zones (AFZ) and stagnation (SZ) zones, which differ in their mineralogical and geochemical characteristics.

Mineralogical zoning of the HS upper level was studied in detail. This zoning is fundamentally different from the typical HS zoning of epithermal deposits, in which the central zone is composed of vuggy quartz and alunite, and peripherals — of kaolinite. At all studied objects mineralogical zoning is shown in the development of kaoliniite-dickit changes near AFZ and the gradular transition to alunite zone and then to quartz-opal zone on the periphery.

In this case alunite is represented as a potassium type. As a part of alunite rocks SZ latter generation of alunite is represented as titan alunite (TiO_2 weighed from 12.28 to 28.25 %) in association with rutile, goethite and cryptocrystalline aggregates of oxides Zr, Y, Sc. This titan alunite was has never been described before.

Hydrothermal solutions had a low temperature (200–100°C) and with predominance of meteoric component. This indicates the formation of kaolinite-alunite changes at the front of mixing of deep low-acid to neutral high-H2S solution (200–250°C) with oxidized meteoric waters in near-surface condition. Granular cooling of the fluid over time lead to the penetration of alunite changes to the lower level. This caused the formation of alunite-barite-quartz paragenesis in quartz-barite veins, which is characterized by a low Sr content in barite.

Metamorphic Evolution of Pobuzhzhya Granulite Complex

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Pobuzhzhya granulite complex is an example of metamorphic complexes which make up the bottom of the crust. It consists of enderbites (3.0–2.8 billion years) [Щербак Н. П. и др., 2005] with minor relics of metamorphosed ultrabasic and carbonate rocks. Younger metamorphic events were preceded by the intrusions of basic dikes (2.0 billion years [Степанюк, 2011]). Deformations of the crust led to the formation of new mineral associations whose age varies between 2 and 1.9 billion years [Щербак Н. П. и др., 2005].

The samples were selected from the areas of the deformations and differ by their mineral paragenesis. They were studied using optical and electron microscopy, and the composition of minerals was determined by EDS microanalysis. Based on the results of the study, the PT conditions of the formation of mineral associations were determined using WinTWQ software package (version 2.3) [Berman, 2007], PTMAFIC [Soto, 1995] and monomineral Ti-biotite thermometer [Henry, 2005]. In the metamorphic transformations recognize three main events can be identified that are recorded in the following parageneses:

I. Diopsite + Ca-rich garnet + ilmenite, formed in the deformation zones in enderbites. Hornblende appears in the areas of weak deformations as a part of the paragenesis. Formation conditions of the paragenesis vary between 550° C and 5.8 kbar (areas with the minimal development of diopside) and 680° C and 8 kbar (zone of the maximum development of diopside) .
II. Ortopyroxene+clinopyroxene+quartz in thin-striped granulites. The temperatures, determined using opx-cpx thermometer, range from 910 °C to 973 °C, with the pressure being approx. 9–11 kbar.
III. Garnet + biotite + plagioclase + quartz + sillimanite (or andalusite) ± rutile ± ilmenite paragenesis that develops in the narrow zones of plastic deformation. Quite common in the paragenesis are zircon, apatite, Th-monazite, xenotite, thorianite, allanite. Belts of garnet-biotite shales are characterized by mineralogical zoning, especially with regards to plagioclase-quartz and ilmenite-rutile. Evolution of the paragenesis is completed by the change of sillimanite into andalusite and by the replacement of plagioclase by quartz. The calculation of the PT conditions shows large amplitudes of temperature and pressure fluctuations. The highest parameters (750° to 800 °C and ~10 kbar) have been recorded for early garnet porphyroblasts in association with quartz, basic plagioclase and biotite. Lower PT parameters (530°–560 °C and ~4 kbar) have been determined for garnet-biotite-plagioclase association in clevage cracks in large garnet porphyroblasts. The lowest temperatures and pressures (~500 °C and 3.5 kbar) correspond to the moment of the formation of andalusite porphyroblasts. The formation of gr-bt metamorphic rocks occurs in an open system with an addition of Si, Al, Na, P, REE, Th.
IV. Amphibole + chlorite paragenesis with pyrrhotite, magnetite and graphite in the zones of brittle deformation.

The parageneses under study record a new trend of metamorphism imposed on a granulite complex. It consists of a progressive branch that reflects the sinking of the block (the transition of garnet + diopsite→ ortopyroxene + clinopyroxene) and a regressive one that is connected with the rapid uplifting of the block, against a background rise of the geothermal gradient.

Comparison of three CL methods: caninning CL, color CL, color scanning CL

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Tescan Company from Brno has developed a new cathodoluminescence detector. The detector combines the panchromatic CL scanning method with the color CL method. For the presentation purpose there were selected quartz samples from the Teplice rhyolite, in which the trace elements are examined. Before the laser ablation analysis is performed it is necessary to know whether or not the quartz is zoned, and if so, how do the zones look like. For this purpose, the cathode luminescence study is suitable. So far we had two options for this study. First, the panchromatic scanning CL, which provides only black and white pictures and works on the principle of electron microprobe and the light reflection, and second the color CL (with hot or cold cathode), which provides color images, but works on the principle of the light passing through the sample. In the case of the study of quartz samples, which will be further studied by LA-ICP MS, we have come across two problems regarding the color CL. The lifetime of the luminescence, which the quartz emits, can be very short, so it is hard to capture. Furthermore, the thin section of the sample used for laser ablation must have the adequate thickness so as not to be burned through. At this thickness, however, the light required for the color CL analysis does not pass through, so the sample can be analyzed only by the scanning CL.

Color scanning luminescence by Tescan company combines the advantages of both methods used so far — a sample of any thickness is shown in color and at the same time the display resolution is better (like that of the panchromatic scanning CL). There much larger samples can be analyzed, regarding their thickness and dimensions. The signal from the scanned sample is divided by filters into three channels (RGB), the microscope software then combines these channels into the final color image. If the current of the volume and dwell time per pixel are properly chosen, it is possible to obtain the image of the required quality, without the negative impact of the quenching.

Decorative Jaspers from the Vicinity of Kłodzko in Lower Silesia — the Sudety, the SW Poland

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The Klodzko area in the West Sudetes is situated at the North-West border of the Bohemian Massif. It constitutes a part of the Variscan Orogeny in Central Europe (Żelaźniewicz, 2005). Over 100 minerals were described in the area and many of them are precious and decorative stones (Węglorz, 2010).

The rock crystal and a few coloured types of quartz are examples of the precious stones of the Klodzko area. Amethysts, smoky quartz and morions occur within the Permian trachybasalts. The rare, green tined type of quartz prasiolit was described near the village Suszyna, not far from Klodzko (Sachanbiński, 1980). The decorative stones include agates, touchstones, the flinted parts of tree stems and jaspers. Jaspers can be found within the weathering zones on trachybasalts**,** on the arable fields near the villages Suszyna, Mrówieniec, Kamieniec, Raszków and Niwa. The jaspers from secondary deposits are also known. They can be found in gravels near the villages Bierkowice, Ścinawka and Gorzuchów. The decorative stones described above are colourful and the large part of them is characterized by wavy, ribbon-like layers or patchy, multi-coloured surfaces. Chocolate or brown shades of jaspers are common among the variably coloured types. It is worth stressing that the specimens are only rarely cracked and they can be as large as 0.5 m. The chocolate brown jaspers with ribbon-like layers are particularly attractive and are perspective for the production of jewellery and artistic stones. Some of them e.g. those of intensive red colour can be used for cabochons or beads production.

The jaspers with ribbon or patchy multi-coloured surface or black touchstones are large enough to be used as a base material for haberdashery products of small and middle sizes, such as ash-trays, caskets, candlesticks, stationer accessories, figures etc. These stones can be easily polished and used for producing small elements of internal facing in the buildings e.g. wall or floor tiles or the casing of the fireplace.

The colourful types of jaspers also include types containing layers of chalcedony (agate in the form of litophise and agatophise**).** Most of them represent valuable specimens for collectors, sometimes even of museum-value. After the proper treatment (grinding and polishing) of the stones the original elements of jewellery products such as bolas, charms and the elements of brooches can be made. Their quality is comparable to jaspers from the most famous mineral deposits from Russia (Ucalinsky, Magnitogorski, Sibanski and Orski).

Comparison of Isotope Record ($\delta^{13}C$ and $\delta^{18}O$) of the Younger Dryas in Carbonate Sediments from Selected Lakes in Poland

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Characteristics and comparison of carbon and oxygen stable isotope record ($\delta^{13}C$ and $\delta^{18}O$) in carbonate sediments of the Younger Dryas (the Late Glacial) from six lakes in Poland are presented.

The Younger Dryas is the last cold period of the Weichselian glaciation most likely caused by termohaline circulation disorders. The cooling is well documented in stable isotope ratio of heavy isotopes of carbon and oxygen (^{13}C, ^{18}O) to light isotopes of these elements (^{12}C, ^{16}O). This record results from several features temperature dependant. Knowledge about fluctuation of isotope records gives us a picture of temperature changes during the Younger Dryas.

Isotopic curves derived from carbonate sediments of Lake Hańcza (Lauterbach et al. 2010), Skrzynka (Apolinarska et al. 2012), Strażym (Różański; 1987), Gościaż (Ralska-Jasiewiczowa et al. 2003), Lednica (Apolinaraska and Hammarlund, 2009) and Perespilno (Goslar et al. 1999) show some similarities however, the isotope records in most of the lakes have different and unique shapes. Moreover, absolute values of the isotopes are not identical in the lakes. This points to local factors, e.g. lake hydrology, soil erosion and changes in vegetation cover as decisive in stable isotope signatures of lake waters and in consequence carbonates precipitated within the lake. Duration of the Younger Dryas is similar in all the lakes described.

Differences between stable oxygen isotope records in Polish lacustrine sediments and $\delta^{18}O$ values derived from ice core in Greenland are also shown.

The Influence of Kaolin Cements on Properties and the Possible Use of Kaolinite Sandstones from the North Sudetes Depression

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The intense chemical weathering processes, lasting from the Upper Jurassic, until the Upper Cretaceous (more precisely the Santon), created primal kaolinite caps in Central and Eastern Europe. As a result of their erosion and redeposition in a deltaic environment, profitable kaolinite deposits were created (Voigt S., et. al., 2008). Typically, such kaolinite mineral deposits as cement can be found in loosely lithified sandstone. An example of such a deposit is Maria III, located in the North-Sudeten Trough, in the Lower Silesia region, from the Upper Cretaceous period. The complicated genesis of kaolinite cement, located within the sandstone demands an in-depth analysis. The processes that occur in the creation of the deposit have a significant influence on the properties and possible future uses of the sandstone. Below, the author presents his research: mineral composition from X-ray powder diffraction (XRD) and thermal analysis (TG and DTA), grain characteristics via laser diffraction particle size analysis (LD-PSA), and finally technical characteristics via mechanical tests (Speczik et. al., 2010). Furthermore, we were able to determine pore space and the structure of cement via petrographic microscope. Currently, the industry possesses rigid standards, which results in the need for enrichment of the kaolinite cements. The resulting enriched kaolinite cement can be used in ceramics, the paper industry (Kościówko H., Wyrwicki R. 1996), as well as nanotube production.

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Paleontology, Historical Geology and Sedymentology

Evolution of Rodents in Pliocene and Their Use in Biostratigraphy

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For decades fossil remains of mammals are used as a biostratigraphical and paleoenvironmental markers of the Cainozoic terrestrial deposits. In biostratigraphy of mammals the most important are remains of small mammals like Rodentia (rodents), Lagomorpha (hares, rabbits), Insectivora (insectivores) and Chiroptera (bats). Still, larger mammals like Carnivora (carnivores), Primates and very diversified representatives of ungulates have essential meaning here. Small mammals, representing organisms evolving in relatively short time spans, quickly spread, being relatively common in younger deposits and easy to identify, constitute valuable source of information of biostratigraphical, paleogeographical and evolutionary studies. But how much these small mammals are useful in biostratigraphical studies and what is their stratigraphic resolution and scientific value?

Terrestrial deposits do not have such a wide range of research as is the case of marine deposits. Marine environments as taxonomically richer than terrestrial have at their disposal much more of floristic and faunistic data to use in biostratigraphical and paleoenvironmental studies. Biostratigraphy of marine deposits is based mainly on foraminiferans, radiolarians, calcareous nannofossils or well-known ammonites and bivalves. But terrestrial deposits also have comparably useful organisms which can be successfully applied in biostratigraphy and paleoenvironmental reconstructions. Available to researchers are remains of vertebrates, molluscs, plants and their spores and seeds.

Due to the presence of enamel (Shmeltzmuster) mammalian teeth are the most durable skeletal elements and often the only remnant of their existence in the studied sediment. Postcranial elements and the skull itself rapidly undergo by destructive action of external environmental factors. To their destruction contributes activity of carnivores, scavengers, bacteria and fungi but also chemically aggressive underground waters, karst waters, floral and humic acids and physical weathering processes. Especially susceptible on these factors are remains of small mammals, which normally have fragile and thin skeletal components.

Among all orders of placental mammals evolutionary the most successful are small rodents, occupying most of the terrestrial ecosystems. Number of contemporary occurring rodent species was determined at 2277, which constitutes 43% of all recent mammalian species.

Rodents appeared as a fully representative group in the Late Paleocene-Early Eocene of North America and Central Asia, whence spread to other continents (except Antarctica).They had already reached considerable diversity of species. However, the highest diversity and surprisingly fast rate of evolutionary radiation accounted for the Oligocene and Pliocene. Throughout the evolutionary history of Rodents the greatest importance in biostratigraphy received only a few groups of them: Sciuridae, Gliridae, Cricetidae, Muridae and the most valuable *Arvicolinae*.

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Palynological Characteristic of the Bug Suite, Lviv-Volyn Basin

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Global stratigraphic scale of the Carboniferous system (as it was confirmed in 2004 by the International Geological Congress) is composed of two subsystems — the Mississippian and Pennsylvanian divided into three parts (lower, middle, upper) and global stages. The new level of the boundary between the Mississippian and Pennsylvanian (between Serpukhovian and Bashkirian) is distinguished in the bottom of the Homoceras goniatite zone and by the appearance of conodonts *Declinognathodus noduliferus* and foraminifers of the Plectostaffella bogdanovkensis zone. Enclosing deposits, namely, the upper part of the Namurian A of Western Europe are included to the Pennsylvanian subsystem. In the Lviv-Volyn basin (LVB) definition of the point of the global stratotype in local sections of the boundaries between the Mississippian and Pennsylvanian is impossible without finding out the volume, border and age of the Bug suite.

Facial-palynological study of the LVB coal-bearing deposits demonstrates that the boundary of the Lower and Middle Carboniferous and dating the Bug suite is clearly distinguished by palynological data. Palynological analysis of the Bug suite was made in sections of eight boreholes. Deposits of the Bug suite are characterized by spores from two palynozones (from bottom to top): the Raistrikia nigra–Bellispores nitidus (NN) and the Neoraistrikia splendidus–Raistrikia fulva (SF).

The NN palynozone is determined in lower part of the Bug suite, in the interval between the limestone N_3 and coal bed n_7. It is a complex zone which is defined by two characteristic taxa — *Raistrikia nigra* and *Bellispores nitidus*. In general, in the deposits of palynozone 74 taxa were identified, including 43 transit, 33 typical (ten species disappear close to the top of the zone and one appears close to the bottom). The NN palynozone of LVB is corresponded to the top of the zone NC by palynomorph composition (Bellispores nitidus–Reticulatisporites carnosus), zone TK (Stenozonotriletes triangulus–Rotaspora knoxi) and lower part of the zone SO (Lycospora subtriquetra–Krauselisporites ornatus) of Northern England, Scotland, upper part of palynozone Tr (Tripartites rugosus) and zone Chp (Chaetosphaerites pollenisimilis) of Lublin and the Lower Silesian coalfields in Poland, zone CL (Reticulatisporites carnosus–Proprisporites laevigatus) and lower part of zone DS (Arcuatisporites densoarcuatus–Acanthotriletes splendidus) of Donetsk Basin (Ukraine).

All mentioned above give the reason to include enclosing deposits to the Lower Carboniferous (Mississippian), Serpukhovian and to assume that they are analogues to upper part of Steshevskiy, Protvynskiy, and lower part of Zapaltubynskiy horizons of regional scale of the East European Platform (EEP), or perhaps upper part of the Pendlean and the lower part of Arnsbergian regiostages of the Namurian A of Western Europe.

The SF palynozone is distinguished in upper part of the Bug suite, in the interval between coal bed n_7 and limestone B_1. It is a complex competitive rank zone which is defined by two characteristic taxa — *Neoraistrikia splendidus* and *Raistrikia fulva*, their spreading is mutually blocked. Palynozone is composed of 63 taxa: 34 transit and 29 typical, five of which appear at the bottom of the zone. They are as follows: *Florinites similis*, *Radiizonates aligerens*, *Alatisporites pustulatus*, *Cirratriradites saturni*, *Raistrikia fulva*. These forms are typical for the deposits of Middle Carboniferous adjacent regions. And four taxa disappeared near its

upper boundary. This palynozone is the analogue for the lower part of such zones as KV (Crassispora kosankei–Grumosisporites varioreticulatus) of Northern England, Scotland, Lycospora pellucida zone of North America, Rc (Reticulatisporites carnosus) of Lublin and Dv (Densosporites variabilis) Upper Silesian coalfields of Poland, LM (Vestispora lucida–Microreticulatisporites microreticulatus) of Ukrainian Donetsk Basin. Deposits of the SF palynozone and, accordingly, upper part of the Bug suite of LVB are included to the Bashkirian of the Middle Carboniferous (Pennsylvanian), and they are the analogues for the lower part of Krasnopolyanskiy horizon of the EEP regional scale and, possibly, for the lower part of Kinderscutian regiostage of the Namur A in Western Europe.

So, palynological data proves that the deposits of the Bug suite have different age: the lower part is the Serpukhovian (Mississippian) and the upper one is the Bashkirian (Pennsylvanian). The major changes in spores composition are determined at the level of coal bed n_7. Serpukhovian taxa (nine species) are disappearing close to this level, and their location is being occupied by typically appearing Bashkirian species (five species). We offer to choose this level as a global point of stratotype of boundary between the Mississippian and Pennsylvanian (the Lower and Middle Carboniferous) in the LVB. These palynological data may be the basis for revision of stratigraphic schemes of the LVB Carboniferous. But it is necessary to confirm them by other methods or other fossil groups.

Coal-building phytomass and maceral composition carbon coal exotics of the Stryi formation

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Prior to our research the coal of Stryi formation of Skybova Zone in the Ukrainian Carpathians had been studied by F. Kreyts, R. Zuber, T. Visnyevski, B. Kronaker, P. Kalugin, R. Copystyansky, A.M. Ishchenko and T. Boldyreva, V. Glushko ahd G.D. Dosin, A. Ivanina, V. Uziyuk, O.S. Dyachyk and others scientists. Wide stratigraphic and lateral distribution of mostly C_2 with rare C_3 exotic coal clasts in rocks of different ages (from Cretaceous to Paleogene) is proved. Clasts undergone low-grade metamorphism to DG and G brands. V. Uziyuk and O. Dyachyk have studied plant material from which coal was made up, its petrographic and chemical composition as well as technological properties of the coal exotics since 2008. This work is a first attempt of complex stadies of the composition and properties of coal-building phytomass of whole Stryi formation.

The phytomass of a plant is, by our definition, the set of all its cells, tissues and functional organs, e.g. roots, trunk(stem), leaves and reproductive organs. A set of plants in a particular area forms phytocenosis which is typical for these environmental conditions. The overall mass of all alive cells, tissues and organs of plants of phytocenosis we distinguish as “intravitam phytomass of phytocenosis”, the mass of dead cells, tissues organs and plants of phitocenosis we refer to as “fossil phytomass of phytocenosic”. Out of the extinct deadphytomass of phytocenosis which was accumulated in marshes the positive conditions peat is formed and then in theduring metamorphysm brown coal (lignite), coal and anthracite is formed.

In sedimentary inorganic rocks, mainly in coal deposits, remains of various plant organs which are of different stages of conservation, systematic attachment and size are found. We call then phytofossils.

According to the size we divide them into: macro and micro phytofossils. Macro phytofossils were observed in the hand specimen by the naked eye and were studied by macro-paleo-botanic methods, and micro phytofossils were determined with the help of microscope in transparent thin section of coal, polished section and polished section blocks under magnification from 90x up to 600x. In general coal macrophytofossils are represented as phytoleims, scars and petrification. Phytoleima — it’s a coalifide tissues of entire organism or it’s part with preserved sculpture other surface or without it. Petrification(cell mineralization) it’s the fragment of plant organ in which cell порожнини are complytely or partly filed which mineral substance. During this process anatomic cell and tissue structure is preserved. Size of macrophytofossils depend from sedimentary conditions and vary from 1 cm to 1 m and more. The best coalified phytomass are phytoleims, the worst — petrification. In the studied outcrops of Stryi formation macrophytofossils are very rare. This is due to the long-term transfer of inorganic rocks and coal in the denudation sedimentation basin. We have indentified and studied small sized rare scars of Lycopodiophyta and Calamophytales.

High Resolution Sedimentary Record of 2011 Tohoku-oki Tsunami on Sendai Plain, Japan

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Tsunamis belong to the most catastrophic geological processes. The insight into tsunami frequency and magnitude can be gained from studies of sedimentary deposits commonly left by tsunamis in coastal zone. However, detailed studies on modern tsunamis are necessary as a reference. The objective of the paper was to test whether the tsunami wave train may be recorded in tsunami deposits. It was based on high resolution sedimentological study of tsunami deposits left by 11th of March, 2011 Tohoku-oki tsunami near Sendai, Japan. Material was collected in May, 2011 during the post-tsunami field work within the frames of UNESCO International Tsunami Survey Team.

For the study was selected a site app. 170 m from the shoreline, with 63 cm thick tsunami deposits filling a scour. The lower part of the deposits was sampled with 35 cm long plastic tube and used for further analyses. The sediments were described, X-rayed and sampled with 0.5 cm resolution for laser based diffraction grain size analysis.

Analyzed deposits are composed of well sorted fine sand. The mean grain size highlight around 0.4–0.6 mm, maximum 0.8 mm. The sediments revealed clear lamination underlined by changes in content of dark heavy minerals and could be divided into three sections interpreted as: pre-tsunami sand and sandy tsunami deposits in two depositional cycles. Each cycle started with coarsening upwards sandy deposits, which were transported and left behind by so called "traction carpet" — collision dominated flow and could exist when shear rates in the flow were high. The second stage of each cycle was reflected in finning upwards sand - likely product of decreasing flow velocity and suspension settling.

The applied high resolution approach allowed not only to identify the tsunami deposits but also to interpret changes in hydrodynamic conditions during the tsunami inundation. The obtained results may be valuable for further modeling studies.

Cuticle Analysis of the Late Triassic and Middle Jurassic Macroflora from Southern Poland as a Basis of Palaeoenvironmental Reconstructions

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For many years plants have played an important role as palaeoecological and palaeoenvironmental indicators (Seward 1892). In this content a cuticle is also a key aspect in identifications of ecological conditions. Cuticle of fossil plants is an extracellular, three-dimensional matrix of waxes, cellulose, pectin and cutin, produced by epidermal cells. Its function is to protect plants from the effect of adverse external conditions, particularly loss of water and mechanical damage. Cuticle analysis includes the investigation of various characteristic features of cuticle. Such traits may be affected by genotype (e.g. type of stomatal complex, stomatal distribution, type, complexity and location of trichomes) or phenotype, resulting from the environment (e.g. position, size and number of hydathodes, number and size of papillae, stomatal density and index, trichome density), as well as controlled by both factors (e.g. type and position of papillae, stomatal position; Barclay et al. 2007).

The study was performed on macroflora preserved in the Norian-Rhaetian (Upper Triassic) grey mudstones and claystones of the Lubliniec area and on macroflora from the Bathonian (Middle Jurassic) kaolinite clays of the Grojec area (both located in southern Poland). The analysis covered the Upper Triassic *cuticulae dispersae* of *Brachyphyllum* sp. Cuticles of these plants displayed xeromorphic features such as thick cuticle, papillae on epidermal cells and stomatal apparatuses, arrangement of stomata in rows, strongly cutinized subsidiary cells and sunken stomatal apparatuses. Microadaptations of a xeromorphic type presently appear not only in plants inhabiting semi-dry or dry areas, but also in plants growing in humid conditions with repetitive periods of physiological drought, caused by intensive evapotranspiration rates, high salinity of water or by geomorphic conditions (Thévenard et al. 2005). Therefore, it may be assumed that the area of Lipie Śląskie was influenced by periodic droughts.

Cuticles of *Pachypteris rhomboidalis*, from Middle Jurassic clays, show a different pattern. Stomata are chaotically scattered on the lower surface of cuticle and their high amount is likely to indicate strong insolation. Occurrence of numerous hydathodes on both cuticles (upper and lower) evidences environment of a great humidity. Structures of a similar micromorphology are found in the extant *Gonocaryum* and *Phaseolus* genera and their function is to remove the excess water and mineral salts (Hejnowicz 2002). The above-listed micromorphological features suggest growth in humid and warm conditions.

To conclude, the type of cuticles observed at both sites is different and clearly indicates that their vegetation developed in various environments and climates. Therefore, cuticle analysis may be considered a useful tool in reconstructions of palaeoecological conditions.

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"Middle" Campanian *I. azerbaydajensis – I. vorhelmensis* Deposits of Epeiric Sea of Southern Poland: a Case Study from the Miechów Area

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Miechów area lies in south-western part of the Nida Trough, which is a part of the Mid-Polish Trough, one of the major Alpine tectonic elements of extra — Carpathian Poland. In the Miechów area only Campanian and Lower Maastrichtian are exposed on the surface. Most of publications from this area refer to the whole interval of Campanian and Lower Maastrichtian as long ranging units namely, Senonian (Sujkowski, 1926, 1934; Kowalski, 1948). During the Late Cretaceous the Nida Trough was covered by the epicontinental sea with domination of carbonate sedimentation. This study is focused on elucidation of sedimentary succession and inoceramid-based high resolution stratigraphy.

Rzeżuśnia, which is an inactive quarry represents the "Middle" Campanian (Inoceramus azerbaydajensis – Inoceramus vorhelmensis) deposits and was a subject of previous papers (Rutkowski, 1965; Jagt et al., 2007). Opokas (siliceous limestone) with cherts and marly intercalation are well exposed and contain rich fauna, mainly epifaunal suspension feeders: inoceramids ("Inoceramus" azerbaydajensis Aliev, 1939; "Inoceramus" vorhelmensis (Walaszczyk, 1997); Inoceramus balticus (Bhöm, 1909), Cataceramus ellipticus (Giers, 1964)), numerous hexactinosid and lychniscosid sponges, less frequent lithistid sponges, gastropods and infaunal suspension feeders: echinoids (Echinocorys sp; Micraster sp). Also two horizons with numerous fragments of inoceramids and baculids in chaotically arrangement were observed. On the surface of fossils fragments ichnofossils of Chondrites were recognized.

Occurred fauna indicates soft bottom condition (infaunal echinoids; bivalves) with good oxygenation and normal salinity. Numerous Lyssacinosid sponges suggest deep water condition (below 100 meters — oral com. E. Świerczewska-Gładysz). Faunal concentration is an effect of storm event but in shallower part of the basin. The fragments were transported and deposited in a deeper part of a basin and after that they were penetrated by organisms.

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Remarks on Palaeoclimatic Changes in the Węgliny area — the Last Transition (Late Glacial/Holocene boundary)

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Quaternary, the shortest geological period, was marked by highly fluctuating climate. Within the last 2.7 mln years, its intensive changes affected the northern hemisphere. During the Last Glacial Maximum, subpolar climate covered entire Europe and a large part of North America, while in the time of the warmest interglacials — subtropical climate controlled even moderate latitudes.

Within the Last Glaciation, dynamic changes, which seem likely to influence the climate of the last 100 000 years, i.e. the Dansgaard-Oeschger cycles including the Heinrich events, were distinguished. The cycles were identified on the basis of changes in the record of $\delta^{18}O$ isotopes, from GRIP and GRIP2 ice cores, and of Heinrich layers, found regularly in marine core samples (Mogensen 2009).

One of the most characteristic Heinrich events is the Late Vistulian/Holocene transition, initiated with a rapid cooling of climate up to several degrees (beginning of the Younger Dryas) and ended with a rapid increase in temperature, indicating a new interglacial – the Holocene (beginning of the Preboreal period). Both boundaries are also recorded in palynological profiles from the entire Europe. Palynological analysis may provide basis for reconstructions of palaeoclimate and vegetation of that period (Litt et al. 2001). Changes in the type of vegetation, occurring in the Younger Dryas, are readibly evidenced in sections from the Węgliny area (Lubusz Land). Pine-birch assemblages of a park tundra type, dominant in the Alleröd, were replaced by a mosaic of open steppe communities, overgrown by grasses, wormwood and dwarf shrubs of the Ericaceae family. Presence of such communities suggests the drying and cooling of climate (Wacnik 2009). Areas of a higher humidity still served as refugia of tree-shrub vegetation. Noticeable increase in the curve plotted for birch in the pollen diagram, accompanied by a decrease in the curve for grasses and other herbaceous plants, corresponding to the Younger Dryas/Preboreal boundary, indicates the gradual regrowth of birch-pine forests. Early Holocene was marked by the development of deciduous forests, comprising oak, hazel and elm, as well as of willow-alder riparian forests. Such a description of flora confirms the improvement in temperature and humidity conditions within the discussed period. It is considered that one reason of such intensive changes in the environment, observed in a relatively short time, are the disturbances in the thermohaline circulation of the North Atlantic waters (Brauer 2008).

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Microfacial Analysis of F_1 Limestones (Bashkirian, Donets Basin)

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The Donets Basin — is geologically well-studied area (one of the most thoroughly examined mining areas in the world). Notwithstanding, some aspects need updating. For this purpose, the microfacies of F_1 limestones carbonate rock are studied and their depositional environment is investigated. In the stratigraphic chart these limestones are included inMandrikian regional stage (horizon) C^1_2 of the Donets Basin, the major part of which is geographically located in theDonetsk and Lugansk regions in Ukraine. Further investigation of carbonate rocks microfacies allows their compare is on with the like strata worldwide and revision of paleogeographic conditions of their origin. The source material of this study is the results of field and laboratory work. Field studies and sampling were done on five outcrops. Particular attention was given to outcrop No. 1 (near village Volnukhine), where F_1 limestones reach their maximum thickness (over 17 m). Here they are exposed in an open pit which allows their thorough examination. To investigate the limestone microfacies 20 thin sections generally accepted methods were applied.

By their structure (relative proportions of coarser clastic particles), samples of F_1 limestone, selected from outcrop No. 1 (Volnukhine) locally correspond to the packstone type. They differ essentially from the "background" wackstones, which were also diagnosed based on the results of studies from other limestone outcrops and, propapbly, of microbial origin.

Based on the study results, an algae bioconstruction was pre-identified. However, it could not be clearly outlined because of scarcity of sampled material. The found algae remains (*Predonezella*(?)*, Donezella*and *Cuneiphycus*) were the most likely chief mound-forming organisms. Microbial organisms, which have not yetbeenidentified, also could play an important role. Foraminifera, ostracods, crinoids, etc. were of a subordinate importance. Wackstone and grainstone with crinoids, solitary rugose corals, foraminifera and frequent oncolites form the capping facies.

Thus, based on F_1 limestone morphology, the study of microfacies and the distribution of fossil remains, an algae mound, which is pre-identified as an algae bioconstruction, is reconstructed in outcrop No. 1 (Volnuhine).

In particular, morphologically and litologically similar Pennsylvanian algal bioconstuctions are described in Spain (Samankassou, E., 2000) and Japan (Higa et al., 2008).

Non-Skeletal Grains as Significant Components of the Upper Jurassic-Lower Cretaceous Exotic limestones from the Polish Outer Carpathians — a Microscopic Case Study

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In the Polish Outer Carpathian, the Upper Jurassic–Lower Cretaceous limestones occur in the form of klippes, boulders and pebbles. These exotic rocks, redeposited from the margins of the Silesian Basin, are located among the deposits of younger age. The studied rocks were collected from localities situated within the Silesian and Sub-Silesian Nappes of the Polish Outer Carpathians, from deposits of the Lower Cretaceous to the Eocene age.

The limestones were formed both in shallow-water and open marine conditions. The age of the rocks was determined on the basis of calpionellids, calcareous dinoflagellate cysts and foraminifera. Limestones are also rich in such fossils as calcareous and siliceous sponges, corals, molluscs, brachiopods, plates of echinoderms, bryozoans, gastropods, ostracods, calcimicrobes, serpulid worms, green algae and calcimicrobes. No less important components of these rocks are non-skeletal grains, being the subject matter of this work. They occur in majority of studied samples, quite often as the main components. The microfacies such as intraclastic-bioclastic or peloidal-bioclastic grainstone/packstone are predominantly observed.

The most common are grains which could be classified as "peloids" – more or less rounded grains of micrite. Presumably only a part of them are fecal pellets, typical for shallow environments and low energy water (Flugel, 2010). Some of "peloids" are not completely homogenous and due to their shape they seem to be micritized bioclasts. Many grains may be identified as little intraclasts rather than "peloids" in cases when they are more angular and accompanied by bigger grains classified as intraclasts. Sometimes poorly defined, very fine peloids create fabrics, which could be also described as "cements" (Adams & MacKenzie, 1998). To the other group belong irregular micritic grains, probably of algal-microbial origin.

Intraclasts are the second in order most common type of grains. Grainstones consisting of fragments of limestones as well as bioclasts, often rounded, can be interpreted as originated from the shallow-marine environment with wave-dominated regimes (Flugel, 2010).

Coated grains occur less frequently than the aforementioned kinds of grains. Single oncoids and ooids are common, whereas oolitic limestones are scarce. These include radial and radial-concentric ooids being typical rather for low-energy conditions, microbial ooids - formed in situ within a microbialit and concurrent with peloids, superficial ooids with thin cortex, compound ooids consisting of ooids and bioclasts and micritized ooids (Flugel, 2010).

This brief overview shows that highly diversified non-skeletal grains are significant component of the studied limestones that can indicate the variety of environmental conditions in which these deposits were formed.

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Sedimentary Environments and Evolution of the Middle Weichselian Basin, SE Part of the Baltic Sea Depression

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Little is known about the Middle Weichselian time in the territories covered by the Scandinavian ice sheet. This study reveals sedimentary facies description of the clastic deposits of the Middle Weichselian basin, which has been dated to a range from 52–26 ka BP (Saks et. al., *in print*). The study is based on facies analysis from the outcrop and drilling core data in western Latvia, SE Baltic. The aim of the study is to describe the depositional environments and reconstruct the basin evolution during the Middle Weichselian time.

In total 19 sedimentary logs have been studied from outcrop sections and facies analysis carried out. Borehole lithological data from the borehole database was used to map the distribution of these sediments.

Up today 13 sedimentary facies have been distinguished, which reveal deposition under various sedimentation rates. The succession is composed mainly of very fine- to medium–grained sand with silt interlayers and with thin mica, silt and heavy mineral drapes. The most dominant facies are: current and wave ripple-laminated sand, cross-stratified sand with silt and mica drapes, structurless sand, plane-parallel stratified sand, sand with deformed structures. Other facies, such as sand with gravel interlayers, large scale cross-stratified sand, parallel-laminated sand with heavy mineral and silt drapes, parallel-laminated sand and silt, irregularly laminated sand and silt are also abundant. The facies assemblage reveals deposition under following hydrodynamic conditions: i) low energy environment — deposition from low energy currents by migration of ripples; deposition from plain beds in lower flow regime and occasionally from suspension; ii) high energy environment — deposition from traction currents by migration of 3-D dunes and possibly larger scale bedforms; deposition from plain beds in upper flow regime, and rapid sedimentation due to high deposition rates with no preservation of sedimentary structures or with secondary soft sediment deformations caused by shear stress and escaping pore water.

This study is still ongoing and thus does not allow yet interpreting the depositional environments in detail. However the preliminary results suggest sedimentation in a shallow basin and lagoonal environments.

Analysis of Trace Fossil Preservation from the Upper Devonian in Daugava Formation in Latvia

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Daugava formation deposits in Latvia are mainly alternations of dolomites and dolomite marlstone and clay with infrequent limestone and gypsum. The Daugava formation is common on the most part of the territory of Latvia, except northern and southeast edges. The thickness of the Daugava formation in Latvian-Lithuanian depression ranges from 9 to 27 m (Сорокин, 1981). In the eastern and central part of the Daugava basin there was a fairly free water exchange with the sea of Moscow Syneclise, therefore Daugava formation on this territory is characterized by a variability of organisms. Among the animals on the friable bed there were numerous sea lilies, sea urchins, lingulids and mussels, conchostracs, ostracods, miscellaneous and plenty of bottom jawless and other fish forms (Сорокин, 1981). The assemblage of the trace fossils from dolomites of Daugava formation (the Upper Devonian, Frasnian stage) as such ichnogenera has been discovered: Chondrites, Planolites and Lockeia.

During the period from 2010 to 2012 trace fossil samples were collected from Daugavas formation deposits in quarries and natural outcrops. The research territory is part of the classic distribution areas of Devonian sediments named the Main Devonian field. This area is characterised by relatively complete Devonian geological cross-section sequence.

Collected ichnofossil samples have poor preservation and does not allow to determine precise ichnotaxa. To find out whether trace fossils, mostly consisting of organism burrows, are different from inclusive material, cuts with trace fossil cross-section were made. In samples with well-marked organism burrows in cuts the internal crystal structure and colour of the sample did not differ. Around several organism burrows a border between dolomite matrix and a structure formed by burrows appeared. In comparison, the trace fossils formed in dolomites were less preserved than trace fossils in samples of sandstone, clayey or limestone. The research will be continued to study bioturbated samples from dolomitic limestone.

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3D Reconstruction and Analysis of the Ichnofossils Using GIS

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Paleoichnological studies in Latvia are mostly related to indications of trace fossil findings in works of Kuršs (1975), Sorokins (Сорокин,1981). Savaitova (Савваитова, 1977), and Lukševičs *et al.* (2008). However, looking back in a little distant past there appear to be several studies that show a purposeful and updating determination of trace fossils, such as work of Krauss (1930).

During the period from 2008 to 2011 trace fossil samples were collected from the Frasnian stage (the Upper Devonian) in Latvia deposits in quarries and natural outcrops. Locally, favorable outcrops allow recognition of burrows, but usually differentiation of discrete biogenic structures is difficult. Some of collected ichnofossils consists of different materials from inclusive rock. The aim of this study is to reconstruct net of burrows using data from scanned samples and create a 3D model.

In the simplest case the information about medium can be binary where material is present or not. In another case, when there are more than one material, it is possible to analyze not only the mutual arrangement but also interaction. Different characteristics which are possible to describe numerically, can be transformed and spatially visualized inside a material, thus allowing to extend analysis of the given object. 15 scanned JPG images were used to create 3D model. Each image represents section and the step size between sections is 2 mm. After loading such images in GIS environment, it is necessary to do preliminary work with all loaded images. As JPG file is compressed, the image is not exactly binary. There is transition border between binary data. Such transition border must be eliminated before isolines are generated from these images. Raster values for given jpg dataset are as follows: 0 — where material is not present and 255 — where material is present. In the transition border there are raster cells with values between defined max and min cell values. The raster algebra can eliminate this problem using condition: if raster cell value is lower than a half of the amplitude (in our case, if value is lower than 127), then the cell value is equal to 0, else (if the value is equal or greater than 128) the cell value is equal to 255. Such preliminary work transforms loaded raster data to true binary raster data. For each raster section isolines were generated and the value of isolines was given the same as a serial number of the section, representing level or height of the given section. Isolines from all sections were consolidated together and using different GIS software which allows 3D isoline visualization, it is possible to visualize structure as 3D model, e.g. ArcScene 3D or other GIS and visualization software (Grass GIS, ParaView).

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Rhodoliths from Paleocene Flysch of Silesian Nappe (Polish Outer Carpathians)

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In flysch of the Polish Outer Carpathians, coralline red algae usually occur as debris of thalli, rarely as rhodoliths. We present the results of study on rhodolith-bearing sandstones and conglomerates cropping out in the surroundings of the village of Brzyska (central part of the Silesian Nappe). The sedimentary succession represents the Late Paleocene Upper Istebna Beds. The studied sediments originated from high-density turbidity currents and debris flows. The rhodoliths are mixed with siliciclastic material and are located in lower part of beds.

The rhodoliths are mainly spheroidal in shape and range in size from 1 to 7 cm (max. 10 cm). They have laminar internal structure and are composed of thin thalli of coralline algae (mostly the genera *Sporolithon, Lithotamnion* and *Mesophyllum*). Furthermore, Peyssonneliaceans also are present. Fragments of foraminiferids, bryozoans, echinoderms, bivalves and serpulids together with terrigenous material occur between coralline thalli. The siliciclastic material is similar to that surrounding the rhodoliths. The nucleus of the rhodoliths is composed of sand and bioclasts (mainly bryozoans and bivalves). The inner parts of rhodoliths are strongly abraded, while in their external part abrasion is weak. The rhodoliths are characterized by numerous borings of sponges, bivalves and fungi.

The structure of the rhodoliths together with enclosed siliciclastic material indicates origination in shallow water environment on siliciclastic substrate. The borings evidence periods of reduced sedimentation. The investigations indicate that the rhodoliths have been formed during sea-level rise, whereas during sea-level fall, rhodoliths together with siliciclastic sediments were re-sedimented to the deeper basin parts. Analogous sediments occur in the area of Melsztyn (Silesian Nappe) and were described by Leszczyński & Kołodziej (2004).

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MolecularPaleobiology of *Tyrannosaurus Rex*

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Process of fossilization leads to destruction of virtually all organic components of the specimen. Despite that there are findings of several structures of possible biological origin that are well preserved in remains of various age, including DNA from an insect trapped inside amber being 40 million-year-old (Bada *et al.* 2004) or amino acids from the vertebra of a sauropod *Seismosaurus* being 150 million-year-old (Gurley *et al.* 1991).

Tyrannosaurus rex, species of coelurosaurian theropod dinosaur, was one of the biggest land predators of all time; roaming North America during the Maastrichtian age of the upper Cretaceous period from67 to 65 million years ago. After years of studies that concentrated on morphological assays search for potentially preserved biological molecules has begun.

Well preserved specimens found in 1990 and 2003 ("MOR1125" or "B-rex") in the Hell Creek (Eastern Montana, USA) allowed multiple analyses on the bone fragments in search for biological molecules, using various techniques that include: optical and electron microscopy, resonance Raman (RR) spectroscopy, nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR) and immunological techniques (Smejkal, Schweitzer 2007).

Unexpectedly, in the specimen found in 1991 presence of structures morphologically similar to non-mammalian erythrocytes was demonstrated by electron microscopy as well as the presence of original organics, including heme, was discovered by RR, NMR and EPR inside these structures (Schweitzer *et al.* 1999). In the "B-rex" specimen, highly unusual bone tissue was found, similar to avian medullary bone, the one typical for reproducing birds. It was concluded that "B-rex" was a nesting female aged 18. Demineralization of the bone in EDTA showed the presence of soft, fibrous matrix, flexible vessels and structures that were further recognized as osteocytes (Schweitzer *et al.* 2007). "B-rex" medullary bone showed also positive reactivity to antibodies raised against chicken collagen I measured by enzyme-linked immunosorbent assay (ELISA). Presence of collagen epitopes in demineralized tissue was confirmed by time-of-flight secondary ion mass spectrometry (TOFSIMS) (Asara *et al.* 2007). The spectra allowed to reveal seven total collagen peptide sequences that were aligned with extant vertebrate taxa. BLAST alignment showed 58% sequence identity to chicken, 51% identity to frog and newt (Asara *et al.* 2007).

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Selected micro-fauna of Barbara level of Upper Silesian Coal Basin

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Upper Silesian Coal Basin is located in the South-western part of the Poland and the north-eastern part of the Czech Republic. Is developed in the form of orogenic basin is filled with formation of productive Carboniferous, whose shape is similar to a triangle. Paralic series includes rocks from the upper carboniferous established during cyclic ingress of the sea. The marin horizont Barbara is a layer of mudstones and claystones, where is plenty of marine fauna, and sometimes also freshwater species. This level has supplied 110 species of fauna which is important to correlation and sedymentation review. Deposits of marine horizont Barbara was found throughout the Upper Silesian Coal Basin. Object of mikrofaunistic research are exposition of the rocks in underground mine coal Sośnica located in the northwest part of the Upper Silesian Coal Basin.

So far, no research of microfauna was done on this area, therefore presented here species are first known speciments. The purpose of the study is the characterization of the type of microfauna and its stratygrafic significance.

The studies uses approximately 15 kg of samples taken from the excavation levels of 750 and 950 m in Sośnica mine.

Conduct analysis of rock began from the mechanical crush of rocks to grains several centimeters in diameter, then a rock was flooded by concentrated solution of Sodium sulfate $Na_2SO_4 \cdot 10H_2O$. Material was then bring to the boil, and then quickly frozen. The process was reiterated until rocks was crumbled in the effect of the intense crystallization of salts. Shredded material has been rinsed on a column of sieves and after drying were undergo microscopic analysis to gain fossils.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

In the test material found 2867 microfauna specimens with dimensions between 0.1 to 2 mm. There was found five types including: Protista, Mollusca, Arthropoda, Echinodermata, Brachiopoda; amond them the five clusters: foraminifera, Ostracods, gastropods, tusk shell, crinoids. Including 18 described species of fauna. Founded forominifera: Ammodiscus semiconstrictus Waters, and Archaediscus krestovnikovi Rauser-Chernousowa; snails: Mourlonia striata Sowerby [Fig. 4], Soleniscus primogenius Conrad, Donaldinia sulcatula McCoy, Straparollus (Euomphalus) parvulus Weigner, Knightites (Retispira) concinus Weir, and Glabrocingulum ostraviensis (v. Klebelsberg); tusk shells from the specie Coleolus

polonicus Weigner [Fig. 2]; ostracods: Bythocypris tenella Kumerow [Fig. 1], Jonesina silesiaca Kumerow, Bythocypris gibbosa Kumerow, Bairdia (Rectobairdia) venterba Gründel; crinoids: Pentaridica simplicis Moore et Jeffords, Cyclocrista asimetrica Głuchowski, Preptopremnum delicatum Głuchowski [Fig. 3], Cyclocaudiculus gracilis Głuchowski, Floricyclus angustimargo Moore et Jeffords. It was also found fragments of brachiopods shells, which, however, could not be identified because of ill behavior.

By analyzing the composition of organisms, their living environment, you can specify as the coastal area płytkiego of the sea with local wysłodzeniami of water. The conducted specificity may be used for correlation levels and adjacent to their decks coal under the condition of obtaining data from other points in the area of Upper Silesian Coal Basin.

The Project “Fossils of Ukraine”

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Effective promotion of science in Ukraine is the path of civilized development. Here I would like to describe the initial stage of the project "Fossils of Ukraine".

The aim of the National information project is popularization of paleontology and development of geological tourism.

The general interest to Ukrainian fossils is quite great. Many paleontologists come to Ukraine from Russia, Poland, Germany and other countries. A lot of Ukrainian people have paleontological interests. They don’t ask only about popular dinosaurs, they need comprehensive and updated information on fossils.

Methods applied in research are as follows: collection and processing of information from open sources (specialized literature, Internet resources, oral reports of geo-tourists, mass-media), systematic analysis of the fossils found and results of field geological practice.

In Ukraine such project is initiated for the first time. The similar project “List of US state fossils” was realized in the 1980s in the United States. [1]

Ukraine is subdivided into 27 regions: 24 oblasts, one autonomous republic, and two “cities with special status”. (Kyiv and Sevastopol). So the project will select the most interesting fossils for every region.

The main criterion for selection of fossils is their well-known identification.

The report format: the region (in alphabetical order), common name of fossil, Latin name (binomial nomenclature), stratigraphic age, the dislocation, some pictures and a brief description.

Stages of the project “Fossils of Ukraine”:

I. Formation of the short-list of fossils (nearly three candidates per one region). The end of winter 2012.

II. The national debate. The reports of the Project on geological conferences, consultations with the natural scientific institutions, sending letters to local history museums of Ukraine. The end of spring 2012.

III. Publication of high-quality printing is nearly 5000 copies “Fossils of Ukraine” books. The end of 2012.

The author of report is grateful to all who help in creating this project.

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Palaeogeography of the South-Eastern Baltic Region During the Late Cenozoic

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A new research has started for palaeogeographical reconstruction basically focused on the Miocene-Pliocene alluvial sand sediments in Lithuania, Kaliningrad region and Belarus. The most important sites in Lithuania include several outcrops along the Šventoji river near Anykščiai town, pure quartz sand pit and some drill-cores. It appears that only in this area one can see and investigate continental sediment sections of that time, when huge deltaic sediments were formed in the North Sea. Huge area of Northern Europe has been drained by gigantic Baltic River Sytem with huge basin and sediment load. Significant part of Denmark, Netherlands, Northern Germany and the North Sea floor has formed during the existence of this river. This is a really important topic and one that could be expanded in several directions. So little is known about the environment of the Baltic region in the late Cenozoic before the glaciations, that any new discovery would be an important advance. The Baltic River System evidence is just waiting for detailed study to build on what is already known.

It is needed to understand the nature of the sedimentary environments, so a new series of fieldwork accompanied by colleagues from Lithuanian Geological Survey and Cambridge University has been successfully organized and, because there are only few exposures, it would be useful to have some geophysics so that we could potentially interpret seismic sections, assuming the material is available (especially from drill-cores). All sections are reviewed in light of new magnetic susceptibility data and palaeomagnetics gained in the laboratory of the Institute of Geology & Geography of the Nature Research Centre. Along new research a detailed study of all former published material and accumulated data in archives of scientific institutions in Lithuania is carried out.

Palyno-correlation in the Permian and Mesozoic successions, North-Central and Eastern area, Raniganj Coalfield, Damodar Basin, West Bengal, India

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Damodar basin lies in India between the states of Jharkhand and West Bengal. Gondwana sediments in Damodar Basin occur in isolated coalfields in E-W trending linear belt. The Raniganj coalfield is the largest area of coal mining in India. This coalfield is the most eastern depository within the Damodar Basin, situated in two states- West Bengal and Jharkhand. The Raniganj coalfield is semi-elliptical, elongated in shape and covers an area of ca 3000 km^2 lying in between latitudes 23º 03' and 23º 51' N and longitudes 86º 42' and 87º 28' E. It is bounded by the Archeans to the northwest and south, towards the eastern alluvium and laterite over the Gondwana strata. The Gondwana rocks in the Raniganj coalfield are represented by Talchir, Barakar, Barren Measures, Raniganj and Panchet formations.

The Gondwana succession intersected in the north- central and eastern parts of the Raniganj coalfield, Damodar Basin, includes Barakar, Barren Measures (borecores RJS-2 and RT-4), Panchet and Rajmahal formations (bore core RRK-1). Present review is aimed to conform the age correlation of the Barren Measures and Panchet formations in the study area. As a result, strata equitable to the Raniganj Formation have been proved to be in the Barren Measures Formation. Thus, based on the result of palynodating, lithologically delimited Barren Measures Formation is inferred as the time- transgressive deposit. Similarly, infra-trappean sediments are recognised in the uppermost part of the Panchet Formation which in turn re-defines the status of the Panchet Formation. To conclude with the unrecognised unconformity in the Barren Measures and Panchet formations has been identified, thus featuring it in the litho-packages for the first time.

Sedimentary Environments and Provenance Studies of Upper Jurassic Debris Flow Deposits of Sukhorits'ka Formation, Balaklava, SE Coast of Crimea

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Sedimentological studies of the Sukhorits'ka formation has never been held before so it can give new data for better understanding of the Crimean fold belt formation. We reconstructed the sedimentary environment and tried to understand what processes lead to formation of such kind of deposit and draw conclusions about the Upper Jurassic tectonic regime.

Field methods include: sedimentary logging technique including measurements of grain size, sorting, roundness and matrix-pebble correlation. Paleocurrent indicators were taken measuring pebble imbrications. Clast-counting a total of three beds (on the bottom, middle, top of the strata) was made to establish clastic compositional changes. Laboratory methods were as follows: X-ray structure analysis for clays from the matrix, thin section studies and low-magnification binocular microscope studies for sand-sized clasts from matrix. This formation consists of matrix-supported conglomerates with massive texture (lithofacies Gms, Miall 1978). Predominant size of clasts are granule-pebble with rare cobble-sized clasts, roundness of clasts is well, average marix : pebble correlation — 4 : 1, poorly sorted. Up to the middle on the Eastern part of the strata breccia beds occur, which are thin, rare and consist of angular limestone clasts, also sporadic angular limestone clasts of pebble-cobble size occur in some conglomerate beds through the strata. Sometimes huge limestone boulders up to 6 m in diameter occur. Also one can find few conglomerate beds with carbonate cement. Clastic composition gradually changes from the bottom to the top of the strata. On the bottom of the strata grey siltstone pebbles are predominant, in the middle — red sandstone pebbles, on the top – quartz pebbles. Paleocurrent was predominantly E-SE directed, but on the South-Western part of the strata it was N directed.

Interpretation of this data was made by creating 2 sedimentary environment models depending on the age of stratum formation. First model (Late Oxfordian — Early Kimmeridgian) tells that this stratum can be interpreted as a result of debris flows activity with, possibly, a small part of tsunami activity. Rock texture, clast size and composition tell us that the transportation way was short. Abrupt sedimentation made them poorly sorted with massive texture. Angular limestone clasts were brought by tsunamis and scattered over the top surface of a particular debris flow fan complex. It is speculated that debris flows formed a proximal alluvial fan complex located near the adjacent highland located westward. It was also a coastal plain which in eastward direction changes into short shelf and then to coral reef build-ups (Jaylyns'ka formation). As is generally known reef build-ups from the ocean side are bounded by fore reef talus. Debris from that talus was brought by tsunamis to the coastal plain and dropped onto the conglomerates as exotic limestone clasts and boulders. Tsunamis in its turn were triggered by earthquakes caused by orogenesis. The second model (Late Kimmeridgian) is mostly the same but have some differences. At that time there weren't any sea; coral reefs were uplifted and their denudation was a source for limestone angular pebbles and large boulders. Rockfall avalanches brought them to conglomerate beds. Occasionally, during hard

rains fine to sand-sized material was transported by streams and mixed together with debris flows on the sedimentation area to form conglomerate beds with carbonate cement.

We admit two models but prefer the last one because it is simpler and therefore more plausible.

Comparison of Geological Setting of Two, Shale Gas-Bearing, Variscan Foreland Basins — Fort Worth basin, Texas, USA and Silesian basin, S. Poland

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Unconventional hydrocarbon deposits have been known for over one century. However, their importance had stayed out of focus of interest for many decades due to economic reasons and the lack of appropriate technology developments. The last two decades have been especially important for the comprehension of the unconventional hydrocarbon deposits. The most spectacular and well recognized example of such hydrocarbon deposits are the Mississippian Barnett shales, explored in 2000.

The organic-rich Barnett Shale is the primary source rock and the main unconventional reservoir in the Fort Worth Basin, Texas, formed within the Ouachita foreland basin of the Mississippian age. In terms of age, tectono-sedimentary history and geological setting of this basin are very similar to the Upper Silesian foreland basin of the Variscan Orogene. The Early Carboniferous Moravice formation located in the Silesian Basin (Moravian-Silesian Fold and Thrust Belt) is the possible source rock in southern Poland and it is the Polish equivalent of the Mississippian Barnett formation.

Paleogeographic setting of the Fort Worth basin and Silesian basin during the Early Carboniferous.

The study concerning similarities and differences between the Moravice Formation and Barnett Formation has been done in order to demonstrate unconventional reservoir potential of the Early Carboniferous deposits of Southern Poland. The comparison of the two formations concerns: depositional environment, tectonic setting, thickness, depth, organic and geochemical properties and thermal maturity. Both formations display similar depositional setting and they are organic matter-rich. The Moravice formation is however penetrated by only a limited number of generally shallow wells in comparison to the Barnett Shale, so this study should bring some prerequisites to other more advanced researches focused on hydrocarbon potential of the Silesian play.

Facies of Present-Day Tufa Deposits from Buzgó Stream (Slovak Karst, southern Slovakia)

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Tufas are freshwater carbonates which are developed from supersaturated waters near the springs of karstic origin in the result of chemical and/or biological processes. In southern Slovakia present-day tufas occur commonly in the Slovak Karst region. They are developed around springs which drain massifs built of Mesozoic, mainly Triassic, carbonates. In several places tufas occur within the streams flowing out from resurgence caves.

The recent sedimentological and hydrogeological studies conducted in Buzgó stream flowing out of the Krásnohorská Cave let recognize facies of tufa deposits. The tufas comprise major lithofacies: 1) moss tufa — composed of encrusted moss steams, mainly by fan-shaped calcite crystals (up to 200 μm in size) generally orientated perpendicularly to single stems; 2) phytoclastic tufa — composed of calcified fragments of tree leaves, twigs, stems of grasses and liverworts; 3) oncoidal tufa — composed of oncoids (up to few centimeters in diameter and 10 cm long) consist of microbial coated fragments of macrophytes (stems of bryophytes, trunks and grasses); 4) algal tufa — composed of calcified cyanobacterial filaments with local accumulations of diatoms, forming layers up to a few millimeters in thickness intervening with phytoclastic tufa.

Present-day tufa deposits from Buzgó stream represent barrage depositional system. Barrages comprise moss, algal and phytoclastic tufa. Individual barrages reach up to several decimeters in height and a few meters in length. They are developed perpendicularly to the stream. Oncoidal tufas forming lenticular layers up to a few decimeters thick are accumulated in ponded areas upstream barrages in relatively calm settings.

The study was financed by the Polish Ministry of Science and Higher Education grant N N307 600640 and DOCTUS scholarship cofounded by European Social Fund.

Preliminary Investigation on Provenance of Basal Conglomerates of Jamal Formation by Clast Geochemistry and Petrography

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Studied section of the Jamal Formation (the Upper Permian) in the Bardaskan area (Fig. 1) consists of about 50 meters conglomerates in basal part and about 600 meters limestone and dolomite sequences in upper parts.

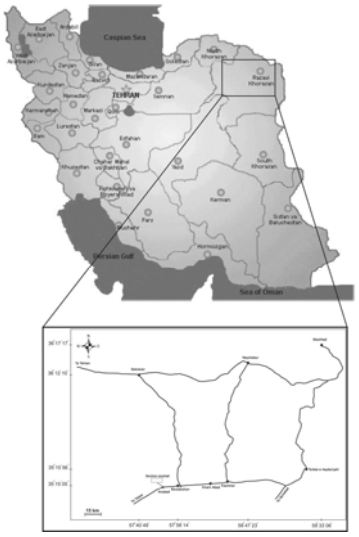

Fig. 1. Location of study area in NE of Iran

In this study we focused on provenance determination of basal conglomerates of the Jamal formation. We have selected about 50 samples from unweathered clasts from these conglomeratic deposits. Initial petrographic studies show that these clasts are divided in three groups: igneous, carbonate and also sandstone clasts.

Petrographic studies of igneous clasts revealed that most of these clasts are rhyolite and dacite to andesite.

We have selected 6 samples of these igneous clasts for geochemical analyses. These samples were sent to ACME laboratory in Canada for determining the major and trace elements of these igneous clasts.

As geochemical data confirmed the petrographic studies; these samples are mostly rhyolite, dacite and some of them are andesites.

SiO_2 versus K_2O plot of these data have shown that these clasts are related to high K or shoshonitic magmatism. Zr versus Nb/Zr plots show that these samples are related to subduction related magmatism.

As a glance to geological settings, these clasts can be related to the Taknar rhyolites and dacites (the Precambrian) that located in vicinity of studied area.

Petrographic investigation of carbonate clasts consisted of *Pseudorermiporella sp* and *Globiralvulina sp* and indicated the Early Permian. So, these carbonate clasts can be related to the early Permian successions equivalent to the Sardar Formation close the studied area.

Petrographic studies of sandstone clasts have shown that these clasts are calcareous sandstones with similar petrography to sandstones of the Shishtu Formation as the age of early Permian.

This paper as first study on provenance of these conglomerate deposits in the area. Better understanding of the provenance of these deposits will be done in future by methods of dating of the igneous clasts in these conglomerates.

Structural Geology and Geodynamics

Structural Framework of Rocks in Ago-Iwoye, NE, SW Nigeria: Evidence from Outcrop and Satellite Imageries

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Structural mapping of rocks in Ago-Iwoye, NE, SW, Nigeria (N 06°56'–06°58' and E 003° 52'–003°56') was carried out with the aim of integrating structures from the rocks with regional structures on larger scale satellite imageries.

A petrographic study of rocks was done in order to identify the rock types of the study area. Structural measurement such as the attitude (strike and dip), length, width and average perpendicular distance was taken on seventy nine (79) foliations, three hundred and twenty six (326) joints, thirty seven (37) veins, eleven (11) intrusions and four (4) boudinages while sixty nine (69) lineaments were extracted from Google Earth imageries covering the study area and its surroundings; the lengths and orientations of the lineaments were also determined and plotted on Rosette diagrams and lineament density map.

Slightly foliated granite-gneiss, biotite gneiss, and pegmatites were identified from the petrographic studies. The general orientation of structures is NNE–SSW for foliations, NW–SE for joints, N–S, NNW–SSE, and NNE–SSW for veins; and N–S for intrusions with dip direction of E, W & SW for foliations and W for the intrusions. The dominant orientations of joints are E–W & ENE–WSW suggestive of dominant N–S or NNW–SSE directed stresses, and joint types mapped include systematic, non-systematic, conjugate, T-joints and cross joints with average perpendicular spacing between joints ranging from 4cm to 67 cm. The Aspect ratio (W/L) for boudinages and intrusion are 0.026 and 0.071 respectively.

Two dominant structural domains were identified from the lineament map; these are NE–SW & NW–SE with dominant orientation of Lineament being NE–SW, suggestive of NW–SE tectonic (extensional forces), minor ENE–WSW and E–W orientation suggestive of shearing evinced by conjugate joints sets were also recorded. Evidence from the lineament density map suggest that the NE, NW & SW parts of the study area were highly dense while the E–SE part is less dense or near zero relative to lineament concentration; this same trend was earlier observed during the ground mapping.

There is overlap between the minor NW–SE/ENE–WSW orientations in lineaments and joints; this implies that these fractures in both cases were produced by similar tectonic events while other orientations are product of dissimilar tectonic events/regimes. Highly jointed areas are concerns for construction works but also important site for mineral and water exploration.

Giant Slump Complex Structure in the Gulf of Guinea According to the 3D Surveying

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The aim of the present abstract is to describe the space (3D) structure of the underwater landslide, which is located in the northern part of the Gulf of Guinea.

The landslide complex described in this work is located in the Atlantic type "Normal" passive margin near the San Paul transform fault. This fact predetermines the gradient relief of syn-rift ocean basement; in addition, such position provides a relatively high tectonic activity during the geological history. Thousands of square kilometers are subjected to large-scaled sliding events, which affect the Post-Albian marine sediments. Marine succession is presented by hemipilagic sediments. Also turbidit sedimentation is taking place. Marine sediments are strongly attracted by syn-rift basement ridges, horst steps, whereas turbidite deposits are quite usual for local depressions between ridges. Tectonic ridges have SW strike; major turbidite channels normally have NS strike. Sediments mentioned above have different rheological behavior (deformation style), and it becomes possible to describe the interior structure of the slump complex. Different seismic packages react in different ways to the stress field, which is formed because of the gravitational forces. Sandy packages act like the brittle layers and have apparent fault events, otherwise clay packages act in different way, and they have a viscous response. This is shown in the seismic field peculiarities.

Initially, the area is divided into the two principle zones: zone of decompression, typical for "the slump crown", and the zone of the compression compensation, typical for the proximal part of landslide.

The decompression zone is a classical example of the landslide structure. We can see both rapture and crown faults, the number of segments which are separated one from another by the listric faults, and the last aggregate to detachment fault in the bottom of marine succession. On the slices the faults are presented as a polygonal system with the horseshoe-shaped crown fault events. Because of heterogeneous compression caused by the neighbor slide-block rotation, slump folds can be formed in the bottom parts of the slide blocks. The medium-sized faults are dominated in the upper levels. The antithetic fault system becomes significant — it adapts rotational deformation.

The compression compensation zone is located in the proximal part of the slide complex. This zone is presented as brittle-elastic deformation in sandy layers and as viscous deformation in clay layers. Also we can see clay injections and thickness anomalies caused by material redistribution. Such behavior is usual for the plastic material as well as for the near slump detachment fault rocks. Also we can see evidence of paleo flows, like mud flow and debris flow, which complicate the entire structure of paternal slide complex.

The zone of compensation of slide deformation is presented as a very complicated surface, which is situated in the bottom layers of marine succession (Cenoman-Turonian); the shape of this surface may be described as typical "Flat-Rump" geometry. That menas that dip of surface elements systematically changes from steep ("ramp") to low-angle ("flat") intervals. This surface is called slide Detachment Fault. Near this surface we can see grinded rocks this type of rock forms a quite unique layer, with a thickness of over 100 meters. Rough estimates show, that the horizontal displacement can be of 5–7 km, while vertical displacement can be up to 500 meters.

The compression compensation zone has importance for the whole system. Brittle deformations and movements that take place in the crown zone are compensated as the viscous deformations in the compression zone.

Influence of Geodynamic Situation and Role of Rock Salt Formations in Chemical Composition Formation and Circulation of Brines of Some Sedimentary Basins

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The processes of brines chemical composition formation and mechanisms of their influx into the adjacent strata depend on geodynamic situation that determines pressure and temperature conditions and region hydrodynamic regime.

According to the recent researches performed by J.K. Warren, S.B. Shekhunova et al. [1–3], among basins with thick rock salt such Formations are distinguished: passive margin burial, pull-apart, collision margin burial, post orogenic burial and interior sag basins (intracratonic).

Passive margin burial realm — in conditions of tectonic disturbance lack rock salt sediments can act as a screen that directs the fluids and heat flows into the undersalt strata and leads to the hydrocarbon reservoir formation (Gulf of Lions, France, Miocene; Gulf of Mexico, Jurassic etc.).

Pull-apart burial realm (continental rift) — in the sedimentary basins of the rift zones observed lateral circulation of highly brine leaching, formed due to rock salt dissolution during their intensive subsiding. In the presence of salt domes contact zone acts as a migration path for deep fluids and highly mineralized rock salt brines into undersalt horizons and dissolution brines leaching into the undersalt adjacent strata (Pripyat Trough, Belarus, Devonian; Dnieper-Donets Depression, Ukraine, Devonian).

Collision margin burial realm (margin Cratonic basins, foreland basins) are characterized by convergent margins overlap, thrust-faults, widespread fracturing and episodic movement of formation water, usually caused by tectonic activation. Rock salt sediments act as a source of primary (sedimentogene) brines (Slave Point Formation, Canada, Devonian); or dissolution brines (Carpathian Foredeep, Ukraine, Miocene).

Post-Oorogenic burial realm is characterized by a lack of intense tectonic activity, the dominance of topographically driven flow, and by relatively high fluid flow rates, which in zones of deep artesian circulation. Flow is driven by elevation gradients created during uplift in the preceding Orogenic phase. Post-Orogenic fluid flow takes over once the main phase of tectonic collision ends. This hydrologic mode drives the dissolution of many buried salt units in continental interiors and encompasses the generation of Na–Cl brines (the European Alps and the High Atlas; the Anadarko, Midland and Palo Duro Basins, West Texas, the San Andres Formation, Permian).

Interior sag basins (intracratonic) — rock salt sediments act as a source of brines with high salinity and concentration of microcomponents and neogenic minerals formation (Dnieper-Donetsk Depression, Ukraine, Permian).

Therefore, thick rock salt Formations in the basin cross-section significantly affects the groundwater chemical composition (total salinity and concentrations of macro- and micronutrients), acts as a screen that directs the fluids and heat flows into the undersalt strata, as a source of fluids (sedimentogenic brine, bittern); serves as pass for deep fluids (salt domes contact zones) into underlaying thicnesses, leads to the formation of brines with high concentration of Fe, Mn, Pb, Zn, Cu, Ag, Li, Ba, Sr, Cs, Br, J, filling of sediments pore-space by paragenetic minerals associations (replacement dolomite, calcite cementation,

anhydrite replacement, barite, celestine, saddle dolomite, halite and sylvite) that might significantly affect the reservoir quality changes of oil and gas fields. And geodynamic situation defines the activity of processes, described above.

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Joints Data Statistical Processing in Skyba and Boryslav-Pokuttya Nappes Using Fabric 8.0 Software (The Ukrainian Carpathians)

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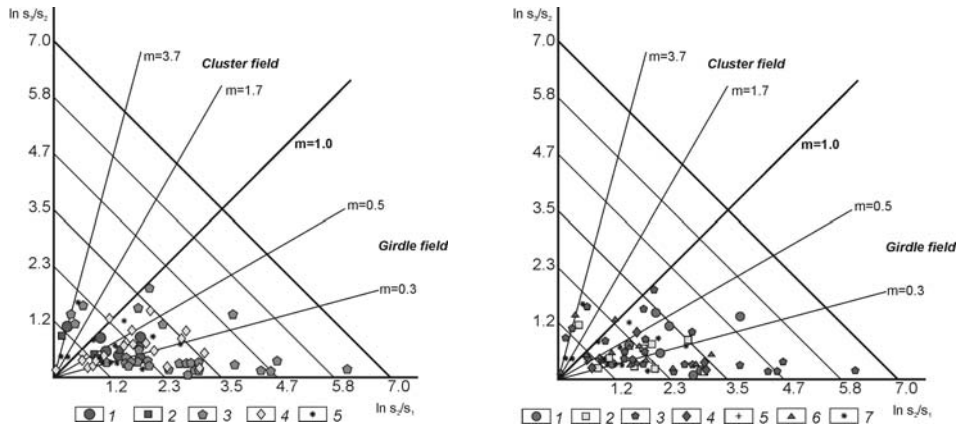
The objective of this work is joints orientation statistical processing. The orientation of joints were measured at natural outcrops in the valleys of Rybnytsia, Sukil, Bystrytsia Nadvirnianska and Prut rivers and at outcrops between the Opir and Oriava rivers, and also in different quarries located near the cities of Dolyna and Bolekhiv. The outcrops belong to the Skyba and Boryslav-Pokuttya nappes (the Ukrainian Carpathians and their foredeep). In each outcrop the number of joints azimuth and angle of dip were measured about 100. The total number of joints orientation is about 5000.

To statistically process joints orientation data Fabric 8.0 computer software was applied [1]. This structural software is important to calculate the different statistic parameters. In this work there are calculated the value m. According to this value fields are divided into girdle and cluster ones ($m = 1$ is the border between fields). These fields show joints order degree of around the main direction of stress fields.

Value m was calculated in different flysch formations (from the Cretaceous to the Neogene) and two tectonic units (the Skyba and Boryslav-Pokuttya nappes). The results of joints statistical processing are plotted in different projections and diagram.

We used the Woodcock diagram for the results of joints statistical processing (Fig. 1).



a ***b***

Fig.1. Joints at Woodcock diagrams
(***a*** — formations: 1 — the Upper Cretaceous; Palaeogene: 2 — Lower, 3 — Middle, 4 — Upper; 5 — the Neogene; ***b*** — thrusts in the Skyba nappe: 1 — Berehova, 2 — Orivska, 3 — Skolivska, 4 — Parashky, 5 — Malmanstanska, 6 — Zelemianky; 7 — Boryslav-Pokuttya nappe).

According to these diagrams the almost all of joints belong to the girdle field in the Skyba and Boryslav-Pokuttya nappes. These joints were created within the limits of one dominant main stress field. Joints data of some thrust belong to cluster field. There was no one main stress field in these tectonic units during the Cretaceous – Neogene.

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Stress and Strain State and its Influence to the Distribution of the Oil and Gas Deposits in Ukrainian Carpathians Foredeep (by Joints and Slickensides Research)

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The areas of the investigations are located at the Boryslav–Pokuttya nappe (the Ukrainian Carpathians foredeep), near the contact with the Skyba nappe (the Ukrainian Carpathians). The research was carried out at natural outcrops, located in the stream and the river beds, and quarries along four transverse profiles: 1. in the valley of the Stryy river (v. Nyzhnye Synevydne); 2. in the quarries near the cities of Bolekhiv and Dolyna; 3. in the valley of the Bystrytsya Nadvirnyanska river (near the city Nadvirna); 4. in the valley of the Prut river (near the city Delyatyn).

The objectives of this work are to determinate the main axes of stress (compression σ_1, tension σ_3) during the Paleocene–Miocene and to connect these results with the distribution of the oil and gas deposits in this region.

The applied methods (analysis of joints and slickensides) are described in detail in works [1, 2]. The orientations of joints (from 50 to 300), slickensides and bedding were measured at each outcrop along the profile in the flysch formations from the Cretaceous to the Palaeogene. All joints were classified into: a) perpendicular to stratum, b) oblique, c) vertical in modern position of layer. In accordance with different types of joints main axes (σ_1, σ_2, σ_3) of stress fields before (stage I, stress palaeofields), during (stage II) and after (stage III, recent and modern stress fields) fold and thrust formation of the Ukrainian Carpathians were reconstructed. Stress fields were reconstructed with the use of slickensides and belonged to stage II and (in some cases) stage III (during the recent intensive landslides etc.). To process data the following computer software were applied: StereoNett 2.46 (for joints) and Win–Tensor 1.4.19 (for slickensides). The main axes of stress at four profiles are shown in Table.

Table

	Profile 1		Profile 2				Profile 3		Profile 4	
	Nyzhnye Synevydne		Bolekhiv (quarry)		Dolyna (quarry)		Nadvirna		Delyatyn	
	σ_1	σ_3	σ_1	σ_3	σ_1	σ_3	σ_1	σ_3	σ_1	σ_3
Stage I	220/05	310/10	197/05	287/10	175/02	265/08	185/02	275/10	266/05	356/07
					240/06	330/09			215/05	305/10
Stage II	320/20	175/70	149/80	240/08	235/29	56/61	248/15	82/75	223/17	85/65
			149/85	298/00	247/76	120/05	260/75	38/10	10/10	138/57
							310/86	130/04	193/02	290/68
									334/79	158/14
Stage III	242/05	332/05	145/10	55/13	258/05	348/07	192/05	282/12	169/02	259/08

We also used the maps and geological cross sections to determinate the main fault structures of the Ukrainian Carpathians foredeep.

Stress fields in the Skyba and Boryslav–Pokuttya nappes during the Paleocene-Oligocene (I), the Miocene (II) and the Post-Miocene (III) (axes of stress: σ_1 — compression; σ_3 – tension).

Conclusions. 1. Before the orogenes stress fields in the Carpathians were connected with the influence of tangential forces of planetary and tectonic character. 2. The oldest jointing in rocks were the planetary and tectonic of extension. The first jointing was connected with irregular rotation of the Earth and the second one was connected with subsidence of the sedimentary basin. Then there were joints associated with the beginning NE–SW compression. 3. During the fold and thrust formation of the Carpathians there were inverse deformation mode. This mode showed the compression of general Carpathians NE direction. 4. The parallel to extending of the Ukrainian Carpathians stress fields were connected with creation and influence of West and South Carpathians. 5. At the present stage the tectonic stress fields show slip deformation mode. 6. After the compression of the Ukrainian Carpathians foredeep took place the large extension. These joints were opened and migration of fluids was possible for them.

The results of this work show the stress and strain state during the creation of large fault structures. These structures and different mesostructures were significant in the accumulation and redistribution of hydrocarbons.

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