

**WMESS 2020**

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# 6th World Multidisciplinary Earth Sciences Symposium

Eco-friendly Symposium - WMESS



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## ABSTRACT COLLECTION BOOK

SEPTEMBER  
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## Preface

This Abstract Collection consists of the abstracts of papers presented in the “6<sup>th</sup> World Multidisciplinary Earth Sciences Symposium – WMESS 2020” in the city of romance Prague (Czech Republic) during 07-11 September 2020. The World Multidisciplinary Earth Sciences Symposium (WMESS) aims to provide a forum for discussion of the latest findings and technologies in different fields of Earth Sciences, to give opportunities for future collaborations. WMESS wants to be a platform for sharing knowledge and experiences in the fields of Earth Sciences, to lead for providing a forum for early career researchers for presentation of their work and discussion of their ideas with experts in different fields of Earth Sciences such as; Tectonics & Structural Geology; Engineering Geology; Geotechnics; Hydro-Hydrogeological Sciences; Natural Hazards; Geomorphology; Geochemistry, Mineralogy, Petrology & Volcanology; Stratigraphy, Sedimentology & Palaeontology; Geophysics & Seismology; Geodesy, Photogrammetry & Cartography; Informatics, Geoinformatics & Remote Sensing; Mining Engineering; Mineral Processing; Blasting & New Technologies; Natural Resources; Environmental Sciences; Energy, Resources & Pollution & the Environment; Environmental Legislation; Biogeosciences; Geological Heritage & Geoparks; Urban Planning; Atmospheric Sciences – Climate; Modelling and Soft Computing Techniques in Earth Sciences; Medical Geology; Occupational Health and Safety.

WMESS 2020 was the 6th of the Annual series and the main mission of the "World Multidisciplinary Earth Sciences Symposium - WMESS" is to lead to contribute in multidisciplinary studies related with atmosphere, biosphere, hydrosphere, lithosphere and pedosphere of the Earth and interaction of the human with them. As another mission, it provides a forum for this diverse range of studies, which report very latest results and document emerging understanding of the Earth's system and our place in it. The Scientific Committee and Institutional Scientific Partners of WMESS was completed by paying strict attention, and all members were selected from well-known, very much appreciated, productive and representatives of the different countries. We are deeply grateful to the members of the scientific committee and institutional scientific partners (International Association for Engineering Geology & the Environment – **IAEG**, International Union of Soil Sciences – **IUSS**, International Geographical Union – **IGU**, The International Association of Hydrogeologists – **IAH**, Geological Sciences of Italy – **SIGI**, Czech Soil Science Society – **CSSS**, Arabian Geosciences Union – **ArabGU**, The Society of Economic Geology of Romania – **SEGR**, World Meteorological Organization – **WMO**, International Medical Geology Association – **IMGA**, Russian Mineralogical Society – **RMS**, National Univ. of Science & Technology - Moscow Mining Institute – **NUST MISIS**, Geological Society of Africa – **GSAf**, University of Architecture Civil Engineering & Geodesy – **UACG**, Geological Society of Romania – **GSR**, University of Petrosani) of WMESS.

We would like to express our sincere gratitude to all participants of WMESS 2020 from different countries all over the world for their interests and contributions in WMESS 2020. We wish you enjoy the World Multidisciplinary Earth Sciences Symposium – WMESS 2020 and have a pleasant stay in the city of romance Prague. We hope to see you again during next event WMESS 2021 which will be held in Prague (Czech Republic) approximately in the similar period.

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**TECTONIC CONDITIONS FOR THE FORMATION OF STRUCTURES OF THE SAKANDZHA ORE DISTRICT (SELENNYAKH RIDGE, NE ASIA)**

Felix F. Tretyakov, Andrei V. Prokopiev, Dmitry A. Vasiliev

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Luis M. Ferreira Gomes

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Ján Ilavský, Danka Barloková, Michal Marton

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Nevzat Özgür

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Gizem Arslan, Ayşe Didem Kılıç

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N. Abrosimova, N. Yurkevich, S. Bortnikova, O. Saeva, A. Reutsky, V. Chernukhin



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Ana Santos, Ana Virtudes

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**POTENTIAL FOR METAL RESOURCE RECOVERY FROM ACID MINE DRAINAGE**

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M. Luz Rodríguez-Blanco, M. Mercedes Taboada-Castro, M. Teresa Taboada-Castro

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M. Mercedes Taboada-Castro, M. Luz Rodríguez-Blanco, M. Teresa Taboada-Castro

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Sorin Anghel

**MINERALS EXPLORATION OF A SHEAR ZONE IN THE METAMORPHIC SOLE OF THE SEMAIL OPHIOLITE, WADI HAM, UAE**

Bahaa Eldin Mahmoud Amin, Abdulrahman Y. A. Alkatheeri; Saif M. S. Aljneibi; Ahmed E. Abdelmawla Mohamed.

**IMPACT OF BIOCHAR ON SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY DURING 2 YEAR FIELD EXPERIMENT**

Maciej Gliniak, Jakub Sikora, Urszula Sadowska,  
Agnieszka Klimek-Kopyra, Agnieszka Latawiec, Maciej Kuboń

**IMPACT OF BIOCHAR ON SOIL TEMPERATURE DURING 2 YEAR FIELD EXPERIMENT**

Maciej Gliniak, Jakub Sikora, Urszula Sadowska, Agnieszka Klimek-Kopyra, Agnieszka Latawiec, Maciej Kuboń

**IMPACT OF BIOCHAR ON WATER RETENTION IN SOIL DURING 2 YEAR FIELD EXPERIMENT**

Maciej Gliniak, Jakub Sikora, Urszula Sadowska, Agnieszka Klimek-Kopyra, Agnieszka Latawiec, Maciej Kuboń

**AUTHIGENIC BARITE IN THE BOTTOM SEDIMENTS OF THE SEAS AND OCEANS: CRYSTAL MORPHOLOGY, COMPOSITION, INDICATOR PROPERTIES**

Liudmila Reykhard, Nina Kozina, Olga Dara, Nataly Shulga



**RESERVOIR PROPERTIES OF THE JURASSIC KHATATBA (SAFA) FORMATION: TUT OIL FIELD,  
NORTH WESTERN DESERT, EGYPT**

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**ABSTRACT**

The Tut oil field is located in the northwestern part of the Western Desert. This work aims to study the reservoir characteristics, to evaluate the hydrocarbon potentiality of the Upper and Lower Safa Members based on the available subsurface data obtained from open-hole well log records of four wells distributed in the study area. The subsurface geologic setting, in terms of defining the stratigraphic and structural settings, is gained through the construction of varying aligned stratigraphic, structural cross sections isopach and lithofacies maps. The petrophysical evaluation, in terms of determining the reservoir properties, net-pay thickness, shale content ( $V_{sh}$ ), effective porosity ( $\phi_{eff}$ ), water saturation ( $S_w$ ) and hydrocarbon saturation ( $S_h$ ), are acquired through quantitative computer processed interpretation. The results of the petrophysical analysis, that achieved on the study area using the wire line log, response to perform the vertical and the lateral distribution of the reservoir characteristics, in the form of litho-saturation cross-plots, iso-parametric maps and lithologic-matrix cross-plots. The obtained results indicate that interested horizons of 3 zones: (Upper Safa-Top, Upper Safa-Bottom and Lower Safa-Top), within the middle Jurassic succession, TUT oil field are hydrocarbon charged. The upper most part of Upper Safa Member: (Upper Safa-Top) reservoir, represent oil producing from shallow marine to alluvial sediments. The Lower most part of Upper Safa Member: (Upper Safa-Bottom) reservoir, represent gas producing from a thick alluvial sand body. Finally, the upper most part of Lower Safa Member: (Lower Safa-Top) reservoir, represent oil-gas producing from shallow marine sediments with high terrestrial input. The iso-parametric maps show that northern and central parts of the study area are the most favorable parts for hydrocarbon accumulation due to the increase in net-pay thickness and average effective porosity and decrease in water saturation toward these parts. The most prospective area is located at the central and northern parts of Tut field. It is recommended to focus the exploration activities on these parts in future.

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**PHYSICAL PROPERTIES OF THE LATE PLIOCENE SHALY SAND RESERVOIRS: OFFSHORE  
SAFFRON GAS FIELD, NILE DELTA, EGYPT**

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**ABSTRACT**

The Saffron Gas Field is located at the Scarab-Saffron Development Lease of the offshore Nile Delta. It was discovered by the exploration well; Saffron-1 drilled in 1998 and appraised by Saffron-2 and 3 wells. Saffron drilled wells encounter sand shale sediments which are mainly of stacked slope-channel systems of the Late Pliocene in age. It consists of 6 different sandstone reservoirs superimposed and hydraulically connected in some places. They can be interpreted as deep-water canyon fill sand-shale deposits on the delta-front slope. Some physical properties of 4 full diameter core samples (164 core plugs) obtained from the Saffron-2 borehole were petrophysically studied. Helium porosity, horizontal and vertical Air-permeability, grain density and electrical resistivity were laboratory measured in order to evaluate the reservoir petrophysical properties. Several frequency histograms were built for most of the measured reservoir parameters in order to determine their distribution type and other statistical parameters. Numerous bivariate plots were accomplished among porosity, permeability, grain density, formation resistivity factor; cementation exponent and Winsaur's multiplier (a) for developing some petrophysical models. Some regression line-equations with robust coefficient of correlations were obtained to be used for reservoir enhancement and characterization. The cementation exponent (m) - Winsaur's multiplier (a) relationship is performed which could be used for reservoir fluid saturation determination ( $S_w$  and/or  $S_h$ ) and then reserve estimation. Some impermeable parts in the studied sedimentary section are represented by core numbers 4&5 of Saffron-2 well. They have severe consequences on the obtained reservoir parameters especially which has been exposed by the porosity- permeability relationship.

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**RESERVOIR CHARACTERIZATION OF THE BAHARIYA FORMATION, NEAG-1, 2 & 3 OIL FIELDS,  
WESTERN DESERT, EGYPT**

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**ABSTRACT**

An integration was achieved between different bore holes and laboratory measured data using several petrophysical parameters of the Bahariya Formation encountered in Neag-1,2&3 oil fields. It illustrates the key control factors affecting the Bahariya reservoir quality. The obtained petrophysical relationships could be used widely in both exploration geophysics and hydrocarbon reservoir production. It provides and demonstrates solutions for both geological and geophysical engineering problems. The measured porosity and permeability are ranging from 2.5 to 32 % and 0.005 to 874 mD respectively. The influence of diagenesis on both reservoir porosity and permeability has been investigated. Pore filling minerals has been classified into four classes by XRD- analysis technique. A reliable regression equation was reached between reservoir permeability and mineral pore fillings. Several relationships among rock permeability, porosity and density obtained from open hole logs were recognized. The pore throat distribution has been laboratory measured by use of MICP technique for some selected samples. The calculated reservoir storage and flow capacity indicate four major fluid flow types which are controlled by the variations in reservoir pore space framework. Formation resistivity factor – porosity relation was accomplished under reservoir conditions, while the Archie's 2<sup>nd</sup> equation was outlined. The Archie's parameters (a, m & n) were calculated for shaly and clean sandstones of the Bahariya Formation. Both cation exchange capacity (CEC), Mounce potential (MP) and mercury injection capillary pressure (MICP) were measured in order to distinguish reservoir facies.

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**THE EXAMINATION OF GROUND SUBSIDENCE OF QUETTA AND ITS PERIPHERAL AREA OF PISHIN  
BY INTERFEROMETRIC SYNTHETIC APERTURE RADAR (INSAR)**

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**ABSTRACT**

This study is based on Interferometric Synthetic Aperture Radar (InSAR) examination of subsidence of Quetta city and its peripheral area of Pishin. The study is comprised of eight images of Synthetic Aperture Radar sentinel 1A, S-1 IW data, from 2016-2018. Further, the displacement methods of time series were used for the estimation of current subsidence in the specific upper region. The study found the subsidence rate of 16.2cm/yr at 30°N that is a pretty serious deformation, which makes the area hazardous on the plate boundary, exceedingly subsidized area in the region. The cities of Quetta and Pishin are on formidable risk due to high rate of subsidence. This rate of subsidence is by reason of extensive discharge of ground water and, on converse, the absence of any source, other than rain, to increase the rate of water table of the region.

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**JUSTIFICATION OF LONGWALL MINING TECHNOLOGY FOR THE DEVELOPMENT OF KIESELGUHR  
DEPOSIT IN SIG MINE ALGERIA**

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**ABSTRACT**

The improvement of mineral extraction technology in underground mines to increase productivity has become an important objective of the mining industry in Algeria in the race for price competitiveness, especially after the sharp decline oil prices as the main income of Algeria. But the increase production in underground mines where the deposits do not have good mechanical characteristics is a major challenge for the decision-makers, as the case of the kieselguhr mine of sig (Western Algeria) which uses the Room and pillar mining method that do not fit the condition of soft deposits and do not have sufficient strength, which causes a lot of collapses from time to time. The only way to ensure the increase of production, by improving the method of extraction and efficiency of the equipment used. In this article, we will combine the Room and pillars mining method and use the technology of the longwall mining method to increase the production of the mine and ensures the safety of workers during operation.

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**PETROGRAPHY OF THE MESOZOIC ALKALINE ROCKS OF THE MEDVEDEV MASSIF (SOUTH YAKUTIA, ALDAN-STANOVY SHIELD, LEGLIER ORE CLUSTER)**

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**ABSTRACT**

The article considers petrographic compositions of the Mesozoic alkaline magmatic rocks of the Medvedey massif. The latter is a part of the Central Aldan ore district and is spatially located in the central part of the Nymnyr block. The massif is a multiphase structure, of the most productive stage of development of the territory – the Mesozoic tectonic-magmatic activation of the Aldan-Stanovoy shield. The main purpose of this work was to identify qualitative quantitative-mineralogical characteristics of the massif rocks, potential for gold mineralization, using crystal-optical methods. As a result of the field works and petrographic studies of the Mesozoic alkaline magmatic rocks, it was determined that, The Medvedev massif has a zonal structure and is represented by three phases of intrusion with distinct contacts between the latter, which rocks differ in structural and material features. The rocks of the first phase of the massif are composed considerably of leucocrate (the content of dark-colored minerals is up to 9%) syenite-porphyry with elements of the monzonite structure. Magmatic formations of the second phase of the massif differ from those of the first phase primarily in structural features and are represented by hypidiomorphic granular differences with an increased content of dark-colored minerals in the rocks up to 15%. The rocks of the final phase have a noticeable difference from the first two phases and are represented by mesocratic monzonite porphyry with a clearly expressed monzonite structure with a dark-colored mineral content up to 20%. Within the Central Aldan ore region, the large Samolazovskoye gold deposit is associated with similar multiphase massifs, in particular with the Yukhtin massif. During field works, it was found that gold-ore mineralization is associated with the massif, which formation is related to an intensively occurred contact-metasomatic effect on the host rocks. Hydrothermal-metasomatic transformations of the latter are the products of multi-stage alkali-silicate metasomatism, associated with the second and especially the first phases of intrusion of the massif, as well as with further weathering processes, disintegration of gold-ore metasomatites and formation of an oxidation zone. Based on the petrographic study of the material composition of the rocks of the massif, it is concluded that gold ore occurrences of commercial scale can be associated with such massifs of multi-phase intrusion.

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**CHEMICAL COMPOSITION OF THE MESOZOIC ALKALINE ROCKS OF THE MEDVEDEV MASSIF  
(SOUTH YAKUTIA, ALDAN-STANOVOY SHIELD, LEGLIER ORE CLUSTER)**

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**ABSTRACT**

The study shows chemical composition of the Mesozoic igneous rocks of the Medvedev massif. The massif is a part of the Central Aldan ore region. It is spatially located in the central part of the Nimnyr Block and is a part of the Leglier ore cluster. The massif is a multiphase structure of the most productive stage of the territory development – the Mesozoic tectonic-magmatic activation of the Aldan-Stanovoy shield. According to the materials of previous researchers, the rocks of the massif are represented by the augite hornblende and hornblende syenite porphyry. As a result of field work, we found that the massif has a zonal structure and is represented by three phases of intrusion. The rocks of the selected phases differ in their structural and compositional characteristics. The main objective of the work was to establish compositional characteristics by studying the chemical compositions of potential gold mineralization rocks of the Medvedev massif. In the course of studies and interpretation of chemical analysis of the massif Mesozoic magmatic rocks, we have identified the following characteristics. According to various classification data the following groups of rocks in Medvedev massif are identified – quartz syenites (Phase I), quartz monzodiorites of shoshonite series (Phase II) and monzonites of high-potassium calc-alkaline series (Phase III). The total alkali content ( $\text{Na}_2\text{O}+\text{K}_2\text{O}$ )>5% in them corresponds to alkaline rocks. All rocks are characterized by high  $\text{Al}_2\text{O}_3$ >14 and low  $\text{TiO}_2$ <1%. The potassium type of alkalinity  $\text{Na}_2\text{O}/\text{K}_2\text{O}$ <1 is typical for quartz syenites of the massif, while for quartz monzodiorites this indicator is intermediate, and in monzonites of the massif this parameter  $\text{Na}_2\text{O}/\text{K}_2\text{O}$ >1 corresponds to rocks of the alkaline potassium-sodium series. The massif rocks characteristic feature is the decrease of rocks alumina (al') values from quartz syenites to quartz monzodiorites followed by the increase to monzonites, while the value of the rocks AG coefficient is significantly reduced in the series. Based on these facts, it was suggested that there are two sources of the mantle and mantle-crustal nature. Also, based on the study of the material composition of the Medvedev massif magmatic rocks and the similarity of the geological development with the Mesozoic magmatism of the Samolazovsky and Ryabinovy deposits, it was concluded that gold manifestations can be associated with such multiphase massifs within the Leglier ore cluster.

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**BRINE CHEMISTRY CONTROL OIL RESERVOIR PRESSURE IN GIANT MISHRIF RESERVOIR,  
SOUTHERN IRAQ**

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**ABSTRACT**

The Mishrif Formation (Cenomanian - Early Turonian), regional shallow water limestone succession is the main reservoir in southern Iraq. It has been investigated hydrochemically and mineralogically at North Rumaila, South Rumaila, Majnoon, Zubair and West Qurna oilfields. The brine chemistry and mineralogical components of the oil reservoir were studied by using the Inductively coupled Plasma-Mass spectrometer (ICP-MS) in and the Scanning Electron Microscopy (SEM) coupled with Energy-Dispersive X-Ray (EDX) Spectroscopy. The brine salinity is very high, six-time greater than seawater and therefore it is playing a great role in generating additional pressure control the fluid flow accordingly. The pressure distribution was modeled via drawing maps of potentiometric subsurface of oil-water contact for each oilfield, and facilitated the marking of abnormal pressure (super-pressure) as an important location need to pay further attention during oil exploration for the future drilling.

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**CHARACTERIZATION OF LATE MIOCENE INJANA CLAYSTONE FROM MIDDLE OF IRAQ FOR THE BRICK MANUFACTURING**

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**ABSTRACT**

The aim of this study is to suggest an ancient clay for the manufacturing bricks as an alternative to the recent clays that are considered as agricultural lands. The Late Miocene claystone bed in the Injana Formation at middle of Iraq was targeted through 18 exposed sections that were sampled by using the trench sampling method. The samples are characterized by mineralogy dominated by quartz (36.4%) followed by calcite (32.8%), feldspar (2.6%), gypsum (0.9%) and dolomite (0.7%) in addition to clay minerals composed of kaolinite (10.1%), illite (7.7%), chlorite (6.7%), palygorskite (6.0%) and montmorillonite (1.2%). New Thermal mineral phases were formed at 950°C include diopside (35.6%), quartz (21.6%), wollastonite (11.4%), akermanite (11.1%), and gehlenite (2.3%). The engineering tests of the raw material showed the plasticity according to the Atterberg limits varies from low to high, low volumetric and linear shrinkage during drying and firing with a temperature at 950°C. The raw material produced bricks with 156 kg/cm<sup>2</sup> uniaxial compressive strength, 23.4% water absorption and nil to low efflorescence. The results indicate the success of the Late Miocene clay in the manufacture of bricks for medium to high quality within the A and B category based on the Iraqi standard specification No.25 in 1993.

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**MANUFACTURE OF PORTLAND CEMENT FROM LATE MIOCENE CLAYSTONE, INJANA FORMATION,  
CENTRAL IRAQ**

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**ABSTRACT**

The aim of this study is to provide a potential reserve of claystone for manufacturing the ordinary Portland cement industry. The thick bed of claystones exposed on Injana Formation cliffs was targeted. The main raw materials required for cement production are limestone and clay. The over-consumption of Recent clay for cement manufacturing stimulated the use of Late Miocene claystones alternatively which are added to the raw mixture of cement at a certain ratio to form the cement composition. Mineralogically, the Late Miocene Injana claystones are composed of kaolinite, illite, and chlorite, quartz, calcite, feldspar, and gypsum. The ratio 1:3 claystones to limestones provided a cement mixture has silica ratio (2.8), alumina ratio (1.94), silica saturation factor (0.9), hydraulic modulus (2.1) and lime saturation factor (90.2) and produced a clinker composed mainly of alite (51.67), belite (26.65), aluminite (9.65) and ferrite (8.4). A considerable reserve of the claystones was proved by this study.

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**IRON OXIDE CU-AU (IOCG) MINERALIZING SYSTEMS: THE EASTERN YAKUTIA (RUSSIA)  
PERSPECTIVE**

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**ABSTRACT**

Iron-Oxide-Copper-Gold (IOCG) are the worldwide economically attractive deposits with significant amount of iron oxides, copper minerals, gold and  $\pm$  silver and REE. In order to obtain more gold resources in Eastern Yakutia (Russia) we provide a descriptive model for IOCG style mineralization for several new prospective sites, which were initially discovered on satellite images and subsequently certified by prospecting. We allocate three basic Fe-oxide-Cu-Au deposit styles in Eastern Yakutia. First is related to Mesozoic hypabyssal intrusions of granodiorites (Kis-Kuel, Kysyltas and Rep-Yure deposits). As follows from the REE behavior in magmatic rocks, the fractionation of the magmatic melt during cooling was extremely insignificant. Due to this, a substantial part of the iron did not fractionate into high-iron melts, and separated into hydrothermal solutions with rich iron oxide mineralization. Second is related to flows of the basaltic and andesitic lavas of the upper Devonian – lower Carboniferous age (Khurat, Rosomakha and Jalkan deposits). Significant accumulations of hematite with copper and gold are associated with calc-alkaline basalts. The appearance of iron oxides in basaltic lavas is a result of decomposition of ilmenite into hematite and pseudorutile. Third style belongs to magnetite rich lavas of upper Jurassic age (Kildyam deposit). Variolithic lava flows saturated with native iron, magnetite, troilite and pyrite, native iron usually spherical in shape. Intrusion related ore bodies are irregular shaped breccias with arrays of variably mineralized veins and veinlets inside intrusives and veins in the host rocks. Associated with basaltic and andesitic lavas deposits occur as massive, tabular bodies, stratified, pyroclastic ores. The gold grade in IOCG ore varies from less than 1 to more than 50 g/t, base metals are optional. Differences in gold' fineness and admixtures characterize the genetic features of ore formation and is represented by a system of alloys: Au-Ag, Au-Ag-Cu and Au-Fe-Pd. Discovered iron-oxide copper gold mineralization in Eastern Yakutia analogous to several World class deposit types. Related to Mesozoic hypabyssal intrusions of granodiorites Kis-Kuel, Kysyltas and Rep-Yure deposits are close to Olympic Dam type. IOCG mineralization in basaltic and andesitic lavas of the Khurat, Rosomakha and Jalkan deposits looks similar to deposits of the Mount-Isa region (Eastern North-West Queensland, Australia). The Kildyam deposit rich iron-oxide ore bodies resemble lava flows and have share many common features with El Laco deposit in High Andes.



**HIGH REE AND Y CONCENTRATIONS IN MO-AU ORES OF THE KIS-KUEL IOCG DEPOSIT, EAST YAKUTIA (RUSSIA)**

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**ABSTRACT**

This paper presents the results of an updated from 2008-2019 study of the Kis-Kuel promising area and is devoted to the discovered unusual molybdenite + gold bearing mineralizing system of the Kis-Kuel Iron Oxide Copper-Gold deposit in Eastern Yakutia (Russia). Economic mineralization is localized within the apical zone of a granodiorite-diorite stock and is represented by hematite, goethite, quartz, chalcopyrite, molybdenite, arsenopyrite, pyrite, native gold and bismuth (no signs of any ore mineralization were found outside the Kis-Kuel intrusive). The intrusive has a Late Cretaceous crystallization age (K–Ar) of 103 Ma. The Mo-bearing quartz vein yields a mineralization age (Ar–Ar) of  $99.9 \pm 1.1$  Ma and is genetically relates to the granodiorite. Kis-Kuel breccia complex (KKBC) consists of a manto-type irregular shaped breccia body with arrays of variably mineralized veins and veinlets inside. The KKBC has a complete gradation from hematite-goethite altered granodiorites and more locally – diorites to intensely brecciated and hematite-goethite breccias. Multiple episodes of brecciating and veining with Fe-oxide-Cu-Au±Ag, porphyry Cu-Au±Bi, Ag-Pb and Mo+REE±Au mineralization occur in Kis-Kuel intrusive. In order to obtain more resources, the research Kis-Kuel target with IOCG mineralization was learn for molybdenum and rare earth minerals. Mainly it is quartz-bearing, Mo-Au-mineralized and strongly enriched in the rare earth elements (REE) material. The textures of REE minerals indicate crystallisation of monazite-(Ce) and xenotime as hydrothermal phases together with molybdenite and arsenopyrite. Analysis of quartz-molybdenite ore from the Kis-Kuel diorite-granodiorite intrusive shows previously unknown high concentrations of rare earth elements and Y, averaging 4.76 wt percent  $\Sigma\text{REE} + \text{Y}$ . Ore additionally contains 2.42 wt percent Mo, 8.8 g/t Au and 231 g/t Ag. We propose that one of the basic factors for mineralization styles at Kis-Kuel consists in the granitoids evolution and strongly differs from unevolved and mantle compatible compositions to highly evolved and fractionated intrusive rocks. The calc-alkaline evolution trend of the Kis-Kuel magmatic rocks, influenced on the accumulation of iron in ore. A significant part of the iron did not fractionated into high-iron melts, and separated into hydrothermal solutions with high grade gold concentrations. An extensively revised paragenetic model for Kis-Kuel deposit incorporates next four stages. Stage 1 was dominated by widespread brecciating and iron metasomatism, which converted granodiorite rocks to Fe-oxide-Cu-Au ore. Stage 2 comprises chloritic and sericitic alteration and associated systems of linear quartz veins with Cu-Au-porphyry and Au-Bi mineralization. Stage 3 includes sericitic alteration and veining with quartz-molybdenite-native gold-REE minerals. Stage 4 consists of Ag-Pb veins.



**CLUSTERING AND SCALING PROPERTIES OF SEISMICITY IN THE VRANCEA NEST AT THE SOUTH-EASTERN CARPATHIANS ARC BEND**

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**ABSTRACT**

The Vrancea zone, located at the sharp bend of the South-Eastern Carpathians in Romania, is a well-defined seismic region in a continental convergence area with unique properties and generating the most destructive subcrustal earthquakes in Europe. The purpose of the present study is to investigate the source parameters of the largest Vrancea subcrustal earthquakes occurred in the last ten years using the Empirical Green's function deconvolution and spectral ratios techniques and to analyze the scaling properties characterizing the Vrancea subcrustal seismicity. In the last ten years five intermediate-depth events with magnitude over 5 were recorded: April 25, 2009 (17:18, 45.68° N, 26.62° E, h=110 km,  $M_w = 5.4$ ), October 6, 2013 (01:37, 45.67° N, 26.58° E, h=135 km,  $M_w = 5.2$ ), September 23, 2016 (23:11, 45.70° N, 26.60° E, h=95 km,  $M_w=5.6$ ), December 27, 2016 (23:20, 45.70° N, 26.60° E, h=99 km,  $M_w=5.3$ ) and October 28, 2018 (00:38, 45.60° N, 26.40° E, h=148 km,  $M_w=5.5$ ). In order to apply the relative deconvolution techniques, we selected a set of Green's events in association with the main events, as co-located events. We considered in total 81 intermediate-depth earthquakes with moment magnitude  $M_w$  in the range 3.0 to 5.6, grouped in two categories: 17 main events and 64 empirical Green's events. The source time function and source spectrum as obtained through deconvolution for all the main events are relatively simple, compatible with a circular source model with homogeneous rupture process. This simple pulse-like function is typical for the Vrancea moderate-magnitude earthquakes as outlined by previous investigations as well. Also, the scaling properties highlighted in the present work are compatible with the previous ones: the linear scaling of seismic moment with local magnitude, increasing rise time and source radius with increasing seismic moment, a tendency of the stress drop to increase with earthquake size (however, this last result should be carefully taken into consideration having in mind the large errors in the stress drop estimations, due to the inherent errors in radius and the variability due to hidden parameters, like rupture velocity or source geometry). Finally, we discuss how the present results integrate in the previous investigations on the Vrancea intermediate-depth source and in the geotectonic modelling of the processes taking place in the mantle and generating such a confined and persistent seismicity.

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## **SOUTH CARPATHINAS: CONTEMPORANEOUS STRESS FIELD AND CRUSTAL SEISMICITY**

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The Southern Carpathians experienced several strong crustal earthquakes located along fault systems with a long geological history, which formed under specific tectogenetic conditions and were reactivated under the action of a complex stress field, controlled by different tectonic processes. Seismic activity is noted throughout the surface of the orthogenic chain but the frequency of strong earthquakes, with major macroseismic effects, is higher in their western extremity, along Cerna-Jiu and Moldova Noua-Oravita fault systems. However, the strongest earthquake known to date in the South Carpathians ( $M_w=6.4$ ,  $I_0=VIII^0$  Mercalli,  $h=28$  km) area occurred in the Brezoi Depression (Fagaras Mountains area) most likely on the Intramoesian Fault, as the focal mechanism and the directivity of the source expressed in the macroseismic field show it. The contemporary stress field, estimated from the inversion of focal mechanisms, is characterized by i) NE-SW oriented  $SH_{max}$  in the western part of the study region, with local variations showing a rotation to ESE and SE (Hateg Basin, Moldova Noua) and ii) NNE-SSW oriented  $SH_{max}$  in East (Fagaras area). The tectonic regime is mixed, transtensive but with the predominance of the strike slip faultings that have a large normal component. The reverse, compressive faults are in small numbers, concentrated mainly on the contact of the orogenic structures with the Moesian Platform (Getic Depression). In West is obvious the influence of the Adria Push towards NE controlled by in the Africa-Europe collision. In the Fagaras area the stress state is more complex with possible interferences with stronger local stress sources (e.g. active large faults, rheological conditions), probably even an influence of the deep processes in the Vrancea area, as can be speculate from the data of the recently obtained lithospheric anisotropy.

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**LATERAL VARIATIONS OF THE QUALITY FACTOR OF THE MEDIUM Q IN THE AREA FROM THE BEND OF THE SOUTHEASTERN CARPATHIANS**

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**ABSTRACT**

The shear wave attenuation in the crust, in the area from the bending of the Southeastern Carpathians, is investigated by using a recently developed procedure based on high-frequency waveform modelling. A non-linear inversion in spectral domain is applied to determine 1-D (depth dependent) models of the quality factor of the medium Q along individual travel paths, using local records of crustal low-to-moderate magnitude earthquakes. The area of interest comprises several juxtaposed structural units: the Carpathian Orogen, the sedimentary Focsani Basin (component of the Carpathian Foredeep), the stable Moesian and Scythian Platforms. The obtained Q-models show distinctive attenuative properties among the paths crossing different crustal provinces: high attenuation beneath the mountain range and the Focsani Basin, and high Q-values in the stable platforms. Several earlier studies investigating the seismic wave attenuation along travel paths from undercrustal earthquakes (depths greater than 60 km) occurred in the Vrancea region pointed out quite similar lateral variations, i.e. low Q-values at the stations above and near the intermediate-depth seismogenic zone, and high Q-values at the stations located on the platforms of the Extra-Carpathian area. These variations were mainly attributed to the structure and physical properties of the upper mantle. The present results evidence, however, that the heterogeneities of the crystalline upper crust and layers above have a significant contribution, which should not be neglected, to the attenuation pattern.

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**GEOCHEMICAL FEATURES OF THE COAL-DERIVED UNBURNED CARBONS IN COMBUSTION FLY ASHES FROM THERMAL POWER PLANTS IN BULGARIA**

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**ABSTRACT**

Coal combustion supplies 48% of the electricity generated in Bulgaria, with the combustion of 35.2 Mt of coal and producing annually about 10.4 Mt solid combustion wastes. In Thermal Power Plants (TPPs) the large part of coal mineral fraction is collected in cyclones (fly ash) to be stored in waste dumps or reused in building industry. Since coal fly ash is applied to many aims such as building industry, or landfilling it is essential to recognize its geochemical features too, apart from the technological ones. Few attempts have been done to characterize unburned organic matter present in fly ash in view assessment the possible impacts of organic matter on human health and the environment. The aim of the present study was: (i) to depict what organic compounds (if any) are present in industrial coal fly ashes from seven TPPs in Bulgaria; (ii) to assess the relationship of the compounds present with the source material using biomarker proxies; (iii) and, to appreciate biomarkers changes in distribution pattern caused by combustion. Samples from electrostatic precipitators of the TPPs were collected to track the changes. It was found that the compounds registered in the coal fly ash have two origins. The first group of them came from the main source fuel and the second one was formed in combustion process or their distributions were changed under the thermal treatment. However, it is not always easy to distinguish the particular group which a given compound belongs to. Often biomarker distributions are unchanged or only slightly changed by heat comparing to those of the source coal investigated. Short chain *n*-alkanes have dominated the distributions of biomarkers in extracts from unburned coal particles present in fly ashes studied. This feature was related to the high combustion temperature which caused thermal destruction of long-chain *n*-alkanes. The changes were rank depended and an attempt for relation to fly ash particles porosity was done.

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**EVOLUTION OF THE PHYSICO-CHEMICAL QUALITY OF THE GROUNDWATER OF KHEMIS MILIANA  
PLAIN - ALGERIA**

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**ABSTRACT**

This article is for goal with the study of the physico-chemical quality of groundwater, which makes it possible to specify the quantitative distribution of the various dissolved elements, to follow their spatio-temporal evolution and to determine the different inter-aquifer exchanges. The study is focused on the analysis of samples of five periods (2010/2011, 2011/2012, 2012/2013, 2013/2014, 2014/2015) at the level of the monitoring network of the tablecloth of Haut Chelif, the dosage chemical elements carried out in the laboratory of water chemistry, the National Hydrous Resources Agency (ANRH - KHEMIS MILIANA). According to the diagrams of Piper, Schoeller and Stabler we can say that the dominant ions are most often chlorides among the anions and calcium and Sodium among the cations. It can thus be seen that the waters of the studied region have two facies according to the direction of flow; it is chloric-calcic in the central part and chlorid-sodium in the western part, which is explained by the geological formations which are not the same in both parts.

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**STRUCTURAL ANALYSIS AND IMPACT OF NATURAL FRACTURING ON THE QUALITIES OF CAMBRO-ORDOVICAN RESERVOIRS IN THE NORTH AKAMIL FIELD, ILLIZI BASIN-ALGERIA**

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The Illizi basin is located in the south-eastern part of the Algerian Sahara. It extends over a North-South alignment of approximately 700 km. Its width exceeds 300 km and this up to the Algerian-Libyan Border. The flows tested in the Cambro-Ordovician units were much higher than the theoretical flows calculated from average properties of the matrix. This suggests a contribution of natural fracturing to production in these units. The target of this work is to determine the characteristics of natural fracturing present in the Cambro-Ordovician reservoirs of the In Akamil field, using well imagery, in order to estimate its impact on petrophysical parameters and on the flow of fluids. Analysis of the seismic profiles showed that the region underwent several phases of deformation which complicated the structure: a. A first compressive or transpressive phase in the Paleozoic cover. b. A second extensive phase which reactivated the pre-existing faults in normal play. It is likely that some reverse faults kept a residual throw from the previous reverse phase. c. The isobath maps revealed that the stretching of the structures is intense at depth. Analysis of the imagery data from the well allowed us to deduce that the nearest well to the major fault is the most fractured (105 fractures in total). The average density at this well is 0.19 (fractures / m) and the IV-2 unit in another well is the most fractured unit. Analysis of the petrophysical parameters revealed that the best permeability values were recorded in the IV-2 unit and the IV-1 unit with an average exceeding 100 md. The porosity and permeability histograms show unimodal and bimodal gaits, but in all cases the porosity is matrix. On the other hand, for the permeability 2 types were defined matrix permeability and fracture permeability. The low porosity and permeability values reflect a reduction of these two parameters caused by compaction and cementation.

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## **GASIFICATION OF WOOD CHIPS BIOMASS IN A FLUIDIZED BED REACTOR**

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### **ABSTRACT**

There is a growing interest to utilize biomass as renewable energy source due to the adverse environmental impact related to the use of traditional fossil fuels and their progressive depletion. Biomass gasification allows to produce a valuable gaseous product, called syngas, which could be utilized to obtain a wide range of products, extending from clean fuel gas and electricity to bulk chemicals, such as ammonia and methanol. In the present study, the effect of the equivalence ration (ER), i.e. the ratio between the oxygen content of air supply and that required for the stoichiometric combustion of the fuel fed to the reactor, on the performance of a bubbling fluidized bed gasifier (BFBG) was evaluated. The BFBG has a maximum feeding capacity of 750 kg/h of wood chips biomass. It is composed of a bubbling fluidized bed reactor, a cyclone, a heat exchanger, a wet scrubber and a flare. The experimental runs were carried out at two ERs (0.22 and 0.30), utilizing air as gasifying agent and by keeping fixed the fluidization velocity (0.5 m/s). Olivine was used as bed material (size range: 0.2–0.4 mm). Tables 1 reports the main chemical features of the biomass utilized in the gasification tests. The results show that the increase of ER from 0.22 to 0.30 determined the rise of bed temperature from 891 to 934°C, as a consequence of the great extension of the oxidation reactions promoted by the higher oxygen concentration in the reaction zone. This is confirmed by the syngas composition sampled at the wet scrubber exit. It is observed an increase in CO<sub>2</sub> (from 15.1 to 17.9%) and a decrease in CO (from 17.4 to 14.9%) concentrations. Another important effect due to the increase of ER is the dilution of the syngas as a result of the higher amount of nitrogen fed into the reactor through the gasifying agent. As expected, rising the ER from 0.22 to 0.30, the nitrogen concentration increases from 48.6 to 53.2%. The diluent effect played by the nitrogen leads to a reduction of the syngas lower heating value (LHV) as it decreases from 5930 (ER=0.22) to 4490 MJ/Nm<sup>3</sup> (ER=0.30). This is due to the lower concentrations of CO, H<sub>2</sub>, CH<sub>4</sub> and light hydrocarbons (C<sub>4</sub>H<sub>m</sub>) in the producer gas. On the other hand, the increase of ER has a positive effect on the syngas specific yield (SSY). It increases from 1.6 to 2.0 Nm<sup>3</sup>/kg<sub>biomass</sub>. The biomass gasification process has given promising performance producing a syngas of fair quality for energy applications.

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**AN IMPLEMENTATION OF GIS-BASED ROCK ENGINEERING SYSTEM METHODOLOGY FOR  
LANDSLIDE SUSCEPTIBILITY MAPPING IN UZUNDERE DISTRICT (ERZURUM, NORTH-EASTERN OF  
TURKEY)**

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**ABSTRACT**

Landslides are one of the natural hazards that often result in great loss of life and destruction of property. In order to decrease the threat of landslides, it becomes essential to develop a landslide susceptibility map. The main purpose of this research is to produce the landslide susceptibility mapping using Rock Engineering System (RES) method and Geographic Information System (GIS) for the Uzundere district, Erzurum province, North-Eastern part of Turkey. To this end, at the first stage, a landslide inventory map was prepared using previous reports, satellite images, and field investigations. Next, ten controlling factors such as slope gradient, slope aspect, altitude, plan curvature, profile curvature, lithology classes, vegetation cover, stream density, distance to the streams, and distance to the roads were selected to evaluate landslide susceptibility. Then, the weight value for each class of the controlling factors was determined using RES method based on GIS technique. RES is a semi-quantitative method that assigns each factor's classes a value between 0 and 4 based on the principles of Hudson (Rock engineering systems, theory and practice. Ellis Horwood, Chichester, 1992). Consequently, landslide susceptibility map was produced and classified into five classes such as very low, low, moderate, high, and very high susceptible zones. Finally, for verification, obtained landslide susceptibility map was compared with landslide inventory map using the Receiver Operating Characteristics (ROC) approach. The area under curve (AUC) was calculated and demonstrated reasonable performance. The produced susceptibility map can be used for safe land use planning and future landslide-related hazard management.

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**RARE HYDRATED MAGNESIUM CARBONATE MINERALS OF THE KIMBERLITE PIPE  
OBNAZHENNAYA, THE YAKUTIAN KIMBERLITE PROVINCE**

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**ABSTRACT**

The first discovery of hydrated magnesium carbonates, dypingite and nesquehonite, in the kimberlite pipe Obnazhennaya of the Kuoyka field, the Yakutian kimberlite province is described. The pipe is composed of kimberlite breccia with abundant diverse xenoliths of practically intact mantle rocks. Olivine in phenocrysts and mantle rock is generally intact. The main body of rock is carbonate-serpentine. Nesquehonite and dypingite are rare minerals and have first been observed in relation to kimberlites. The minerals were found in the bedrock outcrop of the Obnazhennaya pipe as white crusts up to 5 mm thick scattered over an area of a few tens of square meters. To identify and study the crusts we used the following methods: powder X-ray diffraction, electron microscopy, and Raman scattering spectroscopy. A comprehensive study suggests that the main minerals of these epigenetic formations are hydrated carbonates: nesquehonite  $MgCO_3 \cdot 3H_2O$  and dypingite  $Mg_5(CO_3)_4(OH)_2 \cdot 5H_2O$ . Also, Raman scattering spectroscopy revealed a small proportion of hydromagnesite  $Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$ . Hydrated magnesium carbonate minerals we found make a significant contribution to the collection of kimberlites. They are epigenetic in nature, with their origin being related to weathering of silicates, in particular serpentine. Mechanisms of carbonate formation appears to be close to that suggested by Wilson et. al., 2009, with  $CO_2$  being trapped from the atmosphere to form nesquehonite. In the case of the Obnazhennaya pipe, mineral solutions form when rainwater filters through the talus at the top of the outcrop. They are enriched in Mg from minerals and trap  $CO_2$  from the atmosphere. After filtering, solutions reach the vertical wall of kimberlite breccia where modern precipitation of nesquehonite upon evaporation occurs. Further, dypingite and hydromagnesite form via decomposition of nesquehonite. A lip extending over the rock wall significantly contributes to the development and stability of nesquehonite and dypingite aggregates. Crusts of nesquehonite and dypingite are not found on rock outcrops without lips at the top. Thus, despite the fact that intrusion of the kimberlite pipe occurred during the Jurassic (Zaitsev, Smelov, 2010), formation of nesquehonite and dypingite in association with kimberlite rocks continues in the modern time due to favorable environmental factors, first of all, a unique natural outcrop of kimberlite.

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**GEOCHEMICAL CHARACTERISTICS OF THE BARITE DEPOSIT AT BENI SNOUSS (NORTHWESTERN ALGERIA)**

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**ABSTRACT**

The barite mineralization occurs as veins with massive, coarse grains and breccia texture. These veins are present in Paleozoic basement (schists, quartzite by Hercynian granites) and Liassic cover (Limestones). The veins are related to fractures of NS to EW directions and range between 60 m and 100 m lengths and from 10cm to 3m in thickness. The important minerals of the veins, in the order of their abundance, are barite, pyrite, chalcopyrite, galena and sphalerite, and small amounts of Fe-hydroxides. Here, we report the results of rare-earth elements (REE) in the barite and fluid inclusions microthermometry trapped in barite, calcite and sphalerite. The REE concentrations were determined at ALS, Chemex, Canada, using an inductively coupled mass spectrometry. Microthermometric measurements were performed exclusively on liquid-vapour inclusions, on a Linkam THMSG-600 heating -freezing stage, at the Cergy Pantoise University. The analyzed samples are poor in REE, values for Barium range from 1000 to 4000 ppm, Cerium from 40 to 700 ppm, Niobium from 20 to 360 ppm and for Lanthanum 1.4 to 32 ppm. There is no clear separation between samples from basement and those from the cover, the exception of Ce and Pr, whereas the barite in the cover shows slightly higher REE for Ce and Pr. Fluid inclusions microthermometry indicates that the barite is formed from moderate salinity (21%equivalent NaCl) fluids at low temperatures between 120 and 160°C. These results indicate that the basement and cover barites are probably derived from hydrothermal fluids of the same composition.

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**NATURAL AMALGAM OF GOLD IN PLACERS OF THE EBELYAKH AREA – INDICATOR OF TECTONO-FLUID ACTIVATION (NORTH-EASTERN SIBERIAN PLATFORM)**

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**ABSTRACT**

The results of studying the typomorphic features of placer gold in the unique diamond-bearing placers of the Ebelakh river basin (Anabar diamond-bearing region) are given. Detailed study of the morphology, micro-relief of the surface and internal structure of the gold and photographing was performed using a scanning electron microscope JEOLJSM-6480LV. The gold fineness was determined using the Camebax-Micro microanalyzer and the JEOL OXFORD INCA-sight energy spectrometer. The internal structure of native gold was studied by etching gold in mounted thin sections using a proven method, using a reagent: HCl + HNO<sub>3</sub> + FeCl<sub>3</sub> × 6H<sub>2</sub>O + CrO<sub>3</sub> + thiourea + water. It is determined that, modern placer occurrences were formed mainly due to the redeposition of fine high-grade gold from ancient gold-bearing intermediate sources. At the same time, in the placer of the Kamenisty creek a natural amalgam of gold is discovered, which is an aggregate consisting of several cemented rounded gold particles of small size (<0.25 mm) of various morphology. The cement is superimposed medium-grade gold with Hg content of up to 13.3%. Its internal structure is porous, and zoning is noted due to the uneven distribution of Hg. The surface of mercury gold is characterized by a brain-like microsculpture. Along with this, in some placers of the studied area, it was possible to find small (>0.2 mm) gold particles with a specific surface with the thinnest (first microns) fringe of mercury (ртутистого) gold. Obviously, these are single grains of the disintegrated aggregates of auro amalgam. We also found gold particles in an aluminosilicate film of variable Al, Si, K, Fe composition, and the smallest (1-2 microns) mineral phases of gold, sphalerite, galena, zincite and zinc-containing iron are identified on this film. It is assumed that natural amalgamation of placer gold occurred as a result of migration of mercury-containing gold-bearing hydrothermas on fault zones during tectonomagmatic activation. Based on the above-mentioned, it is assumed that there are adjacent sources of supply – low-temperature hydrothermal ore occurrences confined to the faults and formed as a result of tectonomagmatic activation processes. This proposition is confirmed by the identification of hydrothermal-metasomatic formations of K-spar-quartz-pyrite composition with disseminated gold-sulfide mineralization on the studied territory. The similarity of geological conditions of localization and the material composition of apocarbonate hydrothermal-metasomatic formations of the Ebelyakh area with the gold-bearing rocks of the Central Aldan ore district allow to estimate positively the prospects for their further study.



**ORE GEOLOGY, (RE–OS) ISOTOPE GEOCHEMISTRY OF THE OROGENIC GOLD MINERALIZATION,  
VERKHoyANSK–KOLYMA FOLD BELT, NORTHEAST RUSSIA: IMPLICATIONS FOR ORE GENESIS**

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**ABSTRACT**

The paper presents the first results of investigation of the Re–Os isotope system of native gold from the Malo–Tarynskoe, Khangalas, Bazovskoe, and chalcopyrite from the Dvoinoe orogenic gold deposits in the central part of the Verkhoyansk–Kolyma fold belt, Northeast Russia. The deposits occur within the Kular–Nera terrane and are spatially related to NW-trending lithospheric-scale major brittle faults or controlled by subsidiary faults and fracture zones. Such zones served as pathways for fluids rising from below the crust, and they have a long tectonic and reactivation history. The Kular–Nera terrane consists of Upper Permian, Triassic, and Lower Jurassic clastic sedimentary-rock sequences, metamorphosed to initial stages of greenschist facies. Magmatism is manifested by Kimmeridgian–Berriasian S- and I-types granitoids and mafic dikes of the Tas–Kystabyt magmatic belt. Re concentration in gold varies from 0.439 to 6.997 ppb, and that of osmium – from 0.068 to 1.443 ppb. Chalcopyrite from the Dvoinoe ore occurrence contains 0.1522 ppb Re and 0.499 ppb Os. The Re–Os ages of gold from the Malo–Tarynskoe and Bazovskoe (Tithonian) and Khangalas (Valanginian) deposits are determined. Malo–Tarynskoe and Bazovskoe represent the earliest known orogenic gold mineralization in the Verkhoyansk–Kolyma fold belt. The data obtained permit us to correlate the initiation of orogenic gold deposits with the completion of formation of the Late Jurassic Uyandina–Yasachnaya volcanic belt, crystallization and subsequent cooling in the Late Jurassic–early Early Cretaceous of granitoid massifs of the Tas–Kystabyt magmatic belt, and subduction–collision events at the eastern active continental margin of the Siberian craton. Various mantle and/or crustal sources of the ore-forming material are established. The obtained initial Os isotope ratio ( $^{187}\text{Os}/^{188}\text{Os}=0.2210\text{--}0.4275$ ) in gold is inherent in the ore-forming material supplied from a fertile mantle-crustal reservoir, while that in chalcopyrite ( $^{187}\text{Os}/^{188}\text{Os} \approx 3.1904$ ) suggests a crustal source.

Corresponding Author: Valery Fridovsky



## **ENERGY POLICY UNTIL 2040 AND THE FUTURE OF HARD COAL IN POLAND**

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### **ABSTRACT**

The article presents the provisions of the Polish Energy Policy until 2040. The feasibility of achieving the eight basic long-term goals presented in the document was analyzed, i.e. optimization of own energy resources, expansion of energy production and infrastructure expansion, diversification of gas and oil supply as well as development of network infrastructure, development of energy markets, implementation of nuclear energy, development of renewable energy sources, development of heating and cogeneration, improvement of the country's economy energy efficiency. Mathematical models were used to verify the feasibility of these predictions. Forecasts were created whose accuracy was confirmed by means of an ex post error analysis. The rest of the models were also analyzed. Ultimately, the article presents only those forecasts that were subject to the slightest error. Particular attention was paid to renewable energy sources. Obtaining energy using fossil fuels is still more profitable and efficient. However, RES solutions are introduced due to the need to protect the environment and also because fossil fuel reserves will run out in a few decade. If the appropriate measures are not taken today, the demand for primary energy in the world will exceed energy supply in the future. The gradual introduction of renewable energy generation capacity will prevent a drastic jump in prices during the transition period and will allow the extension of the fossil fuels usage time. Renewable energy sources are therefore a safeguard for access to energy in the future. It was found that over the next dozen years Polish energy will continue to produce energy mainly based on coal. It is therefore necessary to use technologies that will allow efficient and clean coal burning. Therefore, the solution in this case may be the so-called Clean Coal Technologies.

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## **BIOSORPTION OF PHARMACEUTICALS FROM WASTEWATER USING MORINGA *oleifera* AS BIOSORBENT**

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### **ABSTRACT**

Pharmaceuticals as emerging contaminants have become one of the most controversial environmental issues at global scale. Over the years, it has increased the presence of antibiotics and anti-inflammatory drugs in rivers, lakes, oceans and even in drinking water streams. The wastewater treatment plants (WWTPs) lack the necessary technology to remove a concentration within the range ng/l-mg/l and therefore, the need to develop effective, low cost and environmental friendly methods arises. The term “Biosorption” is presented as a possible solution. It is a separation process, used in the area of Chemical Engineering, that follows the same fundamentals of adsorption except for the use of biodegradable materials as adsorbent (biosorbent). This work focuses on studying the main characteristics and adsorption capacity of Moringa *oleifera* (MO) to remove Diclofenac (DCF) and Oxytetracycline (OTC) from wastewater. Several tests have proven that in both cases (DCF and OTC), the adsorption processes showed high pH dependence. The first one governed by the mechanism of chemisorption while the second one could be controlled by diffusion of the particles between both surfaces. Kinetics essays were described by pseudo-first-order, pseudo-second order, and Intraparticle diffusion models. The experimental data of OTC and DCF removal were best fitted by Intraparticle Diffusion ( $R^2 > 0.95$ ) and pseudo-second-order ( $R^2 > 0.93$ ) model respectively. It was possible to obtain a removal of 88% for DCF at a pH of 2 and 50% for OTC at a pH of 10, indicating that MO represents a viable option for the removal of drugs from contaminated water.

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## **POSSIBILITIES OF DESIGN OF FLOOD PROTECTION MEASURES IN THE CATCHMENT**

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### **ABSTRACT**

The goal of the contribution is to present possibilities of a comprehensive and complex procedures for proper design of flood protection measures in several parts of Slovakia. The complex approach consisted of mutual integration of results of partial mathematical models – rainfall-runoff model, sewage system model, 1-D hydrodynamic modelling of open channel flow together with partially covered flows, 2-D hydrodynamic modelling of flooding the town residential area. All modelling works have been done in DTM coming from aerial photography or in conditions of detailed morphological and geodetic survey of investigated rivers basins. According to the modelling process appropriate preventive flood protection measures have been designed and afterwards realised in the territory, i.e. detention reservoirs in the mountain region above the urban regions. Designed flood protection measures should store the flood wave volume and mitigate the effect of flush floods on residential areas of small and even larger cities. Several case studies are presented in the contribution all over the Slovak Republic to emphasize the variety of flood wave progress, its reduction in discharge and postponing in time in different hydrological, morphological and geological conditions of mountain regions. Most of the presented proposals of flood protection measures have been projected and some of them have been already realized.

Corresponding Author: Andrej Šoltész



**U-Pb ISOTOPE GEOCHRONOLOGY OF SYNTECTONIC GRANITES FROM HAINAN ISLAND, SOUTH CHINA: CONSTRAINTS ON TECTONIC EVOLUTION OF THE EASTERN PALEO-TETHYS OCEAN**

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**ABSTRACT**

Since the recognition of the Indosinian orogeny in northern Vietnam, Triassic orogens have been widely identified around the western and southwestern boundaries of the South China block. The Paleo-Tethys sutures stretch from west to southeast, from Jinshajiang-Ailaoshan via NE Vietnam to Hainan Island; these sutures exhibit and develop voluminous Permian–Early Triassic magmatism and numerous high-strain shear zones. As ophiolites related to the Paleo-Tethys are lacking on Hainan Island, the eastward extension of the Song Ma suture and subduction and closure time of the Paleo-Tethys ocean on Hainan Island remain controversial. Here, an integrated kinematic and geochronological study has been conducted on two shear zones, called the Xiaomei and Mangsan shear zones, on Hainan Island. Kinematic indicators suggest oblique sinistral shearing for the NNE-trending Xiaomei shear zone. U-Pb zircon dating yields an age of Early Triassic (252-251 Ma) for Xiaomei syntectonic granites, which are used to constrain the Indosinian collisional orogeny on Hainan Island, and their genesis may be related to the closure of the Paleo-Tethys ocean. The kinematic indicators observed in the NE-trending Mangsan shear zone also show oblique sinistral shearing movement. The Mangsan gneissic granites with middle Permian ages (264-262 Ma) formed in the same tectonic setting as the Wuzhi-shan granites that were proposed as I-type granites. These middle Permian gneissic granites (272 - 260 Ma) with arc affinity on Hainan Island may represent an arc setting related to the NW subduction of the Paleo-Tethys. The analyses reveal that granites with Late Triassic ages (235-232 Ma) in the Xiaomei shear zone have characteristics of A-type granites. The Late Triassic extensional events on Hainan Island may be related to subduction of the Paleo-Pacific Plate beneath the East Asian continental margin.

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## **INFLUENCE OF AGGREGATES MICROSTRUCTURE ON TAILINGS BEHAVIOUR**

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### **ABSTRACT**

Conventional constitutive soil models applied in geotechnical engineering have been developed using the phenomenological approach from the macroscopic observations and application of continuum mechanics. Despite the adopted simplification and homogenisation of complex interactions of soil particles, water and air, the phenomenological models and the underlying principles have been proven to satisfactorily describe the stress-strain conditions in most common soils. However, the application of the conventional soil behaviour models has been proven to be difficult in the mining industry and tailings storage facilities in particular, where the structural integrity of the storage facilities often depends on the performance of extensively altered materials (tailings) that are produced as a waste product from ore processing. The difficulties stem from the altered nature of the tailings and the inconsistencies in the tailings deposition, which may result in the formation of porous and brittle matrixes of heterogeneous aggregates. Such matrices are susceptible to static and dynamic liquefaction whereby little changes in the stress-strain conditions can result in a sudden collapse of the soil structure. Sampling and preservation of intact delicate tailings is often unachievable, and the analyses of the laboratory tests are obscured by the simplifications, assumed homogenisation of the sample and the inherent influence of the testing apparatus on the measured properties. Therefore, the characterisation of the *in situ* conditions of the tailings and the prediction of the tailings performance for altering stress-strain conditions using conventional soil behaviour models is very difficult. Yet, understanding the delicate state of the brittle tailings is crucial for upstream and centrally raised tailings storage facilities. This is exemplified by the facility failures which featured devastating consequences in Brazil in 2015 and 2019. These failures were caused by liquefaction of tailings which acted as foundations for the upstream raised embankments. This paper discusses the differences between naturally occurring soils and tailings, the difficulties encountered in tailings characterisation and the influence of the tailings micro-structure on the macroscopically observed behaviour. This paper also shows that, using modern optical and other testing methods, the micro-structure can be measured and then allowed for in the soil behaviour model with the aim to improve the reliability of tailings liquefaction assessment.

Corresponding Author: Jiri Herza



**PETROGRAPHY AND MINERALOGY OF GRANITOIDS OF THE ELIKCHAN MASSIF (NORTH-EAST OF THE VERKHOYANSK-KOLYMA OROGENIC REGION)**

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**ABSTRACT**

The article presents the results of a study of Elikchan granodiorite-granite massif with complex Sn-Au-Ag mineralization. It is shown that the massif localized in the zones of regional fault, where it was preceded and followed by subaerial volcanic outpourings. Considered typomorphic peculiarities of rock-forming, accessory, and restituir minerals of granitoids and petro - and geochemical features of the rocks. A polygenetic nature of the massif is documented, with origination of parental melts of the amphibole-biotite granodiorites and granites from the lower and upper crustal protoliths, respectively, under the influence of deep heat and fluid fluxes rising from the metasomatized mantle to the magma-generation level. Geochemical specialization of granitoids on a wide range of ore elements characteristic of latite ore-magmatic systems has been established (Bi, As, Sb, Ag, Sn, W). It is shown that the crystallization of the granodiorites took place in conditions close to those of gold-bearing ore-magmatic systems, and the crystallization of the granodiorites took place in conditions close to those of gold-bearing ore-magmatic systems, and the crystallization of granites in the conditions close to those rare-metal ore-magmatic systems, what obyashnyat preformationist associated mineralization. An important criterion for the potential ore content of specific magmatic formations and its possible implementation is the regime of volatile elements.



**POSTOROGENIC GRANITOIDS OF THE POLOUSNY RANGE (NORTH-EAST OF THE VERKHOYANSK-KOLYMA OROGENIC REGION)**

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**ABSTRACT**

The article considers the petrology of postorogenic Albian subvolcanic granites of the North-Elikchan and Upper-Elikchan massifs of the South-eastern part of the Polousny synclinorium, which involved Au-Ag and Sn-W mineralization. Structural and textural features of magmatic rocks indicate a multievent pulsation intrusion of a granite melt. Typomorphic features of minerals of the rocks: the presence in rhyolite and granite porphyry of restites of pyroxenes, identical to pyroxenes of derivatives of basite - hyperbasite associations, chromium-containing native iron, zircons of crust-mantle morphotypes D and J, and the presence of globules of rhyolite composition in the matrix of dikes of trachidolerites formed after subvolcanic granites, indicate the interaction of crustal granite melt and alkaline-basic mantle melt in the process of evolution of magmatism. Crystallization of the granite melt at the early magmatic stage under conditions of high activity of oxygen, water and chlorine caused the formation of Au-Ag ore occurrences. During the late-magmatic stage, crystallization proceeded from water-saturated melt under conditions favorable for the formation of rare-metal mineralization with leading part of the borum. Subvolcanic and host rocks are transformed into quartz-tourmaline greisen with topaz and fluorite, tourmaline-containing exogreisens and tourmalinites, and are penetrated by quartz veins with cassiterite, wolframite, and arsenopyrite. The sharp increase of the borum content is presumably related to the supply of volatiles from an external mantle source.



**ASSESSMENT THE ROLE OF EXPANDED-POLYSTERENE BLOCK AND GROGRID LAYER ON  
BEHAVIOR OF BURIED PIPELINES**

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**ABSTRACT**

Geogrid layers and expanded polystyrene blocks have widely been implemented in geotechnical projects, recently. This paper investigates the behaviour of buried pipelines through experimental and numerical analyses by implementing an expanded polystyrene (EPS or geofoam) block and a geogrid layer over the buried pipe rested in a trench and imposed by trench surface loading. In this regard, a 3-D finite element model were created using ABAQUS software which verification and material characteristics have been derived from experimental results. The results indicate that the behaviour of buried pipelines can be ameliorated by employing EPS geofoam blocks; however, the compressible inclusion character of EPS blocks has a side effect of more surface subsidence of buried pipe trenches. Also reinforced soil cover with geogrid and geofoam has a considerable impression on amending the maximum surface settlement and maximum pipe crown displacement values.

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**THE EFFECT OF GEOCELL REINFORCED EMBANKMENT CONSTRUCTION ON THE BEHAVIOR OF BENEATH SOIL LAYERS USING NUMERICAL ANALYSIS**

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**ABSTRACT**

Geocell soil reinforcement method is became one of the common improvement method used in different aspects of geotechnical engineering. The experimental investigation using physical modelling is somehow complicated and needs more financial support specially when using saturated or partially saturated soil. That's why nowadays, researchers are trying to use updated numerical methods to simulate the soil behaviour considering above conditions. In this paper, Geocell reinforcement method in embankment construction has been studied using Mohr-Coulomb model. The embankment is overlaid on two layers of soil with different moisture content conditions. The first layer beneath the embankment is a five-meter layer of dry soil and second layer considered fully saturated soil. The results indicate that embankment reinforcement by Geocell has no significant effect on the excess pore water pressure while the settlement and stress distribution beneath the embankment is highly affected.

Corresponding Author: Omid Khalaj





**MINERALOGY, GEOCHEMISTRY AND LOCALIZATION OF REGIONAL PYRITIZATION ZONES –  
CONSTRAINTS FROM EARLY MESOZOIC DEPOSITION IN CHAY-YUREYA FAULTS OF THE KULAR-  
NERSKY TERRANE, NE RUSSIA**

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**ABSTRACT**

The Early Mesozoic clastic rocks the Kular-Nera terrane in the Verkhoyansk-Kolyma orogenic belt, northeast Russia, exhibit regional sulfidization zones. The most abundant mineral of the zones is pyrite. However, its origin (sedimentary-diagenetic, metamorphogenic-hydrothermal, metasomatic) and contribution to formation of economically important gold deposits remain debatable. Localization of the sulfidization zones is still poorly understood. We have studied geological-structural and mineralogical-geochemical features of pyritization zones in bedrock outcrops on Khara-Yuryakh creek (right-side tributary of the Nera river) within the Kular-Nera terrane, Verkhoyansk-Kolyma orogenic belt. The pyritization zones are distant from the known gold deposits, and they extend along the 1000 km long and 7-10 km wide Chay-Yureya regional fault. The deformation structure of the clastic rocks of the Chay-Yureya fault is defined by different-aged fold-thrust and strike-slip elements. The early deformation are isoclinal and tight folds up to a few hundred meters wide, with rounded and sharp crests and subhorizontal hinges. The early folds were refolded so that their crests may be seen on the limbs of later folds of the same NW strike. These are commonly inclined or, more rarely, recumbent folds. Also present are late folds associated with dextral and sinistral strike-slip motion on the Chay-Yureya fault. The sulfide mineralization of the Chay-Yureya fault is represented by disseminated idiomorphic pyrite crystals 1 to 10 mm in size. Metapyrites exhibit a cataclastic microtexture complicated by later corrosion processes. They contain zircon, rutile, and monazite microinclusions entrained in the process of growth. Microinclusions of galena, sphalerite, chalcopyrite, and other late sulfides are confined to defects in the pyrite grains. Chemical composition of the pyrite was determined on a Camrebox-Micro microanalyzer, using a standard X-ray spectral analysis (DPMGI, SB RAS, Yakutsk). Most of the grains have a stoichiometric composition. 30 percent of analyses showed excess Fe. Typomorphic trace elements found in pyrites are Co, Ni, As, Sb, and Cu, with the total amount of 0.1 to 0.4%. Metacrystals of the pyrite demonstrate variations in the concentration of trace elements, which after leads to chemical zonality. Our investigations showed that pyritization zones of the rocks are localized in the trans-crystal Chay-Yureya fault which served as a transit path for ascending regional fluid flows. Typomorphic trace elements in pyrite metacrystals include Co, Ni, Sb, As, and Cu. They are characterized by low concentrations and non-uniform distribution. Zonality in the distribution of trace elements is attributable to the poly-stage growth of pyrite metacrystals. The diagenetic stage was accompanied by accumulation of Co, As, and Sb in the central zones of crystals, while during the metamorphogenic-hydrothermal stage Ni and As were accumulated in the outer zones.

Corresponding Author: Lena Polufuntikova

**HEAT FLOW IN SW OF GALICIA AND NW OF PORTUGAL. THE INTERPRETATION OF A SEISMIC ANOMALY**

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**ABSTRACT**

Four heat flow density values and five temperature-depth profiles were obtained in a heterogeneous region considering heat flow by conduction in the vertical direction, and heat sources in the crust due to radioactivity decay. The heat produced in the upper layers of the crust was obtained based in gamma-ray charts and published data of laboratory radioactivity measurements on samples taken from the region. Seismic data were used to obtain the thickness of the different layers of the upper and middle crust and the depth of the Moho discontinuity considered coincident with the crust/mantle boundary. The heat flow at the surface is obtained by adding the heat flow from the mantle with the heat generated by the radioactive sources in the crust. The method was applied to a region with one measured heat flow density value (Ourense) and four points without any heat flow density measurement. A heat flow value from the mantle was obtained with Ourense data. A special attention was given to a region (A) with a seismic anomaly near the surface. The anomaly was explained by mass deficit near the surface that gives rise to an abnormal density value and an increase in seismic wave velocity values. The decrease in density is due to the presence of water in the region forming an aquifer. Geothermometer values obtained from samples of water in the thermal springs of Tuy (Spain) and Monção (Portugal) were used as the water temperature at the bottom of the aquifer. Isostatic balance in the region was considered to obtain density values and the amount of water in the region. Thermal conductivity and radioactivity heat source values in the region were obtained considering the amount of water in the region. Values from 86 to 95 mW/m<sup>2</sup> were obtained using the same value of heat flow from the mantle. This is due to different values of heat produced in the crust due to different thickness layer values or/and to different heat production values.

Corresponding Author: Maria Rosa Duque



**GEOMAGNETIC ANOMALIES REGISTERED IN THE IBERIAN PENINSULA BEFORE A TIME PERIOD  
OF INTENSE SEISMIC ACTIVITY**

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**ABSTRACT**

Geomagnetic data registered by Geomagnetic Observatories of Almeria, Coimbra, San Fernando and Toledo, located in the Iberian Peninsula and Tenerife in Canary Islands were used to study geomagnetic field anomalies from August 1968 to March 1969. Data used were obtained in Annals of the Observatories as average hourly values of the magnetic declination and horizontal and vertical components of the magnetic field. Magnetic field disturbances were studied using average monthly values, average daily values and average hourly values. The anomalies were quantified using IGRF model values and monthly average hourly values of the Observatories data. During the time period of our study four earthquakes of magnitude equal or higher than 3 are registered in the seismic catalogue with two epicentres in the Gibraltar Region and two epicentres in the Gulf of Cadis. In the early hours of February 1969 an earthquake of high magnitude ( $M=8$ ) was felt in Portugal, Spain and North-Western Morocco. Near two hours later, another earthquake of magnitude 6.5 was recorded. In that day 32 earthquakes were recorded in the region. In the second part of the work, a special attention is given to the earthquake of February 10<sup>th</sup>, 1969, due to the location of this epicentre and the temporal proximity of February 28<sup>th</sup>. The magnetic field in the region suffered three strong magnetic disturbances during the month of February in 1969. The earthquake of February 10<sup>th</sup> occurred just before the start of the second interval of intense magnetic perturbations. The third time interval of intense magnetic disturbances occurred before and during February 28<sup>th</sup> day. The analysis made using hourly values to time intervals including the earthquake occurrence (five earthquakes) shows “equal values” of magnetic anomalies occurring in time intervals of three hours. Strong variations of the horizontal field occurred before the earthquakes of February 10<sup>th</sup> and February 28<sup>th</sup>.

## CHEMICAL COMPOSITION OF ASHES FROM SELECTED SECTIONS OF THE LIGNITE SEAM MINED IN THE KONIN BASIN, CENTRAL POLAND

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### ABSTRACT

The first Mid-Polish lignite seam (MPLS-1) is mined from the Konin Basin in central Poland. The lignite is then burned in mine-mouth power plants to produce electricity. It is characterised by an average ash yield in the range of 9.7–17.6 wt% on a dry basis ( $A^d$ ) in three selected sections representing three currently operating lignite opencasts: Drzewce, Józwin IIB and Tomisławice. Ash is an undesirable component of lignite because it can have an impact on the environment during combustion and waste utilisation as well as on the potential use of lignite in so-called clean technologies. Hence, knowledge about the chemical composition of lignite ash is very useful. The lignite samples were first burnt in an oven at 850 °C; next, mixed and averaged samples were subjected to chemical analyses according to ASTM D6349-13 standard. The tests were conducted using inductively coupled plasma-optical emission spectrometers (ICP-OES) at the Central Measuring and Research Laboratory in Jastrzębie-Zdrój (Poland). The results obtained included the following oxides:  $Na_2O$ ,  $MgO$ ,  $Al_2O_3$ ,  $SiO_2$ ,  $K_2O$ ,  $CaO$ ,  $TiO_2$ ,  $Mn_3O_4$ ,  $Fe_2O_3$ ,  $P_2O_5$  and  $SO_3$ . In addition, the concentrations of other elements were determined: Ag, Zn, Ba, Cd, Co, Cr, Cu, St, Ni, Pb, V, Mo, Sn, Sb, As, Rb, Be, P, Tl, Li and S. In the analysed ash samples,  $SiO_2$  has the highest content (47.6–54.8 wt%), followed by  $CaO$  (30.9–33.5 wt%),  $Al_2O_3$  (1.92–2.35 wt%) and  $SO_3$  (0.43–2.11 wt%). The remaining oxides were present in an amount less than 1 wt%. However, among the chemical elements, the highest contents were: S (1739–8448 ppm), P (491.3–1238 ppm), Ba (798.5–2046 ppm), Sr (361–1102 ppm) and Cu (100.5–270.9 ppm). On the other hand, the most harmful elements was Pb (61–84.6 ppm), followed by As, Be and Cd (< 4 ppm). Despite some differences between the lignite opencasts, their ashes have a similar chemical composition for oxides and concentrations of individual elements. These ashes can be described as silica-carbonate ones due to the predominant content of  $SiO_2$  and  $CaO$ .

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**TECTONIC AND SEDIMENTARY DEFORMATIONAL STRUCTURES WITHIN THE FIRST MID-POLISH  
LIGNITE SEAM – KONIN BASIN, CENTRAL POLAND**

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**ABSTRACT**

This paper focuses on deformational structures seen at macro and mesoscales within the first Mid-Polish lignite seam (MPLS-1) currently exploited by the Konin Lignite Mine. In fact, the majority of examples presented herein come from the Józwin IIB and Tomisławice opencasts. The deformations are divided into two groups; they are tectonic and sedimentary ones. The first group includes deformations of the floor, faults, cleats, and seismically-induced structures such as breccia and deformed lamination. The second group covers compactionally-induced deformations of MPLS-1 roof, sedimentary breccia, and slumps. All these deformations are described and then briefly interpreted in this paper. Although, in a few cases in the formation of sedimentary deformations, the contribution of the tectonic factor as a trigger mechanism seems obvious. This is supported by the fact that the mentioned lignite seam is mined in the areas of grabens that were tectonically active during the development of the Mid-Miocene mires in the Konin Basin.

Corresponding Author: Marek Widera



**MULTIDIMENSIONAL COMPARATIVE ANALYSIS AS A TOOL FOR ASSESSING THE LEVEL OF DEVELOPMENT OF ENERGY MARKETS IN SELECTED EUROPEAN COUNTRIES**

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**ABSTRACT**

The most important factor affecting the economic development of societies is access to electricity at an acceptable price. The constantly developing economy generates an increasing demand for electricity. The energy raw materials used for energy production are diverse in the European Union countries, hence the assessment of the level of development of energy markets is a multidimensional problem. This article undertakes comparative studies on determining the level of sustainable development of energy markets in selected Member States. Sustainable development of energy markets is a phenomenon characterized by many variables that simultaneously concern various aspects including environmental, economic, technical and technological and social problems, which means that sustainable development can be described by many different variables, the number of which can reach up to several dozen. In this case, comparative analysis using traditional methods becomes impossible. The multidimensional analysis method was used to classify countries into homogeneous clusters in terms of the level of development of energy markets. Multidimensional comparative analysis, or MCA for short, deals with methods and techniques for comparing and analysing multi-feature objects. MCA is a formally coherent set of statistical methods for purposeful selection of information about elements of a certain community and detection of regularities in the mutual relations of these elements. MCA is an interdisciplinary method that uses achievements and methods used in other fields. Multivariate comparative analysis is a method in which the analysis is performed in many stages and in many directions. Research results indicate the position of the energy market development in Poland in comparison to selected Member States.



**IDENTIFICATION OF DIAGNOSTIC VARIABLES FOR RESEARCH INTO THE LEVEL OF DEVELOPMENT OF ENERGY MARKETS**

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**ABSTRACT**

The development of the economies of European countries depends on stable and permanent access to various energy sources such as: oil, gas and coal. Securing the certainty of the necessary minimum energy supply in each country is a basic condition for the energy security of the state and its citizens. The current status and the most probable scenario for the power industry sector shows that the global demand for power will increase between 2000 and 2030 at a rate of 1.8% per year. The energy market in the European Union is under the process of internal integration. Energy transformation requires changes in the structure of energy production in the energy balances of member states in order to achieve the assumed environmental goals. Monitoring the transformation process is a scientific problem in which taxonomic methods are used. The aim of the article is to identify diagnostic variables for comparative analysis of the level of development of energy markets in selected European Union member states. International Atomic Energy Agency United Nations Organizations present an original set of 41 indicators for sustainable energy development, which can be divided into groups such as: indicators on energy resources, efficiency of their use, and environmental pollution during the exploitation of energy resource and energy production technologies, economic indicators, accessibility to energy for society, energy dependence. Based on forty-one indicators, the availability of data for testing was analyzed. Finally, diagnostic variables were selected for which the available data was collected from the Eurostat database and transformed to the level required in the research. The research results will present the level of development of the Polish energy market in relation to other countries and differences in this respect.





**CAREFUL URBAN RENEWAL IN KREUZBERG, BERLIN: INTERNATIONAL BAUAUSSTELLUNG  
BERLIN 1987**

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**ABSTRACT**

International Architecture Exhibitions reinforce the negative idea of pre-established formal concepts in favour of a discussion rich in alternatives and with different thinking processes. *Behutsame Stadterneuerung* – careful urban renewal is established after a long conflict between the political and administrative system in power and construction cooperatives, which has its decisive moment in 1975. The urbanism of the modern movement started to be abandoned and the building industry connected to the promotion of houses, often closely related to political parties, started to decay. The refurbishment and revival of a very specific neighbourhood with a significant plan in Berlin called for measures to interweave and reorganise the old and the new, but also houses and industries. In this area, there was the proposal of creating a better ecological quality that preserved the traditional atmosphere and sought ways to incorporate the political efforts to integrate foreign families. The program “careful urban renewal” was seen as a planning in close connection to the local situation in order to harmonise total and individual conditions. The conditions related to the urban space and the building should be connected to the social assumptions of daily life. This research is focused on the process developed in Kreuzberg, and it provides a general sense of the difficulties that occur in the framework of “careful urban renewal” program. This big district of Berlin used to be a central area of the city, but it became a peripheral area of West Berlin, due to the political division of the city. The neighbourhood would become one of the areas appointed for IBA, whose role was to regenerate and revive the old substance of Kreuzberg and to rebuild the urban fabric, particularly building houses and social amenities.

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**PRESENT SEDIMENTARY ENVIRONMENT AND HYDRODYNAMIC CONDITIONS OF THE WESTERN BLACK SEA SHELF ON THE BASE OF BOTTOM SEDIMENTS ANALYSIS (MANGALIA PROFILE)**

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**ABSTRACT**

Western Black Sea shelf of the Mangalia profile was studied during the NIRD GeoEcoMar expedition (MN-199) in the summer of 2019 from a sedimentological, faunal and environmental quality point of view. The granulometry of the bottom sediments was analysed by laser diffractometry, using “Mastersizer 2000E Ver. 5.20”, Malvern, and analyser. The values of the grain size analyzes showed sediments composed predominantly of sands, with the secondary muddy fraction. Among the sandy subfractions, the most common is “very fine sand”, in the majority of cases. The percentages of mud increase with the distance to the sea. Thus, the location MA-08, located further offshore, contains in the range 2 - 11 cm sediments of “sand silty clay” type (according to Shepard diagram, 1954), which alternate at the top with sediments of “clayey silt” and “sandy silt” type. The most abundant subfraction in the majority of samples in this location is “very fine silt”. Location MA-04 contains “sandy silt” type sediments, with “fine silt”, the most representative subfraction, and the other locations, MA-02, MA-03, MA-10 and MA-11, located much further from the shore, they are made up of sediments alternating between “clayey silt” and “sandy silt”, with fine and medium silty subfractions best represented. The interpretation of the data resulting from the grain size analyzes (percentages of clay, silt, sand and textural parameters) highlighted the dynamic conditions in which these specific to the shelf environment sediments were deposited. The textural parameters were calculated according to the original formulas Folk and Ward (1957), using the Gradistat program (Blott & Pye, 2001).

Corresponding Author: Bogdan-Adrian Ispas

**METALLOGENIC SPECIALIZATION OF THE PRECAMBRIAN CRYSTALLINE COMPLEXES IN THE TYRKANDA TECTONIC ZONE BETWEEN GRANULITE TERRANES OF THE ALDAN-STANOVOY SHIELD (NORTH-ASIAN CRATON)**

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**ABSTRACT**

The study of the composition of the Precambrian crystalline complexes raised and exposed along the margins of the North Asian craton allows us to characterize the conditions of formation and clarify metallogenic typification of the geological structures of various stages of the evolution of the lithosphere. Based on these data identification of the promising metallogenic zones and local potentially ore-bearing objects can also be achieved. The goal of the research was to characterize the chemical composition features of geological complexes in the Tyrkanda tectonic zone between the granulite terrains of the Aldan-Stanovoy shield in the south of the North Asian craton. The object is interesting due to the presence of a large number of different types of metamorphic and magmatic rocks. Complex geological structures with numerous stages of intensive ductile and brittle deformations of various kinematics are observed. As part of the research for the rocks of the zone, the petrographic observation was done and chemical composition was studied. Characteristics and typification of rocks were carried out. Reconstruction of the primary (premetamorphic) types of rocks was performed using the methods of Predovsky and Neelov. Cluster analysis of geochemical data was performed. The excess of background concentrations of chemical elements in clusters were calculated. According to the calculation results, metamorphosed ultramafic and mafic rocks of tholeiitic magmatic series form a single cluster. These rocks are richer with indicator elements for diamond and precious metals. Short description of the probable types of mineralization in these rocks was provided. The most promising for precious metals surrounding areas was determined.

Corresponding Author: Alexander Kravchenko



**MAPPING OF FOLDS AND FAULTS IN METAMORPHIC COMPLEXES OF THE CENTRAL ALDAN AND  
PRIKOLYMA TERRANES USING GEOPHYSICAL DATA**

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**ABSTRACT**

The study of the structure of the Precambrian crystalline complexes raised and exposed along the margins of the North Asian craton allows us to characterize the geological features of various stages of the evolution of the lithosphere. Based on these data identification of the promising metallogenic zones and local potentially ore-bearing objects can also be achieved. The goal of the performed research was to create objective models of the areas characterized by presence of mineral deposits to identify characteristic and promising structures. Using modern geoinformation systems the maps of the high gradient zones of the local components of geophysical fields have been created. These maps reflect the boundaries of geological complexes with contrasting physical properties. For clarity, geophysical background was removed from the maps, and only zones of high gradients of various geophysical fields were left. A combination of maps was performed and it was found that high-gradient zones of the various geophysical fields complement each other along the strike. Based on the obtained geophysical schemes, geological maps and field observations of geological structures, already known and new folds and faults have been deciphered. As a result, models of folds and faults that control the location of mineral resources were created. Models allow to find the common features and to evaluate the minerals prospects of areas. In the framing of the Upper-Timpton dome of the Central-Aldan superterrane and in the Shamanikhin fault zone of the Prikolyma terrane there are many high-gradient zones of the various geophysical fields observed. New ore objects can be expected to be discovered in these areas.

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**USING A DIGITAL RELIEF MODEL FOR SEARCHING FOR PRIMARY SOURCES OF GOLD IN  
METAMORPHIC COMPLEXES OF THE EVOTA REGION (ALDAN-STANOVOY SHIELD, NORTH-ASIAN  
CRATON)**

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**ABSTRACT**

Placers of precious metals and other mineral resources are associated with uplifted basement of the North-Asian craton and metamorphic terrains near at its borders. The complex geological structure of these territories does not allow to make obvious conclusions about the sources of the placers. One of the areas of the southern outcrop of craton basement, the Evota gold-bearing region of the Aldan-Stanovoy shield, was studied. Analysis of morphology of native gold selected from creeks of the region and eluvium from one of the primary deposits show that, grains with similar morphological features occur. Probably, not far from the points of sampling, primary sources are located. Possible erosion and sediment removal should be occurred in positive forms of relief. Therefore, an attempt to determine location of primary sources by modeling positive forms of relief, where erosion occurs and removal could be manifested, was made. The methodology for modeling these forms using modern geoinformation systems was considered and attempt to analyze the obtained results was made. Digitized relief maps (topographic base) of the area and sample points with discovered gold were a basis for the calculations. Further steps were: building a surface of relief as a regular network of highs, calculating directions and slope angle of surface, building a map of removal vectors, construction a path with a maximum slope upward from the point with gold particles discover. Lines of positive forms of relief confined to gold discover points were constructed as a result. Field works for identifying signs of gold content in these lines and point sampling of rock debris were carried out. Microprobe analyses of rock debris were performed. Minerals of gold and silver were discovered in the debris. The obtained data shows that this method of analysis can be useful for deciphering ore-bearing structures and searching for primary sources.

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**ANALYSIS OF TECTONIC ORE-CONTROLLING FACTORS USING OF GEOPHYSICAL DATA ON THE  
EXAMPLE OF THE ELKON ORE DISTRICT (ALDAN SHIELD, NORTH-ASIAN CRATON)**

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**ABSTRACT**

The author investigated the gravitational and the magnetic fields of the Elkon ore unit. The gold-uranium deposits of the Elkon ore district this is unique of his scale and matching with biggest ore units of world. The study of the regularities of forms, location and direction of extension of tectonic ore-controlling structures in magnetic and gravitational fields, the study of their transformation using Surfer 8, Koscad 3D and ArcGIS. As a result, the author obtained get two-dimensional autocorrelation functions, local and regional components of geophysical fields, and their gradients. According to the results of the TDAF calculation of the magnetic field, two systems of linear anomalies of the northwest and northwest-west strike have been identified, the orientation of which coincides with the systems of linear disturbances of the ancient formation and updated into Mesozoic tectono-magmatic activation, respectively. To study the second-order gravitational anomalies, the TDAF of their local component was calculated. As a result of the procedure, submeridional and northwestern strike of geological structures were revealed. It has been established that the northwestern strike is characteristic of plicative and disjunctive tectonic disturbances, submeridional - to the junction of the Elkonsky horst anticlinorium and the Upper Yakokut graben. The most informative transformations of fields are regional component of the magnetic field and local component of the gravitational field. The regional component of the magnetic field is represented by elongated linear anomalies of sub-latitudinal orientation in the southern part of the region and northeastern in the central. On the diagram of the local component of the gravitational field, the axes of plicative structures are clearly traced. The axes of anticlines and synclines correlate with positive and negative gravitational anomalies, respectively.

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**GEOLOGY, GEOCHEMISTRY AND MINERALOGY OF THE GNEISSIC TRONDHJEMITES, TONALITIES, GRANODIORITES AND RELATED ROCKS WITHIN THE PROTEROZOIC IDZHEK-NUIAM AND TYRKANDA FAULTS OF THE ALDAN SHIELD (NORTH ASIAN CRATON)**

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**ABSTRACT**

In this paper, the results of studying rocks of trondjemite, tonalite and granodiorite compositions are presented. On the Aldan Shield such rocks of different age levels are known on all terrains and in zones of tectonic melange. One of such zones is Tyrkanda mélange zone, which is restricted by the Idzhek-Nuiam and Tyrkanda faults. Researched magmatic rocks, which undergone the process of polymetamorphism in granulite, amphibolite and greenschist facies, earlier by some geologist was defined as paragneisses and (or) intrusive rocks. In this paper based on geological and geochemical data argue the magmatic nature of rocks and identity to the calc-alkaline series. The series consists of gabbros, diorites, quartz diorites, granodiorites, tonalites and trondhjemites. Contents of the rock-forming oxides and rare earth elements in these rocks are close to the widely known early Proterozoic gabbro-diorite-tonalite-trondhjemite series of the South-West Finland. These features indicate the probability of formation of the researched rocks with the participation of the subduction. As a result of studies established what in Mariin complex possible inclusion of rocks and bodies from other sites such as Ust-Timpton, Idzhek-Seym and Upper-Gonam pluton. The features of the Mariin series include the linkage with the long-lived faults and associated dynamometamorphic changes of the bodies, polymetamorphism, superimposed chemical changes in the composition of primary rocks, as well as rarely preserved migmatite veinlets in the host rocks. Geochemical similarity of trondhjemite-, tonalites, granodiorites Mariin series and associated rocks with well-known early Proterozoic differentiated series of southwest Finland typical for the Proterozoic and Paleozoic continental margins suggests that the plutons of the Mariin series formed in an active continental margin setting.

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## **PICROILMENITE FROM KIMBERLITE PIPES OF CENTRAL YAKUTIA**

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### **ABSTRACT**

Picroilmenite is one of the most important indicator minerals of kimberlite rocks, which can be used in solving petrological problems and in the search for diamond deposits. The present study shows the results of studying picroilmenite grains from the Manchary and Aprelskaya pipes within the Khompu-May kimberlite field (Central Yakutia). The rocks composing the pipes are represented by porphyritic kimberlite and kimberlite breccia, between which there are gradual transitions. Rocks forming the upper pipe horizons are highly carbonatized and supergenetically altered. Porphyritic segregations are represented by carbonatized serpentine pseudomorphs from macro-, megacrysts and olivine phenocrysts. Pyrope, chromospinel and picroilmenite macrocrysts are found in both pipes. Most weakly altered parts of mesostasis are microgranular and are formed mostly by phlogopite, with xenomorphic segregations of calcite and serpentine. Picroilmenite in both kimberlite bodies occurs as irregular and rounded macrocrysts ranging from 0.7 to 25 mm. Micrograins of this mineral was not diagnosed in the mesostasis. Individual grains of picroilmenite from the Manchary pipe are surrounded by a polymineral border composed of either ferrosphenel and magnetite, or perovskite and magnetite. High- and low-chromium varieties which correspond to two parageneses are identified among the picroilmenite macrocrysts from the Manchary pipe. Crystallization trend of high-chromium ilmenites from the Manchary pipe is clearly seen in the diagram in the coordinates  $Fe_2O_3$ - $FeTiO_3$ - $MgTiO_3$  and associated with the presence of Cr-rich phlogopite from lherzolites xenoliths that are not found in the Aprelskaya pipe. High-chromium ( $Cr_2O_3 > 1\%$ ) macrocrysts from the Aprelskaya kimberlite pipe are more magnesian in comparison with similar grains from the Manchary pipe. Picroilmenite from both pipes in the coordinates  $Fe_2O_3$ - $FeTiO_3$ - $MgTiO_3$  is characterized by a magmatic kimberlite trend of the mineral composition evolution. The distribution of mineral composition points from the studied pipes in the diagram in the coordinates  $MgO$  -  $Cr_2O_3$  has form of the "Haggerty's parabola" (Haggerty, 1975) - typical for picroilmenites from kimberlites of industrially diamond-bearing middle Paleozoic pipes of Yakutia (Aikhal, Mir, Udachnaya). In general, picroilmenite of Central Yakutia pipes differs from picroilmenite of Aikhal, Mir and Udachnaya pipes by the presence of the parabola right branch in the Haggerty diagram and an indistinct left branch. The Aikhal, Mir, and Udachnaya pipes are characterized by a clear demonstration of the left branch and a weak right. At the same time, the composition points of the high-chromium picroilmenite variety from the Manchary pipe in the Haggerty diagram coincide with the high-chromium picroilmenite from the Griba kimberlite pipe (Arkhangelsk diamondiferous province). Thus, the study showed the genetic polygeny of picroilmenite from Mancary and Aprelskaya kimberlite pipes, and also the correlation with mineralogical diamond potential of both pipes traced by comparison with the known industrial ilmenite diamondiferous pipes of Yakutia and Arkhangelsk region.

Corresponding Author: Nikolay Oparin





## **QUANTIFYING PERMEABILITY AND HYDRAULIC CONDUCTIVITY OF THE SURFACE CLASTIC SEDIMENTS**

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### **ABSTRACT**

The surface soil properties control the groundwater aquifers system characterizations. Quantifying and measurements of these parameters are a challenging attempt in arid region like the United Arab Emirates (UAE), Al Ain, Al Ain and Al Suleimei Valleys in Al Ain city. Permeability and hydraulic conductivity of clastic sediments play crucial role in surface water seepage. Soil's permeability depends on number of factors such as the size of soil grains, the properties of pore fluids, the void ratio of the soil, the shapes and arrangement of pores and the degree of saturation. To assess these features, detailed field and laboratory studies such as soil sample collections, sieve analyses and permeability tests (constant head permeameter) were carried out. Hydraulic conductivity of both valleys were approximated from grain size analyses of collected soil samples. The average permeability varies from 0.796 to 2.120 cm/s for Wadi Al Ain and from 0.567 to 2.133 cm/s for Wadi Al Suleimei and the hydraulic conductivity ranges between 0.209 and 6.401 cm/s and 0.348 and 0.641 m/s for wadies Al Ain and Al Suleimei consequently. The results indicate variability of the permeability and hydraulic conductivity in both study areas. On the other hand, both wadies indicate similarities in their lower and upper range of measured and estimated permeability and hydraulic conductivity values. This study reveals changeability of the surface soil characteristics and provides an idea how the surface water moves down to recharge the shallow aquifer. Such an experimental works is unique and certainly supply valuable information for the municipal and decision makers for groundwater resources and their recharge possibility. In addition, this study will minimize or prevent the possible environmental risk and hazards treating for the study area today and/or in the future and offer reliable and practical information to scientists and decision makers.

Corresponding Author: Hasan Arman



## **SIMULATION OF THE DISPERSION OF SUBSTANCES RESULTING FROM GAS EXPLOSIONS**

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### **ABSTRACT**

Directive 2014/34/EU of the European Parliament and of the Council regulates the placing on the market of equipment and protective systems intended for use in potentially explosive atmospheres. The importance of using explosion-proof equipment (certified in compliance with provisions of standards for electrical and non-electrical equipment) is crucial for avoiding catastrophic explosion-type events which may result in human victims, important material losses or may have significant consequences upon the environment. The current paper addresses a possible scenario of a pressure vessel explosion and the computational simulation and analysis of the dispersion of hazardous substances (toxic or explosive) released in the environment following the explosion-type event, in order to highlight the possible consequences. Such computational simulations may be of benefit for employers, who wish to take proactive measures in order to increase the occupational health and safety level within their activity. In this regard, results of computational simulations can be integrated by the companies in the development of emergency response plans, aiming at minimizing the hazardous effects of the releases of toxic/explosive gases upon the workers and surrounding atmosphere.

Corresponding Author: Vlad Mihai Pasculescu

**SOIL MOISTURE SIMULATION IN SELECTED AUSTRIAN CATCHMENTS WITH THE USE OF THE  
CONCEPTUAL SEMI-DISTRIBUTED RAINFALL-RUNOFF MODEL TUW**

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**ABSTRACT**

Nowadays, the rainfall-runoff (r-r) hydrological models are daily used for modeling of the hydrological balance, floods, or drought seasons. However, for all r-r models is difficult to find a correct model structure that will describe a difficult flow transformations process. For the decades the r-r models were tested with many calibration procedures and different model structures. In this paper, we focused on the soil part of the r-r model TUW. For the calibration, we used a lumped and semi-distributed model version in order to compare soil moisture and discharge simulation. We also compare results with measured data. For that purpose, we used soil moisture data from remote sensing. In recent years, remote sensing plays a huge role in the surveying of hydrological phenomenon. Remote sensing of soil moisture data can be very helpful because measuring the soil moisture in nature is not always possible. Quality of remotely sensed data rising each year, these days we can use data with good spatial and temporal resolution. We calibrate the TUW model for three selected catchments with flat hypsometric characteristics. Both, the lumped and semi-distributed version performed well in the discharge simulation. In the case of soil moisture simulation, we find slightly better results from the semi-distributed version. We compare results against measured data from remote sensing, which can be also a problem because remote sensing sensors still have a problem with clouds and snow.

Corresponding Author: Martin Kubáň

**COMPARISON OF SNOW COVER OCCURANCE USING TWO TYPES OF HYDROLOGICAL MODEL  
TUW**

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**ABSTRACT**

Recent rapid development in hydrological sciences is markedly related to the development of mathematical modeling and its application in engineering practice, e.g. for the purposes of hydrological forecasting, the extrapolation of hydrological data in time and space as also estimation of hydrological extremes. Simulation of water balance is also important for effective water resources management. Snow represents an important component in runoff processes. Snow is included in vertical precipitations; it is a specific form of solid-state of water. Snow precipitation fundamentally affects the water balance and belongs to important elements in the hydrological cycle. Snow cover is significant as water supply mainly in mountain regions. Basic snow cover characteristics are a bulk density of snow, snow water equivalent, and height of snow cover. This paper is focused on a comparison of snow cover occurrence simulated in lumped and, semi-distributed conceptual, TUW rainfall-runoff models, with measured values for selected Austrian river basins. For the comparison two types of catchments with flat, and hilly characters were selected. The results show that the semi-distributed version of TUW model got better accuracy in a simulation of snow cover occurrence on both, flat and hilly catchments, what can be caused by a better resolution of the model.

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**EUROPEANISATION OF ENERGY POLICY AND AREA-BASED PARTNERSHIPS: REGIONAL DIVERSITY OF INTEREST IN RENEWABLE ENERGY SOURCES IN LOCAL DEVELOPMENT STRATEGIES IN POLAND**

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**ABSTRACT**

Cross-sectoral, area-based partnerships, known as Local Action Groups (LAGs), are a key pillar of the European Union's Community-Led Local Development approach in member states. LAGs prepare bottom-up territorial strategies, having a relatively high degree of freedom to set their own development goals and the scope of the activities for which they receive EU funding. In this sense there is clear potential for LAGs to implement local scale initiatives around Renewable Energy (RES). To understand the scope and extent of such bottom-up initiatives in Poland, we analyse the regional diversity of operations in RES in the local development strategies of 324 LAGs prepared for the EU Programming Period 2014-2020. We took into consideration all types of LAG operating in Poland. Specifically, we analysed whether local communities planned to undertake educational actions or investments related to RES in their strategies. Content analysis shows a relatively low interest in this subject by the communities analysed at the time their strategies were prepared. Across the country, educational activities were planned in 13% of strategies and investments in only 9% of them. Renewable energy education or investment operations were most frequently planned in the LAGs strategies in the Podlasie (in almost 70% of documents), Warmia-Masuria (33%) and Łódź (28%) provinces. Activities of this type had the least interest in the Kuyavia-Pomerania, West Pomerania and Świętokrzyskie provinces. The relatively high regional differences were probably due to the individual policy of the voivodship (regional) authorities. We discuss the possible causes of this apparent lack of interest in RES among local communities in the context of EU-wide efforts for a low-carbon economy. Possible reasons for the low local interest in RES may relate to the levels of education and income of local communities. These factors are likely to have hindered the diffusion of RES innovation, especially in marginalised rural areas. Alternative policy instruments, or more precise targeting of rural development funding to sustainable energy may be needed to accelerate the transition to low-carbon energy sources in these regions.

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## THE METHOD FOR PRELIMINARY ENRICHMENT OF GOLD-CONTAINING ORE

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### ABSTRACT

In recent years the separation of the tails with minimal content of valuable components at the processing of the minerals before expensive enrichment has attracted considerable attention. This will be favourable for increasing the ore enrichability as well as significant reducing the costs of the further operations for enrichment. The samples for investigation have been taken from the gold-containing polymetallic ores of Georgian Bektakari deposit (Bolnisi district) with the content of gold – 5.61g/ton, of lead – 1.65%, of zinc – 2.43%. At the preliminary preparation of the samples the following was taken into consideration: the crushing of the coarse-grained fragments to the classes of +8, 8-3 and 3-0 mm; separation of the 8-3 mm class from the crushed fragments and their enrichment for obtaining of the tails on the modernized high-frequency diaphragm precipitating machine (Georgian Patent #U 2018 1962 Y) of improved construction. The novelty of the machine lies in the fact that together with the main oscillation, frequency of water oscillation, water discharge) the additional controlling parameters are introduced in the process, such as water low-amplitude high-frequency oscillations, velocity of water downflow. The first one is obtained as the result of the impacts of eccentric axis and diaphragm frame. It should be also noted that the above-mentioned oscillations reduce the frictional force between the suspended grains. As the result the minerals of various density freely move in their own layers, increasing the efficiency of the minerals separation. In the second section of the precipitating machine the enhanced velocity of water downflow is obtained by compressing of the spring fixed on the frame which imparts the various accelerations to the minerals of the different densities and is favourable for their efficient separation. Along with it, the compression of the spring enhances the force of the frame impact as well as the frequency of low-amplitude oscillation. In the course of the investigations on the enrichment of 8-3 mm classes, when the amplitude of water main oscillation comprised:  $A=16$  mm, oscillation velocity  $n = 420$  rpm and water discharge was 5.5 l/min, in the second section of the precipitating machine the product was obtained by the yield – 22.3% by gold content  $Au=0.4$  g/ton. On this basis the mentioned product may be isolated. It may be considered as the tails and the investigation on the enrichment may be performed for residual product. On the basis of the analysis of experimental data the action of the controlling and disturbing parameters for the control of precipitation process was revealed. The optimal control of the process is performed by the requirements of technological criterion: retention of such vales of controlling parameters which provide the maximum content of gold (minimum content of gold in the tails) in the concentrate in spite of the variation of distributing actions. For this reason, the goal function and mathematical model were derived on the basis of which the method for automatic control was elaborated.

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**DETERMINATION OF THE SAMPLING SIZE FOR THE RELIABLE IDENTIFICATION OF ORGANIC CROPS BY INDUCING SUBLETHAL EFFECTS IN BENEFICIAL INSECTS**

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**ABSTRACT**

Among the main innovations in olive growing, the conversion of cultivation practices towards organic agriculture stands out. Since organic crops are subject to the granting of economic subsidies by the Spanish Ministry of Agriculture, this has given rise to fraudulent situations, masking the use of conventional pesticides in "fake organic" crops. To investigate alternative methods, complementary to analytical chemists, that can provide reliable information to discerning organic crops from those subject to synthetic pesticides is the aim of this research. A new technique is being developed, based on the induction of sublethal effects on the beneficial insects, through the experimental application of a commercial insecticide on a small scale, in the target crop. The effect triggered by the insecticide can be monitored by means of a yellow sticky trap device, installed for each olive tree, which allows to observe deviations in its capture rate from what occurs in the absence of insecticide (control) and finally verifying if the populations of beneficial insects affected in the olive grove, whether or not they are accustomed to the toxic action of the insecticide. Obviously, in order to maintain environmental integrity in the supposed ecological target olive groves, this induction test should be applied on the smallest scale as possible, thus reducing the application area of the pesticide, which implies adjusting the sample size to a minimum, maintaining an acceptable reliability in the estimates. During the autumn of 2017, six plots of 7x7 configuration, were selected in an olive grove in the province of Jaén (southern Spain), three of these were treated with Dimethoate, while the remaining were considered as control. After treatment application, sticky yellow traps were installed (one in each of the olive trees), thus allowing a maximum of 49 repetitions per plot. Among the identified beneficial insects, the most abundant species was *Aeolothrips intermedius*. Taking this species as a reference, the results indicate that the differences between treated and control parcel were statistically significant from a minimum sample size of 17 replications onwards. In coincidence with the above, the results have allowed to determine that the minimum size of the experimental target plot, to obtain acceptable population estimates (relative error of up to 10%), would require a minimum area of at least 100 m<sup>2</sup>, representing a minimum number of 17 olive trees. These results provide a reasonable statistical basis for suitably adapting the methodology that allows acceptable estimates, therefore, the application of this methodology of detection of organic crops would require a very small area, equivalent to a practically insignificant number of olive trees, so it would not compromise the ecological quality of the target plantation.

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## **USING LANDSLIDE HAZARD MAPS TO DETERMINE CRITICAL INFRASTRUCTURE ASSOCIATED RISK**

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### **ABSTRACT**

Infrastructure services are essential for raising and maintaining people's quality of life. The risk associated with the landslides in Romania, involves more material risk than human. Usually no human loss is reported connected to the landslides in Romania, but on the other hand a lot of material losses are reported. In that case when we speak about human risk we have to speak about the number of affected people that can mean either one person, or an entire community affected by the landslides. Broken roads, interrupted utilities, no access to transportation, to healthcare, schools, or jobs, can affect people for a long period of time. It is very hard to define how long and how much (speaking of time and money) a community can be affected by large landslides. Usually the most vulnerable social categories are the poor people, because of their informal settlement in an area affected by natural hazards, their low resources and low capability to recover. One of the main uses of the landslides hazard maps should be a better way to estimate the infrastructure risk in order to establish how much a community can be affected by landslides. The modern tools like GIS, databases, and open sources can help produce a good inventory of areas affected by landslides and establish the infrastructure risk. The entire infrastructure (transportation network, utilities) became critical in terms of losses. The study case is located in an old coal mining site where the hilly geomorphological features and mining activities induced a lot of landslides. The community is mostly made up of low income families with most working men being employed as mining workers. The landslide's damage on the critical infrastructure has a domino effect on decreasing the quality of life in the area. The paper work introduces the concept of the systemic hazard, which means a superposition of a natural hazard, a technological hazard and the existence of critical infrastructure. It is not enough anymore to use in landslide hazard study the concept of only one natural hazard. It is more accurate to take into consideration a systemic hazard.

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**DEEP STRUCTURE OF THE EASTERN MARGIN OF THE SIBERIAN CRATON, NE RUSSIA:  
EVIDENCE FROM ANALYSIS OF AN ANOMALOUS GRAVITATIONAL FIELD**

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**ABSTRACT**

The paper presents the results of a study of anomalous gravitational field of the Verkhoyansk fold-and-thrust belt. The belt is located on the eastern margin of the Siberian craton and represents the frontal part of the accretion-collision Verkhoyansk-Kolyma folded region (Northeastern Russia). The base of the fold-thrust belt is the pre-Mesoproterozoic crystalline basement, overlain by sedimentary strata. The purpose of this study is to clarify the features of the deep structure of the Verkhoyansk fold-and-thrust belt based on an analysis of modern geological and geophysical data. According to the results of the analysis of the gravitational field  $\Delta g$ , the Yana, Tompo-Gornostakh gravity maxima and the West Verkhoyansk, Derbekin and South Verkhoyansk gravity minima are identified. Regional anomalies  $\Delta g$  reflect relatively upstanding and downdip blocks of the Verkhoyansk fold-and-thrust belt basement. The maximum subsidence of the surface of the crystalline basement is observed in the South Verkhoyansk sector, the minimum – in the Sette-Daban tectonic zone. The Adycha-Elgin tectonic zone is characterized by a heterogeneous block structure of the basement. In the area of the Kitchansky uplift, a subvertical scarp is identified in the crystalline basement relief. Gravitational anomalies corresponding to magmatic plutons and regional fault structures are identified. The confinement of anticlinoria of the West Verkhoyansk sector to local gravitational anomalies of a negative sign is noted. The correlation of the boundaries of tectonic zones with linear alternating anomalies  $\Delta g$  is determined.

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## **ARTIFICIAL NEURAL NETWORKS FOR THERMAL SENSATION PREDICTION IN CYPRUS**

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### **ABSTRACT**

Thermal sensation is a rational experience usually expressed as hot or cold that is used to assess thermal environments. Thermal sensation may affect behavioural features and health resulting in socioeconomic impacts in societies. Models for assessing thermal sensation have been developed and validated, while several methods for their calibration have been suggested, in order to improve their performance in the various climates. Artificial neural networks (ANNs) are increasingly utilized as an alternative to model complex patterns, such as thermal sensation. The present study developed ANN models for predicting thermal sensation based on field survey data. The data were collected in field-questionnaire surveys conducted in three seasons (summer, autumn 2019 and winter 2020) in outdoor public places in Cyprus. Environmental variables were monitored while asking participants to report their thermal sensation (i.e., actual thermal sensation, ATS) on a predetermined seven-point scale (namely, -3, cold; -2, cool; -1, slightly cool; 0, neutral; +1, slightly warm; +2, warm; +3, hot). An automated mobile station recorded 1 min averages of meteorological data at the height of 1.1m above the ground. Pedestrians were also asked to report additional subjective attributes using a structured questionnaire. About 2,509 questionnaires were utilized in the analysis. ANN models were trained to predict ATS using as input a number of different feature vectors, consisting of the measured air temperature (Tair), relative humidity (RH), wind speed (WS), grey globe temperature (Tglobe), gender, clothing insulation (Icl), the reported main activity (i.e., lying, sitting, standing, walking, doing sports) during the last half hour before the interview and the season. Three ANN models were implemented using a feed-forward multi-perceptron architecture with two, three and four hidden layers and different number of neurons per layer. Overall, six different feature vectors were tested as inputs to the three ANN models and the performance of all combinations, in terms of the prediction error was averaged over 100 executions, each with random splitting of the available data into train (75%) and test (25%) dataset. Results showed that the best performing feature vector was the one consisting of Tair, RH, WS, Tglobe and Icl, followed closely by the vector considering Tair, RH, WS, Tglobe, Icl and activity. This result was consistent in all three ANN models. The inclusion of gender or season into the feature vector, caused deterioration of the prediction error. The ANN model with two hidden layers performed marginally better than the ANN with three hidden layers and significantly better than the ANN with four hidden layers. The best performing feature vector achieved average ATS prediction error equal to 1.4 points of the 7-point scale, involving 25% of the predictions with 0 error, 33% with error equal to 1 and 25% with error equal to 2 points.

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## MEASUREMENT BY ADV METHOD AND INDICATOR METHOD FOR DETERMINATION OF THE FLOW CONDITION IN THE VÁH RIVER

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### ABSTRACT

One of the basic information about hydrodynamics of a stream is its flow conditions – discharge and flow velocity. The paper deals with the discharge and flow velocity in a cross-section profile determination by two different methods: ADV method (Acoustic Doppler Velocimeter) by means of FlowTracker device (SonTek / YSI) and indicator method (tracer experiments) by means of sodium chloride (NaCl). In principle, ADV device is used to measure the flow velocity (in the our case by 3D probe) at various locations within a cross-section profile of a stream and the area to which each measurement refers is determined as well. Indicator method requires the instantaneous release of a known tracer concentration, and the subsequent measures of the tracer concentration in a downstream cross-section profiles measurement section. There were determined and compared the discharge value, mean velocity of discharge cross section ( $v_m$ ) and section velocity ( $v_s$ ) - mean velocity between two cross-section profiles. Measurements were carried out in four cross-section profiles in the Hron River (various distances → 414, 558 and 741 meters). Results showed, that values of discharge measured by ADV device are lower than by indicator method. When it comes to  $v_m$ , values obtained by ADV device are lower than the  $v_m$  values of obtained by indicator method for the first and second cross-section profile. In the third cross-section profile the situation is reversed. This fact is valid for to the  $v_s$ . Values obtained by indicator method are higher for second and third cross-section profile.

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**APPLICATION OF GRAIN SIZE ANALYSIS FOR SATURATED HYDRAULIC CONDUCTIVITY  
ASSESSMENT OF BED SILTS ALONG KOMÁRŇANSKÝ CHANNEL – ŽITNÝ OSTROV**

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**ABSTRACT**

The objective of this study is the evaluation of permeability of the bed silts located along the Komárňanský channel of Žitný ostrov, Slovakia. Komárňanský channel is the largest one from three main channels at Žitný ostrov area – the flat lowland with channel network. The bed silt permeability is expressed by value of saturated hydraulic conductivity. This parameter is one of the key inputs for estimating solute and water movement between surface water channel and surrounding groundwater in the scope of their interaction at this area. The bed silts were obtained by two ways, as disturbed samples and as undisturbed samples. In this study we deal with disturbed samples extracted from Komárňanský channel and for that reason only the empirical formulas based on the grain size analysis could be used for saturated hydraulic conductivity assessment. The disturbed samples were extracted in three levels of silt - top, middle and bottom part of silt layer and subsequently as mixed samples in each selected profile of the Komárňanský channel. The selection of sampling place was made by thickness of bed silt in the measured profiles. The values of bed silt saturated hydraulic conductivity from disturbed samples  $K_d$  were calculated according to three empirical formulas: 1. Bayer – Schweiger formula; 2. Špaček I formula and 3. Špaček II formula, firstly for samples from the top, middle and bottom part of the silt layer and then for mixed samples. The valid values  $K_d$  from single parts of the silt layers reached from  $1.44 \times 10^{-07}$  to  $1.74 \times 10^{-05} \text{ m s}^{-1}$ , the valid values  $K_d$  from mixed samples reached from  $2.96 \times 10^{-07}$  to  $2.05 \times 10^{-05} \text{ m s}^{-1}$ . According to results of comparison of  $K_d$  from single parts of silt layers and  $K_d$  from mixed samples it is not possible to assess explicitly the reliability of saturated hydraulic conductivity value set by that way. Therefore, in the next step, it will be necessary to compare these results with the values of bed silt saturated hydraulic conductivity from undisturbed samples determined by the laboratory falling head method.

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**INFLUENCE OF AQUATIC VEGETATION ON DISPERSIVE PARAMETERS AS A PART OF  
HYDRODYNAMIC CONDITIONS IN NATURAL STREAMS**

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**ABSTRACT**

Submerged and emergent vegetation in a river is a natural and organic component of all processes in the natural rivers and streams. It plays an important role in all physical, chemical and biological processes in the stream biocoenosis. This type of vegetation has also a non-negligible impact on flow conditions. It influences the discharge, hydraulic resistance, velocity as well as other hydraulic parameters. Important part of the river hydrodynamic processes are also dispersive processes and its parameters, which defines the speed and intensity of the dispersive processes in the natural stream. Paper analyses these aspects of the stream hydrodynamics, which are influenced by the aquatic vegetation and analyses the influence of the submerged and emerged vegetation on mixing processes in a river. Presented results are findings of hydrometric measurements and tracer experiments at the Šúrsky kanál stream, located in south-west part of Slovakia. The Šúrsky kanál stream is a typical lowland stream, where significant changes in the vegetation are present during different periods of the year. The hydrometric and tracer experiments were performed on a 1700 m long straight reach of the stream with a relatively prismatic cross-section profile during the vegetation as well as non-vegetation period of the year. The results show, that the level of vegetative growth has a significant influence on the hydrodynamic parameters of the stream, as well as on the dispersive process. The dispersive process is influenced not only by the velocity and concentration gradients, but also by the fact, that the vegetation forms in the stream so-called dead zones. Such dead zones modify the velocity profiles of a stream and affect dispersive mass transport within the stream by collecting and separating parts of the tracer from the main current. Subsequently, the tracer is slowly released and incorporated back to the main current in a stream. This process deforms the shape of the tracer concentration distribution in time. All these facts were confirmed by the experiments results described in this paper. It contains also the analysis of the dead zones effect on the dispersive process.

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## **EFFECT OF VARIOUS FACTORS ON THE ESTIMATION OF DESIGNED DISCHARGES FOR WATER MANAGEMENT**

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### **ABSTRACT**

Flood frequency analysis plays a major role in the design of hydraulic structures and flood control management. One way of estimating the design discharges is the flood frequency analysis and solution of the relationship between peak discharges of the flood waves and probability of their return period (T). Directive 2007/60/ EC of the European Parliament of 23 October 2007 concerning the assessment and management of flood risks requires member States to draw up flood hazard maps of floods with very long return periods T (500 to 1000 years). Therefore, the paper deals with the effect of various factors on the estimation of designed discharges. As input data the series of daily discharges and annual peak discharges on the Topľa River at Hanušovce nad Topľou for the period of 1931-2015 were used. The first, maximum annual discharges (AM) approach was applied with the most widely used Log-Pearson III. probability distribution. The second, we analysed the effect of the time series length and the effect of seasonality (winter, summer) on the accuracy of T-year maximum discharges estimation. As an alternative to this approach (AM), the Peak Over Threshold (POT) method was used. We analysed the effect of the threshold level value selection and using of maximum daily discharges on the accuracy of T-year maximum discharges estimation. Results showed that not only the selection of the distribution function to estimate T-year discharges but also the type of data series may affect the results of the estimation. Results also showed that the estimation of designed maximum discharges using by the POT method did not show significant differences at the selected various threshold levels, but for a relatively fast and large increasing of discharges during floods, it would be necessary to have peak values for all waves included in the analysis. Determining the specific value of a 500- or 1000-year flood for engineering practice is extremely complex and in interpreting the results, it should be kept in mind that estimated values with very high return periods are extrapolated values. Each statistical method includes some uncertainty that may be caused by the method but also the data may be affected by certain measurement error therefore, is also necessary to specify confidence intervals in which the flow of a given 100-, 500-, or 1000-year flood may occur with probability, for example, 90%.

## ACQUIREMENT OF GOLD FROM CONCENTRATE (PEZINOK, SLOVAKIA) WITH UTILIZATION OF ALGAE IN MECHANOCHEMICAL PROCESSES

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### ABSTRACT

The deficiency of primary raw materials and the difficult processing of sulphide concentrates with low gold content, as well as the long-time use of the dangerous cyanide method, instigated the utilization of more efficient method of acquirement this noble metal. For this reason, this work was focused on gold utilization from a refractory sulphide arsenopyrite concentrate (Pezinok, Slovakia) with application of non-cyanide mechanochemico-biological process. Gold in arsenopyrite concentrate occurs physically enclosed in the intercrystalline space of sulphide minerals, and is also isomorphic and fills structure defects in sulphides. The exclusion of gold from such complex mineral matrices of the concentrate can be achieved by using a mechanochemico-biological process. This innovative process can obtain a gold using an application of a thiourea solution, which is a convenient alternative opposite to the toxic cyanidation method. The thiourea compared to cyanide represents an ecologically acceptable leaching agent with exceptional kinetics and selectivity. Mechanochemical processes utilize high-energy milling and intensify processes through the formation of a surface and volume defects in solids. The main advantage of mechanochemical processes compared to traditional technologies is the smaller number of technological operations, the considerably shorter time required to obtain the desired product at ambient temperatures, as well as formation of nanostructures. The utilized of biological process with application of algae has shown that algae with siliceous structures make it possible to obtain of gold from an arsenopyrite concentrate (Pezinok, Slovakia) with dimension in nano range. These algae are part of aquatic ecosystems and, in addition are being food for other animals, utilizing for fuel production and, more recently, they are important raw material for the production of hydrogen, methane and some types of biofuels. Limnetic algae (diatoms, golden algae) have unique properties, they create the largest mass of biomass of all plants on Earth and at the same time they are able to move. The mechanochemico-biological process is a method that enables to obtain gold nanoparticles (100 nm) from the refractory sulphide arsenopyrite concentrate (Pezinok, Slovakia). Mechanochemical activation of this sulphide concentrate and silica shells of the above mentioned limnetic algae of tribes (Dinobryon, Surirella) in thiourea solution caused changes in physico-chemical properties of the minerals of gold as well as in the constituents of the algae minerals. These structural changes had under specific conditions a decisive influence on the exclusion of gold nanoparticles to the thiourea solution. The gold nanoparticles had subsequently fixed in the cellular matrix on mechanochemical activated algae shells. The reason of the fixation of gold nanoparticles was the action of biomolecules that algal cells during activation secreted while they defend again the chemical effect of metal ions present in the solution. Nanoparticles of gold were acquirement from the concentrate after less than two hours by described mechanochemico-biological process. In the case of mechanochemical activation of the concentrate, but without the activation of defined algae, the exclusion of gold nanoparticles was not confirmed even after a triple activation time (six hours). Owing to, the algae had to be activated to recove of gold from the sulphide arsenopyrite concentrate. It follows, the entire mechanochemico-biological process had to be followed. The nanoparticles of gold obtained by the described way may have different uses in practice, such as accelerating the decomposition of hazardous substances or eliminating pollutants in contaminated water, soil and air. Acquirement nanoparticles of gold through this process would also lead to the elimination of algae from the aquatic environment where they are dangerous not only for aquatic plants and animals, but also for humans.

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**DETECTION AND MEASUREMENT OF CRACKS IN ROCK MASSIFS BY MEANS OF GROUND LASER SCANNING**

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**ABSTRACT**

The analysis of the cracking of the rock massifs is an important stage in the process of their characterization, as this largely determines their mechanical behavior. This is the main reason the mining engineers, who are engaged with the analysis of rock massifs, to require a most detailed and reliable study of the cracks that have arisen in them. Metric characteristics, such as the direction and angle of collapse of the cracks, roughness and average distances between the individual cracks, are extremely important for the study of the structural disturbance of the massif. In the process of the metrics forming of these characteristics, a few of methods of measurement and graphical representation, different in nature and technological features, have become necessary. Through these traditional methods, it is very often not possible to obtain adequate quantitative data for the complete geomechanical characteristics of the rock mass and for the analysis of the mechanisms for its instability. Here, the effectiveness of the ground laser scanning in the study of the structural disturbance (direction and angle of decay of the cracks) and the area cracking coefficient of the rock mass has been experimentally proved. Through this technology the research of the structural disturbance of the rock massifs acquires new quantitative and qualitative dimensions. On the basis of an extremely detailed 3D model, even of hard-to-reach sections of the rock massif, a realistic clustering of cracks and prerequisites for adequate determination of the area cracking coefficient of the massif are created. Moreover, ground-based laser scanning data are an indisputable source of valuable information about rock surface roughness. For an object of the experiment, was selected part of a rock massif, which has well-developed, clearly visible cracks. The scan was performed, using a ground-based laser scanner “Scan Station 2” of the company “Leica”.





## **CONTROL IN THE PROCESS OF THE BUILDING COSTRUCTION BY MEANS OF STATIONARY TERRESTRIAL LASER SCANNING**

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### **ABSTRACT**

This study will give an explanation of a contemporary method for Quality Assurance or As-build process during the construction of a building in Sofia, R. Bulgaria by using High Definition Survey (HDS) or more known as Terrestrial Laser Scanning (TLS). Analyses were done on concrete casted elements (Floors, Ceiling Slabs and Columns) for the first eight floors which were already constructed during the time of field measurements. As a reference - data are obtained from the original design in native AutoCAD format, while field data were acquired by using 3D laser Scanners and they are represented in a form of Point Cloud. All data (design and measured) were acquired in local coordinate system and were later georeferenced in to the already established object coordinate system materialized on the field as a network of points with precisely determined coordinates. The study will show the workflows used for data preparation, post processing, and the results from 3D Inspection and Analyses. All tasks were implemented by two survey crews within 10 working days (four days for field work and 6 days for post processing analyses and reporting). During the laser scanning a total of 3 679 440 634 points were surveyed form 368 stations. After the post processing the number of points was reduced to 2 515 520 148 with relative accuracy after registration of individual scan worlds of +/- 3-4 mm. The accuracy for the data transformation in to the object coordinate system is +/- 7.5 mm. In order to have better data visibility and understanding of the deformations and displacements, casted concrete elements were inspected separately floor by floor where ceiling and floor slabs were inspected in 1D (Z direction) while columns were inspected in 2D - (XY) inspection for the position. Thus some will say that the results are within accuracy limits of the classical measuring techniques we should not forget the fact that the percentage of inspected elements/surfaces is more than 95%.

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## CONCENTRATION, DISTRIBUTION AND MODE OF OCCURRENCE OF MERCURY IN BULGARIAN HIGH-SULPHUR COALS

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### ABSTRACT

Mercury is considered to be a global pollutant due to its potential toxicity and global movement, as well as due to its highly volatile nature and tendency to be emitted during coal combustion. Industrial coal combustion is a significant source of Hg to the environment and, according to data from the U.S. Environmental Protection Agency, it accounts for about 34 % of Hg released to the atmosphere. A number of publications have addressed the different aspects of Hg in bulk coal and fly ashes from Bulgarian thermoelectric power plants, but there is insufficient information about the Hg concentration and distribution in Bulgarian coal basins. The aim of the present study is to perform a detailed investigation of Hg in some high-sulphur Bulgarian coals, with a focus on (1) providing new data about Hg concentrations in high-sulphur Bulgarian coals, and comparing these data with previously reported for the upper continental crust, for USA, Australian, Chinese, and world coals; (2) determining the correlation between Hg and sulphur forms values; and (3) making some assumptions about the mode of occurrence of Hg in high-sulphur Bulgarian coals. The lignites from three Bulgarian basins named Maritza-West, Maritza-East, and Stanyantsi are the subject of present study. The investigation is based on 51 samples representing the whole coal beds. The average concentration of Hg for all studied samples is 0.34 ppm and the values varies from 0.07 to 1.20 ppm; the average is 6.8-times higher than the Hg value in the upper continental crust and 3.4-times higher than the average values for world coals. The highest average Hg concentration (0.57 ppm) was found in the Maritza-West samples, followed by the Maritza-East (0.30 ppm), and the Stanyantsi (0.15 ppm) lignite. These data correspond with the sulphur content, i.e, the highest-Hg lignite has the highest S content. It was found a weak positive correlation between Hg and the total and sulphide S and a negative correlation between Hg and the organic S content for the Maritza-West lignite were observed. It is suggested that the Hg is predominantly incorporated in pyrite, which is present in high amount in these coals. The tendency in the distribution of Hg and S forms for the Maritza-East and Stanyantsi basins shows that Hg may be closely connected with S-bearing organic compounds, especially for the Maritza-East lignite. Consequently, the main part of Hg in the high-S coals from the Maritza-East and Stanyantsi basins is closely connected with organic sulphur complexes and may be with inorganic matter other than sulphide minerals. The data determined from this study partially confirms the results for other high-S world coals reported earlier. For the typical high-S Maritza-West lignite it may be suggested that there is a strong connection between Hg and pyrite and especially with epigenetic pyrite infilling the coal veins and cleats, while for high-S Maritza-East and Stanyantsi lignite the Hg is predominantly incorporated in organic matter and especially in sulphur-bearing organic compounds.

*The study was funded by the Bulgarian National Science Fund in the frame of Project KP-06-H34.*

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**GENETIC FOREST TYPOLOGY AS A SCIENTIFIC AND METHODOLOGICAL BASIS FOR ENVIRONMENTAL STUDIES AND FOREST MANAGEMENT**

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**ABSTRACT**

Paper describes key elements of genetic approach to classification of forest types - one of the original forest typological research directions in Russia, summarizes the results of research over the hundred-year period of formation and development of this promising (from the point of view of sustainable management of natural resources) scientific direction. Authors provide a map of current forest type genetic classification use in Russian Federation, and outline key perspective directions in development of genetic classifications within a framework of the described approach. Modern genetic forest typology is an interdisciplinary science. It uses forestry, soil science, biogeography, and landscape ecology, allow you to reflect the processes of forest vegetation dynamics in syntaxons and on maps. Therefore, it gives excellent results for systematizing not only primary forests, but also a variety of secondary plant communities with extremely variable composition. Authors believe that there are the following main avenues of genetic approach to forest type classifications development: improvement of forest zoning technologies based upon assessment of environmental factors' quantitative values, including development of spatial models for estimating factor values; development of new automated quantitative assessment methods for forest site conditions and tree stands' parameters using high spatial resolution data obtained from aerial drones; development and verification of the rules for combining forest areas with relatively close parameter values, i.e. with similar forest-growing conditions, in one spatial unit; development and verification of the rules for combining spatial units with relatively different forest-growing conditions into larger units according to applied silvicultural practices; Improvement of existing and development of new forest typological schemes reflecting changes in climate conditions that can be applied for zones with high levels of anthropogenic impacts; development of silvicultural practices and logging technologies considering classification schemes of forest type dynamics; Genetic studies of the populations that compose forest communities. Genetic forest type classification is based upon the origin (genesis) and development of forests. Therefore, genesis studies of forest communities based on genetic analysis of the populations will become the core theme of future fundamental research in this area.

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## “PRIVATE” JPEG IMAGES

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### ABSTRACT

The purpose of our study is the masking and unmasking of the sensitive biometric data, i.e. face and eyes, that are contained within a JPEG image that contains human faces. The working principle behind our algorithm is to use the JPEG metadata to secretly preserve the biometrics information included in the original JPEG image. In the forward step of the algorithm (the *masking* phase), the biometry to be masked, the scheme and the encryption mode are chosen. Once biometrics have been identified, the correspondent Region of Interest (ROI) is replaced with the mask and the sensitive information are saved in encrypted form in the metadata of the new image obtained through JPEG compression. In the backward step (the *unmasking* phase), sensitive information is extrapolated from the metadata of the masked image and are then used to reconstruct the original image by replacing the mask with the original ROI. Our algorithm therefore allows, on the one hand, to apply arbitrary visual manipulation on certain ROIs, while on the other hand, it secretly preserves the information regarding the original ROIs in the metadata (IPTC and EXIF) of the blurred JPEG image. The image can be exposed by replacing the blurred regions of the protected image with the corresponding original regions extracted from the metadata. We have experimentally tested our approach and the preliminary results are very promising.

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## **SOCIALLY RESPONSIBLE COMPANIES IN RELATION TO THE POLISH ENERGY AND MINING SECTORS**

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### **ABSTRACT**

The article combines the issues of Corporate Social Responsibility in the context of relations with sector indices representing the mining industry or industry related to them. For research purposes, social responsibility is included in the RESPECT Index (RI) and the idea of social investing. In 2009 Warsaw Stock Exchange (WSE), implemented the RESPECT Index, which is a response to a changing reality in a sustainable way. The essence and role of non-financial reporting in the field of Environmental, Social, Governance (ESG) in the context of the new stock index was emphasized. In the paper, the relationships between key sectors of the economy, on the example of selected indices, i.e. WIG-mining, WIG-fuel, WIG-energy in the aspect of socially responsible companies belonging to the RESPECT Index will be discussed. The article refers to stock exchange mechanisms and the rules of companies belonging to sector indices. The main purpose of the research work was to group and estimate the relationship between Polish industry sectors representing mining, energy and fuel sectors and the RESPECT Index, along with their identification. To achieve this goal, publicly available stock exchange quotations were used in the selected time period as input data 2014 – 2019. Relationships between indices were calculated using a known measure in the form of a correlation coefficient. This matrix presents the relationships of selected sector indices relative not only to RI but also to each other. The presented analysis shows that RI and WIG-mining have the greatest relationship between each other. For a professional investor focused on the activities of an entity within ESG, such an analysis can be used to make a decision about choosing a company for the investment portfolio. The article ends with the presentation of results and summary.

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**SPATIAL AND TEMPORAL EVOLUTION IN THE UNSATURATED ZONE OF POLLUTANTS RESULTING FROM ACCIDENTAL DISCHARGES OF PETROLEUM PRODUCTS**

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**ABSTRACT**

The exploitation and processing of oil resources are factors of regional progress and development; in this regard, the final products resulting from exploitation and subsequent refining can be accidentally spilt on the ground destabilizing the relationships between flora, fauna, water and soil, generating irreversible effects on terrestrial and aquatic ecosystems. The impact of the effects generated by petroleum products on soil and water resources is limiting nature and imposes severe measures to restrict the resources used for economic, administrative and consumption purposes. Experimental research involves the usage of geostatistical methods for modelling the unsaturated area and the usage of specialized applications for estimating the dispersion of pollutants in the studied area based on an accidental pollution scenario. The application of the method used in the areas with a significant risk of contamination (oil fields) it aims to identify the movement of the contaminant at various times and concentrations in order to choose the best measures to reduce and minimize pollution of the unsaturated (vadose) zone. The objectives of the reduction and minimization measures are to limit the transfer of contaminants in the saturated area or to the strategic drinking water reserves. The applied method supports researchers, hydrologists, hydrogeologists, environmental engineers who want to deepen the transition elements of the pollutant in the unsaturated area, the phenomenology and dispersion of pollutants in waters located in the unsaturated area and the problems caused by pollutants on the environment. For a geographical area, with a high or medium risk of groundwater contamination, the application of the method in conducting research can make a significant difference in improving groundwater quality indices.

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**NON-GRAPHICAL DATA STRUCTURE FOR THE PURPOSE OF BIM-BASED LIFE CYCLE  
ASSESSMENT: METHODOLOGY FOR THE CZECH ENVIRONMENT**

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**ABSTRACT**

The article deals with the data structure for the purpose of life cycle assessment of buildings using the Building Information Model (BIM), for implementation in the Czech construction industry. Construction industry produces a significant amount of waste while the capacity of landfills is being limited. Effective management of already used materials, that have the potential to be reused, can significantly help to decrease consumption and save natural resources. Life Cycle Assessment (LCA) is a method that can be used to demonstrate the suitability of proposed materials, structures, or buildings in terms of their whole life cycle and its environmental impact. For the LCA evaluation it is crucial to obtain life cycle inventory (LCI) input data, however, the structure of this data is not clearly defined for the Czech environment. The BIM includes, in addition to geometry, the information part applicable to this assessment. The aim of the article is to analyse previous approaches and to define a BIM data structure for LCI purposes of a particular material. The new methodology is based on standardization of non-graphic information model data structure, called SNIM, which was developed for the Czech construction industry. From the SNIM database, "mark-up syntaxes" has been taken over to further identify the data for LCI base structure purposes. The MatLab matrix solver was used to classify these data. Advantages of the proposed methodology have been demonstrated on the case study of monolithic concrete slab structure, in which three types of concrete were evaluated. The results indicated the percentage of impact categories for each concrete type. These results are useful for expanding the BIM model with new data necessary for further LCA calculations. BIM model, extended by LCA calculation, will lead to a reduction of natural resources extraction as well as positive impact on environment.

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**GEOLOGICAL INTERPRETATION OF THE RESULTS OF FACTOR ANALYSIS OF XRF- AND XRD-  
DATA ON CARBONATITE AND ALUMINOSILICATE ROCKS OF THE KONTOZERO ALKALINE  
COMPLEX (KOLA PENINSULA, NW RUSSIA)**

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**ABSTRACT**

We applied factor analysis for statistical comparison of XRF and XRD data for 198 samples of carbonatites and aluminosilicate rocks of the Kontozero Devonian carbonatite paleovolcano. This method helps to identify main, secondary, and some accessory minerals, as well as to estimate the approximate contents of these minerals and to assess their contribution on the distribution of major and trace elements (Fomina et al., 2019). With the view of control purposes, qualitative and semi-quantitative analysis of diffraction data were performed using QualX v. 2.24 with the indexed XRD database POW\_COD. 30 factors easily yielded to mineralogical interpretation. For the studied samples, a functional relationship was established between the assessment of the mineral content and the score of the factor corresponding to the mineral. Thus, the factor score can be considered as a tool for assessing the content of the corresponding mineral. This made it possible to visualize the distribution of minerals in the space of the studied object and to find out that some minerals are ubiquitous, while others present only in certain parts of the section, and some occur sporadically. The use of Spearman's nonparametric rank correlation coefficient as applied to the values of interpreted factors enabled us to resolve the main mineral associations. By analyzing the factor loadings on the geochemical variables, we traced the relationship between these associations and variations in the petrogeochemical characteristics of rocks. This, in turn, allowed us to make a mineralogical interpretation of the results of factor analysis, performed solely for the geochemical variables. Thus, the main trends in the mineralogical and geochemical evolution of carbonatites and aluminosilicate rocks of the Kontozero Devonian carbonatite paleovolcano were determined and statistically substantiated. It is important that all these results are obtained in a short period of time at the earliest stages of the research. Moreover, they were obtained by a “blind” statistical method and therefore were not subject to the influence of a priori hypothesis of the researcher. Time-consuming classical techniques (e.g., petrography, mineralogical studies, and quantitative analysis of diffraction data) act as a tool for verifying the geological model preliminarily described by statistics. *This study was funded by the RSF, project №19-77-10039.*

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**APPLICATION OF THE METHOD OF STATISTICAL COMPARISON OF XRD- AND XRF-DATA FOR IDENTIFICATION OF THE MOST REPRESENTATIVE ROCK SAMPLES: CASE STUDY OF A LARGE COLLECTION OF CARBONATITES AND ALUMINOSILICATE ROCKS OF THE KONTOZERO ALKALINE COMPLEX (KOLA PENINSULA, NW RUSSIA)**

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**ABSTRACT**

We investigated a collection of carbonatites and aluminosilicate rocks from the Kontozero Devonian carbonatite paleovolcano (198 samples). Its geological exploration is complicated by some of its specific features: a) the rocks of the Kontozero complex are predominantly volcanic, which complicates their petrographic studies due to the small dimension of minerals and the diversity of their structural relationships; b) because breccias are common in many parts of the complex the rocks are mostly not homogeneous; c) Kontozero belongs to the alkaline-carbonatite formation, which is typically characterized by mineral diversity and the presence of rare minerals. The purpose of this study was to develop an algorithm for selecting from a large collection of rock material those samples that are most informative for mineralogical and geochemical studies. As a tool for this selection, an original method of statistical comparison of XRD and XRF data using factor analysis was chosen. This methodological approach enables mathematical identification of all main, secondary, and several accessory minerals and a rough estimation of their contents (Fomina et al., 2019). The mineralogical interpretation of factors was carried out according to the peak positions on the graphs of factor loadings (by using both the on-line XRD AMCSD database and the QualX v. 2.24 program with the indexed XRD database of POW\_COD) and according to qualitative analysis of diffraction data of rock samples with maximum factor scores. For the studied rock collection, this approach allowed us to identify more than 20 rock-forming minerals based only on XRD data. Also, we found ca. 10 mineral phases, the lines of which are very weak and/or overlap by more intense lines of other minerals in the diffraction patterns. Verification of the mineralogical interpretation of the factors of such “hidden” minerals requires a microprobe study of specific samples that are “predicted” by factor analysis. Based on the results of this study, we developed an algorithm that remarkably facilitates choosing samples that are most contrasted in mineral and chemical composition and contain the entire set of mineral phases characteristic of the rocks of the study object with minimal effort. In the case of our Kontozero rock collection, 30 representative samples were identified, which is about 15% of the initial sample set.

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## **MECHANISM OF PROCESSES STIMULATED BY ULTRAVIOLET RADIATION**

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### **ABSTRACT**

Modern technologies for creating integrated circuit elements offer many innovations, both in terms of the technological cycle and the introduction of new technologies. Stimulated processes in this regard and their mechanism require a thorough study in order to further improve the technology and the parameters of the micro and nano devices made on their basis. We have studied the processes stimulated by ultraviolet radiation, such as: Stimulated Plasma Anodizing and Stimulated Magnetron Sputtering. In the study of stimulated mechanism should be considered processes which are going on with ultraviolet irradiation on the sample and plasma. In these processes, UV light effects on the plasma, on the surface of the synthesized material, its volume, and the interface area of the material. In particular, in the case of plasma anodizing, UV radiation: 1) produces an ozone in the plasma that is much more active than oxygen ion. 2) Ionizes interface area of Plasma-oxide, producing additional current carriers, and 3) transferring electrons from the oxidized material bond zone to the anti-bond zone, thereby weakening the bond strength between the oxide atoms. As a result of these effects, the process of mixing anions and cations is facilitated and, consequently, the oxygen diffusion coefficient is increased and the oxidation process is accelerated. At the oxide-semiconductor interface happens roasting existing charge trapping levels, which reduces the concentration of charge carriers and improves the oxide parameters. The same processes are observed in the case of Magnetron Sputtering. In the deposited layer excites mechanical tensions and it can be removed by UV irradiation in the same way as in the case of plasma anodizing.

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**RESULTS OF THE EVALUATION OF THE FUNCTIONAL PARAMETERS OF THE COMPONENTS OF A  
DETONATOR, IN VIEW OF THEIR USE IN CONDITIONS OF INCREASED  
ACCURACY AND SAFETY**

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**ABSTRACT**

Explosives for civil use present a high degree of operational risk and therefore a special regime for their design, manufacture and conformity assessment is required. The essential safety requirements for explosives for civil use (explosives themselves and means of initiation) are set out in the Annex to Directive 2014/28 / EU and describe the measures to combat any risks related to explosives for civil use in all situations and all related operations. In order for an explosive to detonate at a stable speed rate, in which case it releases almost maximum energy, it must be initiated with a sufficiently strong and precise shock, this being the role of the means of initiation. The performance and the technical level at which the tests on the determination of the functional parameters (e.g. sensitiveness to impact) specific to the means of initiation are performed, give an increased credibility to the accuracy of these parameters. The purpose of this is to carry out blasting operations without recording faults due to inadequate compliance with the safety and quality of the detonators used and which may lead to economic losses, technical damage and endanger the safety and health of personnel operating or having to manage them. The paper summarizes the evaluation of the results of the tests performed on the components – base charge and fusehead, related to a detonator - as a constructive component of an electronic detonator, regarding the determination of sensitiveness to impact according to the applicable references, respectively: SR EN 13763-3: 2005 - Determination of sensitiveness to impact, using a state-of-the-art technical test infrastructure, type BAM Fall Hammer BFH-12A. This test ensures that the Bruceton lift-fall test is performed in order to determine the average and minimum heights at which the explosion effect is observed (a positive result is recorded). After evaluating the result indicators on sensitiveness to impact, both on the base charge and on the fusehead, it was found that the values of the parameter determined by the Bruceton test (average height) for each case, ensures the possibility of assessing by comparison the level of sensitivity of the two detonating components tested, for the fusehead device having a lower value of the average height (0.725 m) compared to the base charge (0.8827 m). The result of the evaluation highlights the importance of the safety quality of detonators components as part of an electronic detonator, from the perspective of their differentiated level of sensitivity and which must be determined in conditions of increased accuracy with predictable results and specific to the way how electronic detonators are functioning.

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## UHPHT GLASSES IN BOTTOM SUEVITE FACIES (UST`-KARA, ARCTIC OCEAN, RUSSIA)

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### ABSTRACT

Numerous amorphous substances belong to very valuable types of materials, where glasses are especially important for different applications. The high top interest in the field is connected with the state of matter under extreme conditions. In the nature the formation conditions of the glasses arise from magmatic melts (for example volcanic glasses and buchite); under impact (shock) processes (including melt impactites and tektites), and also, by quite rare fulgurite occurrences formed under lightning discharges, additionally in the nature some matter can be formed under nuclear weapon explosions. Analyzing a variety natural glasses, it is follow that they are quite widely spread on the Earth, on the Moon and Venus. In general, the substances have very wide range of chemical composition, structure and properties. Among the listed glasses the impact matter is especially potentially interesting. According to the technical possibilities of the modern facilities for lab modeling of high pressure high temperature (HPHT) materials only tiny-sized particles can be produced with sizes no more than counting hundreds of micrometers under pressure usually up to 100 GPa and usually at room temperature. The mentioned impact glasses are formed under extremely high conditions - up to hundreds GPa and thousands degrees Celsius. The impact glasses recently attract active attention after our discovery of unusual natural UHPHT impact glasses forming vein bodies within the Kara astrobleme (Pay-Khoy, Russia) in 2015. The Kara glasses have been described in our publications in 2017-2020. In 2019 we have provided additional studies at the Baydaratskaya Bay for the field observations and sampling of melt impactites on the territory of the Baydaratskaya Bay (Arctic Ocean, Russia) at the Ust`-Kara region (so-called in some publications as Ust`-Kara astrobleme) with the aim to find new occurrences of the vein-type UHPHT glasses. By the field studies we have found impressive ribbon-shaped glasses and spots in suvites, with similar characteristics to vein ultrahigh pressure impactites from the Southern Kara sector of the Kara astrobleme. The analytical studies of the ribbon-like impact glasses of the Ust`-Kara area revealed the presence of multilevel differentiation of impact melt, similar to the Kara UHPHT vein glasses. The very special feature of the glasses is abounding by high pressure silica phase – coesite, widely present within pure silica glass drops within aluminosilicate matrix. Following to the specifics of the Ust`-Kara UHPHT glasses they rather belong to bottom facies of the suevitic breccia covered by air falls of low pressure facies of impactites. The find allows to see new evidence of UHPHT impactites in geological structure. The latter can help to understand more in impactites origin for giant astroblemes forming huge volumes of impact rocks and demonstrate essential distribution of the unusual UHPHT impact glasses.

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**3D MODELING OF THE UHPHT GLASSES COMPLEX IN SUEVITE (KARA ASTROBLEME, PAY-KHOY, RUSSIA)**

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**ABSTRACT**

The unusual natural ultrahigh pressure high temperature (UHPHT) impact glasses have been discovered at the Southern part of the Kara astrobleme (Pay-Khoy, Russia) in 2015. The glasses form a complex of stockwork-like system of thin vein bodies set within suevite breccia at the right bank of the Kara river. The Kara glasses have many specific features pointing to UHPHT origin (Shumilova et al., 2017, 2018, 2019). For better understand the geological position of the UHPHT impact glasses we have provided additional field observation with the use of copter facility to observe the outcrops from the «air-bird high» and collecting data for 3D modeling. The latter allow see many natural topological and details for the more complex analysis of the discovered UHPHT complex. The field observations have been provided in 2017 on the right bank of the Kara River. For the study, we used DJI Mavic Pro drone. The limit for the wind conditions for the drone model exploitation is 10 m/s. In our case the overage wind velocity was about 8 m/s. The Cinema 4K resolution camera and 3-axial gimbal stabilizer allowed to get high quality photo- and video-documentation – 4096 × 2160 pixels, with the frequency of 24 frames/s. The field video record has been evaluated with the program PIX4DMapper. The 3D model allows to watch the overview of the UHPHT massif and to recognize tiny details of its position with the target sedimentary rocks. The UHPHT complex is presented with the massif of 80 m in extension and up to 20 m in high in the general part having tooth-like morphology. The general massif is accompanied with several small columns of the first meters in high. The observed contact of the UHPHT complex with the sedimentary rocks well corresponds to the sedimentary strata laying of the target rocks. The results support the preliminary interpretation of the inject nature of the UHPHT complex and allowed to conclude about the specific origin of the impactites presented with suevitic breccia containing UHPHT impact melt glasses. The provided study demonstrates high informative use of the drone facility and allow to get the detail information impossible for any other methods of the topographic observations.

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**HIGH PRESSURE AFTER-COAL CARBON FROM MELT ROCK OF THE GIANT POPIGAI  
ASTROBLEME (SIBERIA, RUSSIA)**

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**ABSTRACT**

The Popigai astrobleme is a unique geological object with huge storages of impact diamonds of high hardness quality being perspective as an abrasive material. In spite on very well-known after-graphitic nature of the Popigai diamonds, it was predicted that a part of them might have non-graphitic precursor (Shumilova et al., 2014) as the target of the meteorite crater partly consist of sedimentary rocks with coals and bitumens. In this study we have analyzed unusual carbon particles from impact melt rocks of the astrobleme. The sampling was provided by V.V.Vladykyn from melt rocks at the Skal`ny deposit of the Popigai meteorite crater. The analyzed carbon particles had been enriched by chemical dissolution of the host melt rock by acid treatment. The undissolved material had been analyzed under optical binocular for selection of the carbon particles. The selected particles were studied by a complex of methods including microscopic, structural and spectroscopic observations such as optical microscopy observations (POLAM-312, LOMO), scanning electron microscope (SEM) (VEGA 3 TESCAN SEM with VEGA 3LMN, INCA ENERGY 450 energy dispersive detector, Tescan, Czech Republic), visible Raman spectroscopy (LabRam HR800, Horiba Jobin Yvon, France) and isotopic analysis at the IG Komi SC UB RAS (Syktyvkar, Russia). Also, we have analyzed the carbon matter by UV Raman spectroscopy measurements which have been provided at the SSC FSUE Keldysh Research Centre (Moscow, Russia) with a Raman spectrometer T64000 (Horiba Jobin Yvon, Japan) at 244 nm laser excitation. The carboniferous matter have specific morphology with abounding bubbles presence up to forming of pumice texture. Sometimes carbon particles have stream-like/fluidal texture. According to the provided analysis we have found that the extracted carbon particles are presented with glass-like carbons presented with amorphous hydrogen-containing matter (bitumen-like composition). The complex data point to nongraphitic initial nature of the studied carbons from the melt impactites. The analyzed matter is rather presented with high pressure product of impacted coal matter. It is known (Masaitis et al., 1998) that the Popigai target is partly composed of 5 stratigraphic levels of sedimentary rocks enriched in coals and bitumenes of Proterozoic-Cretaceous and Pliocene-Quaternary ages. Our find of “after-coal” products within the melt rock can allow to suppose that the coal could be a source for a part of the impact diamonds formation within the Popigai structure. The latter was predicted earlier in the published work in 2014 (Shumilova et al., 2014). The isotopic measurements are in a good correspondence with the proposed idea of after-coal nature of the analyzed carbon material. In the future, the described non-crystalline matter can be interesting for determination of high pressure carbon polymer structure which can be interesting as a possible new material.

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Corresponding Author: Tatyana Shumilova





**APPLICATION OF THE WATER EVALUATION AND PLANNING (WEAP) MODEL TO QUANTITATIVE WATER BALANCE MODELLING IN THE HRON RIVER BASIN (SLOVAKIA)**

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**ABSTRACT**

The assessment of water resources and water availability in a river basin is one of the main tasks enabling efficient water management. The recent development of the computer industry and information technology allows us to create powerful computer systems for solving water management balances. Their advantage is in the ability to solve several variant variations with the help of computers, both in sources and in water requirements. In Slovakia, at present, the individual elements of the water management balance are divided and evaluated separately, i.e. into surface and groundwater, and these are further divided into a quantitative and qualitative component. The paper aims to model the quantitative water management balance of surface waters using the simulation balance model WEAP. The water management balance of surface waters is evaluated in a monthly time step in selected profiles in the Hron river basin for the period 2010 - 2015. The input data to the model were flows, abstraction, discharges and manipulations on reservoirs. The paper is focused on the functionality of the simulation model WEAP with respect to the implementation of the current methodology of water management balances in Slovakia, either in terms of details of input information, their amount but also the time required for preparation and compatibility. It is shown that the software does not require very detailed input data and offers an integrated approach to solving various problems in the management of water resources. The WEAP model has a user-friendly graphical user interface (GUI), providing the ability to present and interpret results in the form of tables and graphs. Its application in a selected pilot river basin showed that it could be an easy-to-use models building tool for optimal and successful development, planning and forecasting in water management and knowledge of water redistribution in space and time in Slovakia.

Corresponding Author: Roman Vyleta





## **POTENTIAL CONTRIBUTION OF HARGHITA NATURAL LABORATORY TO ENHANCE CO<sub>2</sub> STORAGE MONITORING**

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### **ABSTRACT**

Natural laboratories (sites with natural CO<sub>2</sub> emissions) can contribute to a better understanding of CO<sub>2</sub> leakage pathways, environmental effects of CO<sub>2</sub> leakage and early detection of leakage through testing of surface monitoring methods. The study of these natural laboratories is very important for the development of new cost-effective monitoring strategies and a better understanding of risks associated with CO<sub>2</sub> geological storage. Romania has a large potential for providing natural test sites for CO<sub>2</sub> storage monitoring methods, although its sites with natural CO<sub>2</sub> emissions were not assessed previously for this purpose and are not included in any international database. Harghita area, located in the Eastern Carpathians, includes many sites with post-volcanic activity that can be taken into consideration as natural laboratories for CO<sub>2</sub> storage. The origin of CO<sub>2</sub> emissions is related to the magmatism of Eastern Carpathians and the existence of a complex system of faults, combining crustal, regional and local fracture lines. The natural CO<sub>2</sub> emissions from Harghita include wet and dry gas emissions (moffetes) and numerous mineral springs (most of them used in the mineral water industry). Dry gas emissions occur on the major crustal faults. As part of a project funded by the Ministry of Education and Research of Romania (PN19200503), included in the GeoEcoMar core project, we have started the assessment of potential natural laboratories from Harghita. After collecting all the geological and geophysical information for the area and creating the initial database, we have implemented a field campaign in September 2019 for the identification and selection of a natural laboratory in the area. The investigated sites were: Harghita Băi, Selters, Sântimbru Băi, Băile Apor, Sulphur Cave, Lăzărești and Tușnad. Many of the mofettes we have encountered were covered and used for medical treatment, being also important points of touristic attraction. Taking into account the presence of wild moffetes (not covered), dry and wet, the accessibility of the site, and the high level of CO<sub>2</sub> concentration at the gas vents, we have selected Lăzărești, north of Tușnad resort, for further study. Based on the distribution of moffetes on the selected field and the previous knowledge on the geology of the area, we have prepared detailed plans for acquisition of geophysical (GPR and electric methods) and geochemical data (soil flux, CO<sub>2</sub> concentration measurements at different distances and depths from the gas vents) to be implemented in the next two years. Furthermore, we plan to make also a vegetation study in order to document the presence of early-CO<sub>2</sub> leakage indicators related to plant health and the presence of some species at different CO<sub>2</sub> concentrations in the soil. The main objective of planned geophysical surveys is to identify CO<sub>2</sub> migration pathways and prove the efficiency of these near-surface methods for the study of a CO<sub>2</sub> leakage from an anthropic storage site.

Corresponding Author: Alexandra-Constanța Dudu



## **DETERMINATION OF SPONTANEOUS IGNITION BEHAVIOUR OF CALCIUM STEARATE DUST ACCUMULATION**

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### **ABSTRACT**

The self-ignition of combustible dusts depends on their chemical composition, on the properties of the substances in the composition, on the granulometry and geometry of the mass of the material and, last but not least, on the ambient temperature. Self-ignition is a complex process that takes place in three successive or simultaneous stages of development. These stages influence each other and are the following: self-heating, evaporation of moisture, and self-ignition itself. The underlying cause of self-heating (or possibly self-ignition) is that molecules on the surface of combustible dust particles are subjected to exothermic reactions with oxygen in the air transported in the free volume between particles, even at normal temperatures. Any amount of heat released will then cause an increase in temperature in the reactive dust-air system, thus accelerating the reaction of other dust molecules with oxygen. Calcium stearate is a carboxylate of calcium, classified as a calcium soap. It is a component of some lubricants, surfactants, as well as many foodstuffs. Due to its large utilization, it was considered important to analyse the flammability properties at bulk depositing in order to ensure proper safety regulations to avoid unwanted events such as fires or explosions. This paper aims to describe/present the self-ignition behaviour of combustible dusts as a function of volume by evaporation tests under constant temperature conditions. The obtained results showed the maximum quantity that can be stored in bulk and the time until an ignition could take place, so that protective measures can be taken to avoid incidents (fires, explosions).

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## **GEOPOLYMERS AS A POTENTIAL MATERIAL FOR PRESERVATION AND RESTORATION OF URBAN BUILD HERITAGE: AN OVERVIEW**

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### **ABSTRACT**

Since the introduction of the term 'geopolymer' by Davidovits in 1978, many papers have been published, sometimes providing clear and concise indications, and other times creating confusion about what are a geopolymer. What seems interesting, beyond the terminology discourse, is the advantage of low CO<sub>2</sub> emissions, the possible use of waste industrial by-products in their production and the good resistance to air pollution and aggressive agents. Changing appropriately precursors and alkaline activators, geopolymers can reach competitive mechanical properties and significant environmental benefits. The materials, with specially designed formulations, can be fireproof, breathable, to be resistant to rising salts and acid rains, as well as materials to low emission of carbon dioxide. Furthermore, a further advantage is the ability to imitate natural, artificial and stone materials. There are hundreds of papers about characteristics, properties of both precursors and final product, but only few of them about the Cultural Heritage applications. Despite this, the data shown by the few publications present to date give hope for a use of these materials for the consolidation, conservation and restoration of the heritage built within the historical centres. Right in the buildings of the historic centers, the low CO<sub>2</sub> emissions and the characteristics shown by the geopolymers could bring a huge benefit to the environment and the protection of the structures themselves. In this work, we briefly review the bibliography available on the application of these materials to cultural heritage, hypothesising future uses aimed at specific urban contexts, where application could play a key role in future projects to restore the built heritage.

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## **A FAST AND USER-FRIENDLY SOFTWARE FOR QUANTITATIVE CHEMICAL ANALYSIS THROUGH XRF**

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### **ABSTRACT**

X-ray fluorescence (XRF) spectroscopy is a technique widely used for the study and conservation of cultural heritage materials. A Microsoft Excel spreadsheet to determine major (Na, Mg, Al, Si, K, Ca, Fe) and minor (P, Ti, Mn) elements in rocks and other materials by XRF is presented. The code is based on the analytical method proposed a few decades ago by Franzini et al. (1975), which is based on the algorithm:  $C_i = I_i \cdot \sum K_{i,j} C_j$ , where  $C_i$  is the concentration (expressed as wt%) of the chemical element "i",  $I_i$  is the intensity of the characteristic line,  $C_j$  is the concentration of interfering elements, and  $K_{i,j}$  are experimental coefficients that account for the matrix effects (absorption and enhancement).  $K_{i,j}$  have the dimension of mass absorption coefficients and they may be calculated from a set of N reference samples using multivariate regression methods. The algorithm proposed by these authors is particularly suitable for processing samples prepared in the form of pressed powders. The Microsoft Excel spreadsheet allows you to: a) choose a set of reference samples (international or interlaboratory standards); b) evaluate the expected matrix effects on the basis of the XRF total mass absorption coefficients; c) calculate the correction coefficients  $K_{i,j}$  through multivariable regression; d) calculate the analytical accuracy and graphically represent the results; e) choose five samples (monitors) for the correction of instrumental drift. Based on these steps, the software allows you to: i) enter the analytical intensities of major and minor elements measured on the monitors and on unknown samples (the loss on ignition must be determined separately); ii) calculate the correction of the instrumental drift; iii) determine the concentration of elements and express them as wt%.

Corresponding Author: Marco Tamponi



## **LAND-USE CHANGE ANALYSIS OF SELECTED RIVER BASINS IN SLOVAKIA**

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### **ABSTRACT**

Land-use change is caused both by humans and nature. It can be perceived as a transformation process of the natural landscape, usually by giving priority to the functional role of land for economic activities (e.g., deforestation, overgrazing, rapid population growth, urbanization, and industrialization, etc.). The specific factors that affect the land-use change vary not only over time but also by geographical scale. This research aims to compare changes in land-use for the period from 1990 to 2018 on the territory of Slovakia. Three river basins were selected and analysed, each one to present specific land-use characteristics of the located area. The Boca River basin, a small mountainous watershed, is located in the Low Tatra National Park, in the north of central Slovakia. This area has been affected by several windstorms and bark beetle outbreaks in recent decades, which had a significant impact on the changes in forest cover. The Myjava River basin is located in the hill land area of western Slovakia, represented by agricultural areas and forest. Deforestation and extensive agricultural cultivation of originally natural areas in this region have caused an enormous intensification of the land use and landscape-forming processes, which led to tillage and gully erosion. The Žitava River basin is located in the southern Slovakia. The terrain of this watershed is mostly lowland; therefore, it is agriculturally used. Land-use changes are usually nonlinear and unpredictable and can cause a series of other problems, from loss of functionality and adaptability of the ecosystems to socioeconomic changes. Favourable interventions in the way the land is used can bring positive results. Therefore, it is important to assess and analyse the changes in land use over time, and to suggest or design possible solutions for adverse changes in the future.

Corresponding Author: Marija Mihaela Labat



**ANALYSIS OF FUTURE CHANGES IN SHORT-TERM RAINFALL CHARACTERISTICS IN THE HIGH  
TATRAS REGION**

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**ABSTRACT**

The paper focuses on the analysis of future changes in short-term rainfall characteristics in the High Tatras region. The analysis was performed at 5 climatological stations namely: Podbanské, Tatranská Lomnica, Javorina, Liptovská Teplička, Liptovský Hrádok. The area is located in the northern part of Slovakia in a mountainous region which belongs to mountain climate with characteristics long cold winters and short summers with heavy rainfalls (June, July). The future changes were analyzed from the predicted short-term rainfall intensities using Community Land Model. The Community Land Model was a multidisciplinary project between scientists from several working groups in the USA. The model uses ecological climatology concepts, which explains impacts of changes in vegetation on the climate. The model well relates to the current processes in the atmosphere, it is a semi-pessimistic scenario with a predicted global temperature increase is about 2.9 °C by the year 2100. The focus of the paper was put on the changes in seasonality, trend analysis and scaling exponents. The analyzed rainfall durations were available from 60 minutes up to 1440 minutes for the future period 2041-2100. The results were compared with the simulated data from the historical period 1961-2020. The analysis is focused on the seasonality changes in extreme rainfall which was analyzed by Burn's vector methodology, then the trend testing provided by Mann-Kendall trend testing method. Finally, we focused on the analysis of future changes in scaling exponents which were derived by simple scaling method.

Corresponding author: Gabriel Földes



**RESOLUTION QUALITY IMPACT OF DEM ON CALCULATION OF THE DESIGN FLOODS IN A SMALL MOUNTAINOUS BASIN**

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**ABSTRACT**

A Digital Elevation Model (DEM) is a powerful tool for representing the surface of a particular area of interest. The containing data in the DEM is used for determining the characteristics of the surface. The main quality factor of such data is the resolution of the DEM. In this paper, the authors focus on the resolution impact of the two DEMs, which were used to calculate the design flood in the Boca River basin. The Boca River basin is a small mountainous catchment located in the Low Tatra National Park in Slovakia. Authors have used Digital Elevation Models of the Boca River basin with the 20x20m and 1x1m resolution of the raster, and S- JTSK coordinate system. DEMs were downloaded freely from the Basic Database for GIS (ZBGIS®) which is a part of spatial database of the cadastral information system in Slovakia. The design values of short-term rainfalls from actual observations from Kráľová Lehota – Čierny Váh climatological station and Corine Land Cover land use map for 2018 were used as an input for the calculation of design floods. The design floods were calculated for the return period of 10, 20, 50 and 100 years, using the Soil Conservation Service - Curve Number method, and ArcGIS software and raster tools. The peak design floods were calculated by calculating the time concentration, the maximum potential river basin retention, the design rainfall intensity, the depth of runoff, and the flood wave volume. The aim of the paper was the result comparison of these calculations when the two different quality resolution DEMs are used. Results show that the design floods calculated using the more precise DEM with 1x1m raster were lower by 3.9% than the design floods calculated using the DEM with the 20x20m raster.

Corresponding Author: Milica Aleksić





## **BUILT ENVIRONMENT CHALLENGES DUE TO CLIMATE CHANGE**

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### **ABSTRACT**

Climate change has become one of the most significant problems of recent years. It results in higher incidence of extreme events, such as strong winds, heavy precipitation, floods and droughts. Their consequences have a negative impact not only on the environment, but also on engineering structures and the safety of the population. In this article, the relationship between the built environment and the effects of climate change is characterised in order to propose systemic changes to improve the adaptation of cities to climate change. Weather- and climate-related hazards for built environment are analysed, and the possibilities to reduce the risk and mitigate the effect of construction disasters, should they occur. Moreover, a case study conducted in Central Europe has been presented. Based on quantitative data from the Central Office of Building Control in Poland from 2006-2018, the occurrence of construction disasters, their causes and consequences were examined. It was found that the main cause of disasters occurring in Poland during this period were random events (73%), which consisted in particular of extreme weather events such as strong wind or strong wind with accompanying heavy precipitation causing floods and landslides. The highest number of construction disasters (1113) was recorded in 2008, and as many as 95.6% were caused by random events. The conclusion indicates the need to prepare the built environment for climate change and to develop appropriate solutions to reduce the risk of climate-related hazards and to mitigate their effects. Based on the conducted analyses, a conceptual framework of improved climate-resilient built environment management was proposed.

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## **IMPACT OF DISMANTLED SHEET PILE VIBRATION ON COHESIVE SOIL PARAMETERS**

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### **ABSTRACT**

Dynamic impact of geotechnical works can affect subsoil as well as structures and technical devices. In order to prevent hazards resulting from vibration, the monitoring of geotechnical works execution is necessary. This paper presents an analysis of the relationship between the vibration caused by pulling out sheet pile and the variability of cohesive soil parameters. The authors present the case study of a construction site in Wrocław (Lower Silesian Province, Poland). The sheet pile profiles were used as temporary protection of the foundation excavation. After the underground floors were constructed, the sheet piles were pulled out from the ground using vibrating techniques. This is a typical action to recover steel profiles that can be reused. While the sheet piles were being pulled out, the cohesive soil adhered to steel surfaces. In order to analyse the impact of dismantled sheet pile vibration on the variability of soil parameters, laboratory tests of basic soil physical and mechanical properties were carried out. The results were then compared with the primary parameters of soil as specified in geotechnical documentation, which had been made at the initial stage to determine the geotechnical conditions for foundation of the designed building. The comparison has shown a negative effect of vibrations on soil properties, including a decrease in the strength parameters, as well as an increase in the liquidity index. Therefore, vibration works increase the earth pressure on the existing underground structures and reduce the bearing capacity of shallow foundations.

Corresponding Author: Zofia Zięba



## **GEOHERMAL POTENTIAL OF MINING WATER IN THE BÍLINA MINES**

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### **ABSTRACT**

This article is focused on utilization of geothermal potential of mining water in the Bílina Mines. The intention to explore geothermal potential in this area of interest based on consideration to use of this type of the Earth's heat, such an alternative source of energy. Geothermal energy is cost effective, reliable and sustainable. Using of the geothermal energy leads to the production of green energy. Although geothermal energy has many advantages is not so much utilized. Geothermal energy is natural heat of the Earth, which is accessible from the surface. Economically recoverable only in places its accumulation in the anomalies. In terms of geothermal energy, the site, as part of Podkrušnohorské area, and these are to the most promising areas in the Czech Republic sections characterized by high heat flow. In article is presented research of geothermal energy at Bílina mines, where the temperature of mining water and abundance of four hydro-geological boreholes were monitored in 2009-2010, 2011-2012 and 2018. Over 200 000 m<sup>3</sup> of water is dewatered from the Bílina Mines annually. These boreholes are used for water monitoring from the mine. Due to the large amount of water pumping is area of interest interesting for using geothermal energy. Results showed that although the geothermal potential of the mine water is not so significant, there will be great potential in low-temperature energy source use for heat pumps. Heat pumps are less expensive, they do not drill deep and their installation is easier. For our case study is recommended use water-to-water heat pumps.



**TECTONIC STRUCTURES OF THE SOUTHEAST FLANK OF THE JUNCTION ZONE OF THE IN'YALI-DEBIN SYNCLINORIUM AND THE OMULEVKA TERRANE (KOLYMA-OMOLON SUPERTERRANE, NE ASIA)**

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**ABSTRACT**

The study area is located in the zone of junction of the In'yali-Debin synclinorium and the Omulevka terrane (Kolyma-Omolon superterrane of the Verkhoyansk-Kolyma fold belt). The main tectonic structure is the Momontay syncline made of Middle Jurassic clastic rocks overlain by Upper Jurassic volcanic and volcanoclastic rocks of the Uyandina-Yasachnaya volcanic arc. The Au and Au-Ag occurrences known here are combined to NE-trending faults and hosted in subvolcanic and volcanogenic rocks including mainly rhyolites and dacites. The studied Middle Jurassic rocks are found to be characteristic of near-shore shelfal environments changing, in certain time intervals, to deltaic conditions of sedimentation. The presence in the conglomerates and sandstones of large poorly rounded quartzite and carbonate fragments and of mudstone and volcanite pebbles indicates a proximal provenance of the clastics. For the first time we established a sharp angular unconformity between the intensely deformed Middle Jurassic and Upper Jurassic rocks in the region. Relations between the Late Jurassic subvolcanic deposits and the host rocks were studied. The carried out structural and tectonophysical investigations showed that folding occurred in two deformation stages. During the first stage, the Middle Jurassic clastic rocks were draped into small recumbent to isoclinal folds, cylindrical and parallel-type, with a NW strike. Cleavage is rare. The structural paragenesis, represented by bedding-plane detachment faults, thrusts, normal faults, and strike slip faults is found to have formed in a single stress field with the folds of the first deformation stage. The intensity of the first-stage folding increases from west to east. Reconstructed are axes of paleostresses responsible for the formation of fold-and-thrust structures of the first deformation stage. The Upper Jurassic volcanogenic-sedimentary strata were deformed into superposed large, simple, open folds of the second stage, which exhibit sublatitudinal orientation. They associate with small-scale thrusts and, rarely, strike-slip faults. It is recognized that in the late Middle Jurassic or the early Late Jurassic the region was affected by intense folding which produced tectonic structures of the NW strike. Accumulation of the Late Jurassic volcanogenic rocks and intrusion of subvolcanic deposits occurred on/into the already deformed Middle Jurassic rocks.

Corresponding Author: Dmitry A. Vasiliev



**TECTONIC STRUCTURES OF THE MANGAZEYA ORE CLUSTER (VERKHoyANSK RANGE, NE ASIA)**

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**ABSTRACT**

The Mangazeya ore cluster is located in the central part of the West Verkhoyansk sector of the Verkhoyansk fold-and-thrust belt, in the zone of junction of the Kuranakh anticlinorium and the Sartang synclinorium. High-tonnage Ag deposits and occurrences are concentrated here, which are thought to be associated with the zones of longitudinal strike-slip faults and bedding-plane thrusts. Structural studies were conducted in the dome and the eastern limb of the Endybal anticline, in the areas of the Nizhne-Endybalskoe, Verkhne-Endybalskoe, Bezymyannoe, Vertikalnoe, Sterzhnevoe, and Semyonovskoe ore deposits. The Endybal asymmetric anticline 10-15 km wide and 60 km long, with a wide gentle dome is the major tectonic structure of the territory. The conducted structural and statistical analyses of tectonic structures in the study area allowed better understanding of their specific features and trends in development. Morphology of the fold structures indicates manifestation of concentric-type folding produced by bending of strata as a result of bedding-plane slipping. The same NS orientation of the cleavage and folds gives unanimous evidence for their genetic relationship and formation in the conditions of EW horizontal compression. It is established that the structural paragenesis represented by fractures, normal faults, and extension structures in the hinge zone of the concentric Endybal anticline, which determines the general tectonic pattern of the Mangazeya ore cluster and controls localization of ore bodies, was formed at the first deformation stage or in course of bedding-plane faulting and fold-and-thrust deformations rather than as a result of strike-slip motions. It is shown that strike-slip motions of the second deformation stage not only produced new structures but also inherited disturbances of the previous stage. It is found that normal faults in the study area formed synchronously with the fold-and-thrust structures. A similar orientation of the major faults and the strike-slip faults suggests that the regional faults have strike-slip kinematics. The occurrence of different types of tectonic deformation is controlled by rock lithology.

Corresponding Author: Dmitry A. Vasiliev



**TECTONIC CONDITIONS FOR THE FORMATION OF STRUCTURES OF THE SAKANDZHA ORE DISTRICT (SELENNYAKH RIDGE, NE ASIA)**

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**ABSTRACT**

The Sakandzha gold-ore district occurs in the north-western margin of the Selennyakh allochthonous block of the Omulevka terrane forming part of the Kolyma-Omolon superterrane (Verkhoyansk-Chersky orogenic belt, NE Asia). Tectonic structures of the Sakandzha ore district were formed in two stages of the Late Mesozoic deformation: thrust and strike-slip fault ones. Formation of the fold-and-thrust structures of the early Late Mesozoic deformation stage within the Selennyakh block and its thrusting, in the form of a thrust sheet, over the fold structures of the Tuostakh-Polousny zone in Neocomian time were almost synchronous with the intrusion of large granite plutons (Sakhanya and Syachan) into the fold-and-thrust structures in the northern part of the Verkhoyansk-Chersky orogenic belt. By the end of the Neocomian or in pre-Aptian time, strike-slip deformations of the second Late Mesozoic stage were superposed on the early thrust structures. At that time, the Selennyakh block was divided into smaller blocks by strike-slip faults, among them the Kalychan one. Two ore-bearing segments of different structure, Pology and Arbat, are distinguished within the Kalychan dextral strike-slip fault zone. As a result of strike-slip motions, the sedimentary rocks of these segments became steeply inclined, strongly deformed, and were pierced by a network of variably oriented fractures and cracks, which made them highly permeable for the circulating hydrothermal and ore solutions. The major Kalychan, Upper Kalychan and Arbat strike-slip faults are interpreted as the ore-feeding faults. The feathering subsidiary faults as well as strongly fractured zones are considered as ore-controlling and ore-bearing structures. The end of the Neocomian was marked by completion of the collision, and the Aptian-Albian period saw the inception of the Dzhakhtardakh volcanogenic belt of Early to Late Cretaceous age. Its formation is considered to be related to the crustal extension processes preceding the opening of the Eurasian ocean basin.

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**SEISMIC ACTIVITY INDUCED BY EXPLOITATION IN VICINITY OF MINED-OUT SPACE, CASE STUDY  
FROM DEEP COPPER ORE MINE IN POLAND**

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**ABSTRACT**

Rock bursts are one of the most difficult to recognize and assess natural hazards in deep copper ore mines in Poland. The occurrence of rock bursts is conditioned by a number of complex geological and mining factors. The impact of each of the factors on the state of seismic hazard is sometimes impossible to be determined. The correct recognition of the rock mass condition and the causes of rock burst threat gives a chance for advance preparation of adequate prevention, and thus for eliminating or reducing the threat to the level of tolerated risk. In Poland's copper ore mines, continuous observation of seismic activity is carried out, which is expressed in the number of tremors and their energy over a specified period of time. Moreover, the effectiveness of prevention measures and, in particular, of the active ones, which are aimed at provoking seismic energy emissions through properly executed winning blasting works, is calculated and analysed. Reducing the amount of energy accumulated in the rock mass reduces the risk of rock bursts. Exploitation is carried out in a way that avoids parallel approach of the operational front towards the goafs, drifts, and faults with drops greater than the height of the mined deposit. However, over forty years of mining of the copper ore deposit, which has created the large areas of mined-out space mean that mining works are increasingly carried out under restrained conditions. There are unfavourable geological and mining situations in the exploitation fields, disrupting rhythmic development and an even front line. The specific structure of the copper ore deposit in Poland makes it possible to conduct multidirectional cutting and to introduce local changes in the adopted directions of exploitation. Cases of operational fronts approaching goafs occur often in the vicinity of old mining infrastructure and when there is the need to mine remnant parts of the deposit not previously intended for exploitation or not mined yet. Generally, exploitation in the direction of goafs or yielding zones is limited to the cutting and yielding works. The purpose of the study was to analyse the seismic and rock burst hazard in an exploitation field located at a depth of 850 m in a copper ore mine, over a period of 6 years, when mining was carried out towards goafs. Seismic activity and the effectiveness of rock burst prevention measures were assessed and analysed. The active prevention i.e. the group winning blasting works was an inseparable element of the excavation technology. It was found that when the operational front progressed towards adjacent goafs, there were symptoms of an increase in rock mass pressure causing the destruction of roof rocks and, as a consequence, deterioration of roof stability, squeezing of floor, relaxation of the side walls and increase of seismic activity, which posed the potential threat of rock bursts

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**MODELING AND COMPARISON OF DATA OBTAINED BY GPR, FOR GEOLOGICAL / STRUCTURAL ANALYSIS OF A CARBONATED ORNAMENTAL ROCK QUARRY - BLOCOMETRY VALIDATION - CASE STUDY IN VALINHO DE FÁTIMA, PORTUGAL**

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**ABSTRACT**

Portugal, in the continental and insular territory, has raw geological resources in diversity and quality that are materials for the manufacturing industries, particularly linked to the civil construction, architecture and public works with great weight in its exports, revealing to be one big producer of ornamental stones worldwide. In this industry, the presence of discontinuities, grain size, colour, textural anisotropy and porosity are factors that can determine the economic viability of the exploitations. For this, it is important to develop effective prospecting routines that allow the geological/structural fast analysis and economic potential assessment of the massifs and subsequent correct planning and dimensioning of the exploitations. This work intends to model and integrate data from the ground penetration radar (GPR), together with close range photogrammetry, derived from UAV (DJI Phantom 4) imagery. The objective is to identify and determine the spatial distribution of the various elements by modelling the acquired data, as well as verifying the feasibility of the technical disassembly option adopted. We have used GPR as it is non-destructive, fast to deploy, survey, process and interpret. It was used a PULSEEKKO GPR acquisition equipment (SENSORS & SOFTWARE), with a system of two bi-static antennas (transmitter and receiver), shielded, with a frequency of 250 MHz, using the reflection method with common displacement and with an antenna separation of 0.40 meters (m), in a predefined grid, localized in the quarry, with the tested block being entirely composed of oolitic limestone and oolitic limestone with crossed stratification. The acquired data was processed using the GPR-SLICE, where a 3D final dataset was obtained and interpreted. GPR and photogrammetric model was integrated and interpreted and validated with direct field observations. The model obtained showed in its upper part, an area corresponding to the presence of sludge from the cut of the rock, followed by a strip that corresponds to the oolitic limestone. Further down to the end of the block, the presence of oolitic limestone with crossed stratification is identifiable. Curiously from direct field observation, the oolitic limestone has a blue hue that doesn't produce a noticeable direct response in GPR signal. There was a textural and structural correspondence between the GPR data and direct field observations. GPR did not reveal any major morphostructural discontinuity, validating the technical option of choosing the places where the cuts were made for their individualization, as the block was cut clean. The GPR and photogrammetry data integration method revealed to be complementary, where results were obtained easily, fast and with centimetre accuracy. The same methodology presented, revealed to be cheap and effective for both localized studies and optimization of overall quarry's extraction plan and design.

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**QUALITY OF AN UNDERGROUND HYDRO RESOURCE IN ORDER TO CLASSIFY IT AS NATURAL MINERAL WATER FOR TERMALISM: THE CASE OF THE NEW RESOURCE "TERMAS DE SÃO TIAGO"**

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**ABSTRACT**

A Medical Spa in Portugal to work legally needs to be supplied by a groundwater that is classified as natural mineral water. After the referred classification, that water is considered as a geological resource and of the public domain, that is, protected by the Portuguese State. Among several studies, mainly hydrogeological, the quality of that natural resource and its physical-chemical and microbiological stability, over a hydrological year, is absolutely crucial to obtain the official classification of the resource. Thus, the main objective of this paper is to present the fundamental elements of that domain, in the sense of presenting a case study, which serves as an example to other situations. The results of physical-chemical and microbiological analyses, performed monthly, for 12 consecutive months, as well as, the results of a very complete analysis with trace chemical elements, gases, radiological parameters, mineral oils and polycyclic aromatic hydrocarbons, are presented, analysed and discussed. Finally, the main hydrogeochemical classifications of that natural resource are presented, which led to the new mineral water called as "Termas de São Tiago", and which was responsible for the fact that Portugal can currently count on a new medical spa in operation.



**VULNERABILITY OF THE TERRITORY OF SÃO TIAGO MEDICAL SPA AREA IN RELATION TO THE PRESERVATION OF ITS MINERAL WATER QUALITY**

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**ABSTRACT**

The world is becoming more and more demanding in the quality of life of the common citizen. One way to achieve this quality is to enjoy health tourism. Medical Spas are an excellent equipment in this sense, because they allow practices of health treatment, or relaxation and well-being, aqualudic, focused on the use of natural mineral water, and with direct or indirect monitoring of health professionals (doctors). Thus, in Portugal, for a medical spa to function as such, it must have mineral water of stable quality. For this to be possible, it is necessary to comply with a set of procedures in the exploitation of water, and to impose restrictions on certain types of activities and due limitations on the occupation of the territory, in accordance with the implementation of the Protection Perimeter of groundwater abstraction of the medical spas. The maps of vulnerability to groundwater contamination are excellent instruments to contribute in the elaboration of the aforementioned Protection Perimeter. Thus, this paper presents the fundamental hydro-environmental elements in order to present the vulnerability map of the São Tiago medical spa territory. The General DRASTIC method is used, with a set of adaptations, called Specific DRASTIC, in order to preserve the areas most sensitive to the potential contamination of natural mineral water, and to liberate other areas that are not of potential danger to its contamination. It is also presented the map of occupation of the territory with registration of the main sources of potential pollution, making an analysis of the relationship between the results of the vulnerability map and the types of occupation. Finally, some conclusions and recommendations are briefly presented.

## **THE ASSESSMENT OF POTENTIAL PREDATOR PREY INTERACTIONS THROUGH ANIMAL-VEHICLE COLLISIONS IN SOUTHERN POLAND**

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### **ABSTRACT**

Predator-prey relationship can serve as a fundamental element of urban ecosystems. Specific locations of animal crossings of the roads sometimes act as a potential trap for those wildlife species being more frequently hunted by predators than elsewhere in the surrounding environments. In our study, we used locations of animal-vehicle collisions (AVC) to explore the potential relationship of predator-prey interactions in an urban gradient. The study area, Krakow, is the second largest Polish metropolitan city with a population of 775000 in 2019. The research aimed to analyse prey-predator interactions in relation to seasons, habitat types and some biometric measurements of the road killed animals. Data collected between 2007-2013, included AVC of over 1500 mammals and 250 birds of potential prey, and 300 and 1000 cases of wild predators (mostly red fox *Vulpes vulpes* and stone marten *Martes foina*) and domestic predators (cat *Felis catus* and dog *Canis lupus familiaris*) respectively. In 3050 analysed cases, domestic cats (55%) were the most common predators involved in AVC followed by domestic dogs (18%) and red foxes (17%), whereas the most frequent AVC cases of prey species included roe deer *Capreolus capreolus* (61%) and wild boar *Sus scrofa* (7%). The geographic coordinates of each AVC were recorded to perform spatial analysis by GIS. Based on the literature of home ranges of the most common in Poland AVC species, we have modelled the locations of hot spots (places of high occurrence of collisions) and analysed a spatial and temporal overlap between predators and their potential prey. Additionally, both predator and prey animals were grouped under three categories based on their body mass. We found a distinct seasonal pattern of AVC overlapping both predator and prey. AVC was high during spring and autumn implying consequent greater interactions during these periods. Spatial analysis determined the locations of AVC of prey and predators such as roe deer and domestic dogs, also our results showed strong seasonal positive interaction of AVC between red fox (predator) and roe deer (prey) during spring and between cats (predator) and birds (prey) during summer seasons.

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**THE METHOD OF CORRELATION OF THE PASHISKY HORIZON DEPOSITS IN THE CENTRAL PART OF THE ORENBURG REGION BASED ON THE COMBINED SELECTION OF ELECTROMETRIC FACIES AND LITHOTYPES OF ROCKS**

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**ABSTRACT**

Reducing the active residual oil reserves of large fields is a prerequisite for forced approaches to maintaining the rate of production in regions with developed infrastructure by involving previously unclaimed, small-scale reserves and complex geological formations in the development. One of such promising objects within the well-developed territories of the Orenburg region is the terrigenous deposits of the upper Devonian Pashisky horizon, characterized by heterogeneity of reservoir layers. The identification of regularities and determination of the causes of heterogeneities in the filtration and reservoir properties of the upper Devonian Pashisky horizon on the territory of the Orenburg region, which significantly improve the reliability of the geological model and geometry of the formation in order to optimize its further development, is possible with the use of the proposed integrated approach, even in conditions of low representation of logging and core selection. The aim of this work is to develop a combined approach to the identification and well correlation of productive layers of the upper Devonian Pashisky horizon in the Central part of the Orenburg region. The structure of the work includes the following tasks: 1. Selection of lithological and genetic types of rocks of the Pashisky horizon based on such geological and geophysical data as macroscopic description of the core of wells and microscopic description of the thin sections. 2. Isolation of electrofacies in the section of the Pashisky horizon by V. S. Muromtsev. 3. Identification of the dependence of electrofacies with selected lithotypes corresponding to the idealized facies profile of M. Irwin. 4. Correlation of wells based on the identified dependencies. As a result, lithological and genetic types of rocks were identified for the study area– sandstones, mudstones, siltstones, limestones, and alternation of siltstones and mudstones. The analysis of the PS curve allowed us to divide the section of wells, including those not covered by core, into conditional identical units, which were compared with Muromtsev's electrofacies. It is established that the deposits of the Pashisky horizon were formed in the conditions of the sea coast with mixed wave activity. As a sealrock, we consider a pack of mudstones in the upper part of the horizon. As a result, the method has been developed that includes a number of sequential steps for detailed correlation of wells using complementary methods for characterizing well sections and determining sedimentation conditions. The proposed approach has shown a satisfactory result of predicting the filtration-capacity properties of different facies deposits of the Pashisky horizon, which may become a prerequisite for testing the combined method on other deposits of similar genesis.

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## **STUDY OF THE EXPLOSIVE PROPERTIES OF A HYBRID MIXTURE OF METHANE AND COAL DUST**

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### **ABSTRACT**

Notwithstanding the significant scientific and technical measures (events) preventing the explosion of methane and coal dust in coal mines, today, the incidents and accidents in mines caused by explosion, still remains the main challenge of security. Annually several hundred miners die or acquire serious trauma from explosion. During of recent decade, more, than 50 serious accidents were occurred in the different countries of the world, which were caused by explosion of methane and coal dust. The explosions constitute a serious issue for the active mines operating in Tkibuli – Shaori (Georgia) coal field. Here, as a result of two explosions during 2018 year, 10 people died and 9 was seriously injured. The literature analysis shows, that the properties of explosions caused by methane and coal dust mainly are independently studied, there aren't foreseen the character of their interaction, while methane and coal dust are mixed with each other. Even more is unstudied the impact of coal dust's fraction on explosion ability and flammability of the mixture of methane and coal dust. Besides, the explosion ability and flammability of methane and coal dust mixture varies according the coal from different fields. This is caused by fact, that coal's physical, chemical and material composition is different. The paper presents G. Tsulukidze Mining Institute research defines the coal dust fraction's influence on the explosion ability of the mixture with methane composition and dangerous concentrations for the Tkibuli coal mine terms. The experiments defining the detonation, deflagration and ignition / flammability of the mixture of coal dust and methane is being held in the explosion chamber of new construction shock tube in the underground explosion complex of the Mining Institute. The explosive ability of the mixture of coal dust and methane into the shock tube will be defined according to EU standard: EN 14034, ASTM standard E1226 and Chinese standard GB/T 16425. The shock tube consists of explosion chamber, sectional pipes, the system of metered supply of water, methane, solid particles, fuel, high pressure and flame sensors to study the explosive properties, computer module managing the processes and devices recording the oscillogram showings. The mixture's deflagration will be studied via high-speed video cameras (models: MotionBLITZ EoSens Cube7 and MotionBLITZ EoSens mini2).

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## **UTILIZATION OF ENERGY BY-PRODUCTS FOR GROUND STRUCTURES IN TERMS OF PRODUCTION PROCESS**

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### **ABSTRACT**

Energy by-product (EBP) is generated during coal combustion and gas desulfurization in conventional coal-fired power plants. Utilization of EBP has become a frequently discussed topic. It is desirable to use EBP for further processing – e.g. for technical reclamation of former mining activities, ground structures, construction products, etc. A significant proportion of EBPs is used as an additive in various construction mixtures, with subsequent commercial use as a certified product. EBP is gradually finding an ever-wider application in traffic construction and in the environmental assets, where it functions as structural layers of earth bodies and dams. The suitability of EBP for ground structures significantly depends on its production process. Its properties are influenced by brown coal flotation and by the usage of desulphurization methods. At the same time its properties depend on other added components, especially mixing water, and slag. EBPs include fly ash, slag, gypsum, and so-called stabilizer. Design and implementation of soils (including EBP) for the construction bodies of road structures is specified in Czech national technical standard „CSN 73 6133“. Suitability of soils (including EBP) for various zones of dams and embankments is given via Czech national technical standard „CSN 75 2410“. Grain size of the material is the most decisive physical-mechanical attribute for the abovementioned use, which can differ fundamentally regarding the method of production of various types of EBPs. Within the studied issue, a comparison of physical-mechanical properties of different types of EBPs was performed. Most data on EBPs was obtained from a comprehensive archival research, which was supplemented by own laboratory analyzes performed on samples of EBP taken from selected repository. The aim of the work was to compile an apparent table of Utilization and suitability of EBP for ground structures – road earth bodies, dams and embankments according to the process of their formation. The table contents also characteristic values of main physical-mechanical parameters.

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**ABOUT A POSSIBLE SECOND SOURCE OF TRAP MAGMATISM IN THE EAST OF THE SIBERIAN CRATON**

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**ABSTRACT**

There was made a comparison of trap formation of two major tectonic structures of the eastern part of the Siberian craton - north-east of the Tunguska syncline and Olenek uplift. Using the analysis of geological data and isotopic age determination by methods of  $^{40}\text{Ar}/^{39}\text{Ar}$  and U-Pb (also outside the researching area), we can conclude, that the traps of the Tunguska syncline are 264-240 million years Permo-Triassic age, at the same time the age of the traps of the Olenek uplift defined as Lower Triassic. The traps of the Tunguska syncline were formed in three independent intrusion phases, each has its petrochemical specifics, but at the Olenek uplift there was a single impulse that formed the rocks of the same type, with a well-defined pre-chamber stage of melt crystallization. The magma that formed the dolerites of the Olenek uplift was more magnesian. The REE distribution patterns for the traps of the Olenek uplift are steeper ( $\text{La}/\text{Ybn}=2.4-2.8$ ) in comparison with the Tunguska syncline traps, the total amount of REE (g/t) in them is within 58-63. A well-defined Sr maximum, promoted by the presence of the early-formed basic plagioclase, is mostly shown in the Olenek uplift traps. In the Nb/Th-Zr/Nb and Nb/Y-Zr/Y diagrams of chemical behavior to incompatible elements, dolerites of the Olenek uplift form composition fields, which are isolated from the Tunguska syncline traps, thus showing their specific nature. So this information gives us the right to talk about two different sources for the trap forming of the Tunguska syncline and the Olenek uplift. They resulted from independent plume-induced magmatic events.

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## **BEHAVIOR OF TiO<sub>2</sub> IN DOLERITES AS A POSSIBLE SEARCH SIGN OF KIMBERLITE CRITERIA**

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### **ABSTRACT**

A generalization of studies of the chemical composition of dolerites of the Vilyui-Markha dyke swarm (VMDS) in the Eastern part of the Siberian Platform is carried out. This belt stretches along the North-Western side of the Vilyui paleorift system (Eastern part of the Siberian platform) for almost 700 km. The formation of VMDS intrusives took place in the interval of 372 million years. The Devonian kimberlites, which formed three kimberlite fields: Malo-Botuobinsk, Nakyn, Suldyukar, are confined spatially to the VMDS. One is in the Southern part of the belt, and the last two are in its Central part. The formation of kimberlite pipes according to K-Ar, <sup>40</sup>Ar / <sup>39</sup>Ar, Rb-Sr dating is close to 362 Ma. When studying dolerites, it was found that near the kimberlites, the proportion of TiO<sub>2</sub> increases in the first (almost 2 times - up to 4-5% versus 2.2-2.5%) and a number of heavy rare-earth elements, such as Th, Hf, Y, Nd. An increase in the content of these elements proceeds gradually from the edge of the kimberlite field to kimberlites and reaches a maximum of 7% (a single case) directly near kimberlites. The authors suggest that the latter is indirectly associated with kimberlites. According to the experimental data of A.Y. Medvedev (1987), the solubility of titanium in a basite melt sharply increases with increasing pressure. The kimberlite-forming system is long-lived, associated with diapir-like kimberlite protrusion, which subsequently produces kimberlite pipes. Long before the formation of kimberlites around the diapir, possibly located in the lower horizons of the earth's crust, excessive stress pressures are created (Nikishov and Gusev, 1984). A basite melt, penetrating through these abnormal (relative to pressure) regions, reacts with an increase in the content of titanium and HREE. Outside the kimberlite field contours, the content of the elements in question in dolerite dikes remains normal, i.e. 2-2.5%. Based on the above stated fact and the study of the geochemistry of dolerites of VMDS, the authors suggest the discovery of two more kimberlite fields within the swarm: Tenkelyakh, located 20-30 km North of the famous Nakyn field, and Orto-Kyulunke, whose location is possible in the North of the VMDS. The authors gave the names of the fields by the names of the rivers flowing through this territory.

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**THE NEW DISCOVERY NATIVE IRON IN TRAPS OF THE SIBERIA**

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**ABSTRACT**

A massive manifestation of native iron nodules weighing up to four hundred kilograms was established in a trap intrusive near Aikhmal settlement. In addition to large segregations, the native iron occurs as drops in the rock-forming minerals of dolerites rimming the iron nodules. In terms of petrochemical composition, dolerites of the sill belong to typical tholeiites of the traps of the Siberian platform, and correspond to low-Ti basites ( $\text{TiO}_2 \sim 1\%$ ) with increased magnesium content ( $\text{Mg\#} = 56\text{-}63$ ) that have passed through the deep (pre-chamber) stage of melt crystallization. The dominant mineral in the nodules is native iron, with subordinate cohenite ( $\text{Fe}_3\text{C}$ ), troilite ( $\text{FeS}$ ) and magnetite ( $\text{Fe}_3\text{O}_4$ ). X-ray phase analysis revealed that the native iron has the  $\alpha\text{-Fe}$  structure with the unit cell parameter  $a=0.2860$  nm. The Brinell hardness is in the range of 110-117 HB units (or 1080-1150 MPa). With regard to low Ni content ( $< 1\%$ ) the native iron corresponds to the mineral species ferrite. It is assumed that the main condition for the presence of native iron in megascopic quantities in traps is fractionation of a basaltic melt in the deep-seated intermediate chamber. In this situation, the interaction of the basaltic melt with a high-temperature intratelluric fluid, characterized by highly reducing properties, led to dispersion of the initially homogeneous basaltic liquid into liquates of silicate and metal composition. It is the finely dispersed state of the fluid-magmatic system that favored the appearance of the native phase, above all of iron.

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**CHANGES IN PRECIPITATION IN POLAND IN 21<sup>ST</sup> CENTURY IN THE LIGHT OF QUANTILE CLASSIFICATION OF PRECIPITATION**

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**ABSTRACT**

The study aims to analyse the variability of the precipitation character of seasons and years at selected stations in Poland in the 21st century. The work includes six meteorological stations located in specific regions of Poland. The precipitation character of years and climatic seasons was determined using the Miętus quantile classification (2005), based on the values of 10, 30, 70, and 90% quantile of the empirical distribution of seasonal and annual precipitation. 1971-2010 precipitation data (normal period) were applied to calculate the quantiles values. In spring (March-May), the highest frequency of precipitation anomalies was recorded in Wrocław station. In the 21st century, precipitation of only one spring period was classified as normal at this station. Seven springs were dry or very dry, and 11 were wet or very wet. The most stable seasonal precipitation in spring was observed in Suwałki station. In the years 2001-2019, the twelve spring seasons had normal rainfall. Three spring seasons in Suwałki were classified as dry or very dry and five as wet or very wet. In the summer season (June-August) stations in Szczecin and Wrocław recorded a high frequency of precipitation anomalies. At each of these stations, 15 summer seasons were characterized by abnormal rainfall. The frequency of rainfall anomalies in the summer season was the smallest at the station in Suwałki, where ten seasons with abnormal rainfalls were recorded, including three seasons with low or very low rainfall and six seasons with high or very high rainfall. In the autumn season (September-November), precipitation was more stable in western and central Poland, where the number of seasons with abnormal precipitation ranged between 9 at the stations in Szczecin and in Wrocław to 10 at the station in Łódź. In Lublin, on the other hand, as many as 15 seasons with abnormal rainfall was recorded in the 21st century. In the winter season of 2001-2019, rainfall amounts of unusual nature dominated at all stations, with the frequency being higher at stations located in eastern Poland. The analysis of annual sums of precipitation showed all stations that most years were abnormal in terms of precipitation, with a higher frequency of precipitation anomalies at stations located in the eastern part of the country.

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## **NOISE IN THE MINING WORK ENVIRONMENT - CAUSES, EFFECTS, THREATS**

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### **ABSTRACT**

According to reports, the European Agency for Safety and Health at Work, millions of employees in Europe are exposed daily to industrial noise and other risks associated with it. About 7% of employees suffer from hearing problems, noise-induced hearing damage is the most common occupational disease in Europe because it accounts for about one-third of all work-related diseases and is more common than skin and respiratory diseases. The industries with the highest noise emissions in the work environment include heavy industry, mining and construction, although noise is also increasingly appearing in other sectors of the economy. The research issues discussed in the article introduce the issue of noise in the mining work environment of Polish hard coal mines and identify its causes, effects and threats. The article presents the results of hearing screening tests conducted in 2019 using a mobile diagnostic center among over 3,000 employees of 37 hard coal mines located in the region of Upper Silesia and Lesser Poland voivodeships as well as describes the effects of exposure to noise among employees. The article also identifies noise sources and presents the level of their emissions in connection with the operation of machinery and equipment used in Polish hard coal mining. The obtained results of the measurement of the sound intensity of mining machines and devices point to repeatedly exceeding the permissible hygienic standards of Polish and European noise emission. The results of the research presented in the article indicate the urgent need to take action to constantly control the noise level at the workplace and introduce solutions that will enable its reduction and allow better protection of employees against its disastrous consequences. The article is an interesting case study of research conducted in a natural industrial environment that allows you to start a broad discussion on harmful factors in the work environment and look for solutions that increase the level of employee safety during work.



**A REVIEW OF GEODETIC AND REMOTE SENSING METHODS USED FOR DETECTING SURFACE  
DISPLACEMENTS CAUSED BY MINING**

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**ABSTRACT**

The article describes the main development trends of methods for determining surface displacements (deformations) resulting from the phenomenon of induced seismicity by mining operations. This phenomenon occurs along with anthropogenic activity that violates the natural state of the rock mass through mining, mining of conventional and unconventional hydrocarbons, underground storage of liquids and gases, production of geothermal energy and retention reservoirs. Due to the unpredictable and sudden nature of induced seismicity, it is difficult to make measurements of displacements by traditional geodetic methods. In order to determine the methods used to determine surface displacements, an extensive review of current scientific literature was carried out. The selection of the displacement measurement method is important because it provides basic information about deformations that is used in further studies, e.g. predicting future deformations or the impact of deformations on surface objects. The scope of the analysis included methods for measuring deformations in mining areas during and after mining. Based on the review of over a dozens of research papers, geodetic and remote sensing methods are presented, which are used to determine surface displacements at a lower or higher intensity. The analysis of the methods concerned in particular: leveling, Global Navigation Satellite System (GNSS), satellite radar interferometry, airborne LiDAR and aerial photogrammetry. The development of electronics and the space sector has meant that techniques based on measurements from air and space have a significant share in the review. As a result of the analysis, it was found that satellite radar interferometry is presently the predominant displacement detection technique. This is largely due to the widespread availability of satellite imagery, e.g. from the European Space Agency's Sentinel-1 mission. The satellite radar interferometry method gives the opportunity to study deformations that have occurred in the past, which is impossible with the other methods. In addition, it was emphasized that each method has certain limitations, which is why it is important to select the measurement technique for the phenomenon and area of research.

## PANCHINA CALCARENITE: A BUILDING MATERIAL FROM TUSCANY COAST

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### ABSTRACT

The “Panchina” calcarenite widely outcrops on the Tuscan coastline from Livorno to Baratti (western Tuscany). It is a stone, highly porous with medium sized grains rich in organogenic calcareous fragments mainly consisting in shells of bivalves, gastropods, and echinoderms visible to the naked eye or by using a lens. In the framework of the ongoing research on the building stones and mortars used throughout the Middle Ages in and surrounding the Pisa’s city (western Tuscany), this study focuses on the determination of the main physical and mechanical properties of “Panchina” stone samples from Livorno coast (Tuscany, Italy). The “Panchina” stone is no longer quarried and data is collected from unweathered rocks sampled from currently accessible outcrops. The data collected on eighteen samples from six outcrops of the Tuscan coast showed that the analysed specimens are made up of abundant calcite (63-90 wt%), subordinate quartz (8-34 wt%) and feldspars, and traces of phyllosilicates. They are characterized by medium-high porosity (12-37 % by vol.), highly variable water absorption by capillarity (at 5 minutes, 10-514 g/m<sup>2</sup>) and by total immersion at atmospheric pressure (3-19 wt%), medium-low uniaxial compressive resistance (5-50 MPa). Thanks to the good physical and mechanical properties that characterize the stone, the “Panchina” calcarenite is very easy to work and extensively used in the necropolis of the Gulf of Baratti coast since Etruscan times and, in medieval times, in various public and religious buildings in the city of Pisa. While weathering appears to improve the stone cohesion and resistance, this material is sensitive to frost, which luckily is not an important factor in the climate of western Tuscany.

Corresponding Author: Andrea Aquino



**THE SOURCE MATERIALS FOR LIME PRODUCTION IN THE MONTE PISANO AREA (NW TUSCANY, ITALY)**

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**ABSTRACT**

In the Monte Pisano area (north-western Tuscany, Italy) several limestones outcrop and some of them are carbonate-rich rocks that were used for air-hardening lime or hydraulic lime production. Since Roman times, carbonate rocks outcropping in the Monte Pisano area have been used for that purpose. Monte Pisano is a mountainous system of modest size that is part of the Tuscan Apennine, located in the north-western part of Tuscany, and it separates the two cities of Pisa and Lucca. As an obvious consequence of the presence of good source rocks useful for the production of lime, in the surroundings of Monte Pisano there was a great use of carbonate rocks for the production of aerial lime and hydraulic lime. In fact, the monumental buildings in the Middle Ages were built making extensive use of binding materials obtained by firing rocks belonging to formations of the Tuscan metamorphic sequence: the Monte Pisano marble and the Selciferous Limestone. Several famous monuments in Pisa's Miracle Square and in Lucca's historical centre were built by using air-hardening lime and hydraulic lime obtained by firing these rocks. The aim of this work is to characterize samples from the Monte Pisano quarries, where the aforementioned carbonate-rich stones were quarried to produce air-hardening lime and hydraulic lime, by mean of chemical, mineralogical and petrographic studies and by determining their physical and mechanical properties. These same properties will also be determined on handmade mortar samples made up of self-produced binders and normalised sand to evaluate the best uses, and the optimum time and temperature of stone firing.

Corresponding Author: Andrea Aquino



## **GEOTOURISTIC POTENTIAL OF FORMER QUARRIES IN NORTHERN BOHEMIA**

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### **ABSTRACT**

Former quarries are among the places that are interesting for geotourism: they are mineralogical or paleontological sites, some quarries are valuable from an aesthetic or environmental point of view. In the quarries where mining was stopped centuries ago, traces of earlier mining technologies can be found, having significant historical value. Despite all the listed values, it is a sad fact that most of the quarries in the Czech Republic are revitalized after the end of mining in a way that destroy the values of the geosite. If nature conservation authorities intervene, it is usually because geosite is also a habitat for endangered species of fauna and flora, not for the protection of inanimate nature. The article analyses the process of making former quarries accessible to the public. First, the geosite evaluation methodology is presented, on the basis of which the localities with the greatest tourist potential and the lowest risks are selected. The methodology is based on six synthetic indicators, which are scientific value, cultural-historical value, aesthetic value, educational value, tourist value and vulnerability of the site. The methodology is explained on two examples of former quarries in northern Bohemia: Panská skála and Hamerský Špičák. The purpose of the methodology is to select suitable geosites, whose values should be protected and used to popularize geosciences and for geoeducation. The discussion points to good examples of making former quarries accessible to geotourism from nearby regions (e.g. UNESCO Geopark Muskauer Faltenbogen / Łuk Mużakowa). On the contrary, the issue of safety of visit to the geosite is mentioned too, which is in some cases the biggest obstacle to access to quarries. The conclusion summarizes the strengths and weaknesses of the use of former quarries for geotourism purposes.

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**STRUCTURE RESPONSE ANALYSIS OF THE SEISMIC ISOLATED BUILDINGS IN BUCHAREST CITY**

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**ABSTRACT**

The paper intends to evaluate and analyze the response for certain buildings located in the Bucharest metropolitan area, one of the most exposed in Europe, with three strong earthquakes with magnitude  $M_w > 7$  in the last century. Starting from information comprised by data bases for soils and buildings existing in Bucharest, were selected certain types of structure, accordingly to their specificity (old buildings, retrofitted, etc.) and placed under continuously seismic surveillance. Some of these buildings are seismic isolated. The results of these structures exposed at medium intensity strong motion will be discussed in terms of peak ground acceleration and spectral acceleration. Based on the currently accepted standpoint that the dynamic response of certain structures is strongly dependent of the ratio between the natural period of the structure and the dominant period of the construction site, a comparative analysis against free-field data will be presented. There would be presented the improvement of seismic response of isolated buildings in Bucharest, and the reason these buildings were protected choosing this method. The aim is to provide warnings regarding the severity of seismic events, by means of characteristics of the ground motion, gathered from the response spectrum, which may be given soon after the seismic event took place. All the data recorded on instrumented structures during one seismic event ( $M_w=5.5$ ), together with the subsequent analysis, can represent a reference study for future earthquakes with similar or higher magnitude. The integration of near-real-time seismology with performance-based earthquake engineering allows for providing the information useful for design of engineering applications and in this way to achieve mitigation of seismic vulnerability of buildings.

Corresponding Author: Alexandru Tiganescu



## **AUTOMATIC CONTROL OF ROADHEADER CUTTING HEAD SPEED AND LOAD TORQUE**

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### **ABSTRACT**

Roadheaders are nowadays using both in mining engineering and in civil engineering (tunnelling). They often operate in hard rocks, so it is very important to optimize their performance by the full use of their power in different operating conditions. The coal seams are opened deeper and due to rock compactness and their uniaxial stress compression there increase serious problems with power demand and machine wear. The angular speed of cutting head should be adjusted to the rock hardness (the harder is the rock, the lower should be the speed) Nowadays, most of the produced roadheaders have constant speed driven cutting heads. In these cases, sometimes the rock cutting process is performed in conditions far from optimum. The paper presents a concept of the cutting head speed control system and selected results of research performed on laboratory stand equipped with a special R-130 roadheader with an inverter-fed cutting head drive. The closed-loop speed control is accomplished with a PI-controller. Optimum settings of this controller have been calculated using the model in the loop simulation and ITAE (Integral of Time multiplied by an Absolute value of Error) criterion. This criterion is widely used in electric drive technology. The application of the ITAE criterion for the selection of PI controller parameters usually provides a short settling time and an acceptable overshoot value. Local stability of the system has been checked using a Nyquist criterion. Results of the experiment show that the system is capable to maintain demanded speed and to follow commands from the master load controller. The drive operation parameters (motor power utilization and frequency of momentary overloads) are much better with automatic control of inverter frequency than with constant frequency drive operation. It should result in lowering power consumption and knife wear intensity.

Corresponding Author: Adam Heyduk



**SEDIMENTARY RECORD FOR PAST CENTURY FOUND IN CLAYEY-SILTY SEDIMENTS FROM THE GULF OF GDANSK (SOUTHERN BALTIC SEA)**

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**ABSTRACT**

Lithological research was conducted on three marine sediment cores ranging in length from 21 to 29 cm that had been collected in the Gulf of Gdansk at depths of 55, 70 and 98 m, which are characterized by the deposits of clayey-silty sediments. The cores were sampled every centimeter, while the corresponding sediment granulometry was established by sieve analysis. The granulometric sediment types and their grain sizes were described by using Shepard's diagram (1954) and Folk and Ward indices (1957), respectively. The obtained indices were analyzed in relation to the age of sediment layers and sedimentation rates that have been measured by employing Pb-210 and Cs-137 radioisotopes. The results allowed the reconstruction of conditions under which the marine sediments were deposited during the past century. The analyzed cores contained sandy silt, silty sand, silt, clayey silt, silty clay and the mixed sand-silt-clay sediments. For all cores, the grain sizes with the diameters above 4.5 phi dominated. The mean grain diameters varied the most in the sediment core sampled from the area influenced by the spreading inflowing waters of the Vistula River (70 m). The correlation was found between the time-dependent grain size and increased loading of terrigenous material originating from the Vistula River flood waters. In addition, the highest dynamics of sedimentation processes were also noted in this case. The sediment types identified in all the analyzed cores were poorly sorted, and even very poorly sorted at times. The lowest variation of this parameter was observed in the core collected at the lowest depth (98 m). The sediments found in the cores had settled out from homogenous pelagic suspensions. With increasing depth, a noticeable increase in the share of pelagic suspension in the sediment cores was observed. Despite the fact that the analyzed core sediments belong to the same lithological types, they accumulated at different rates (from 1.6 to 2.8 mm/yr) and are characterized by varied compaction levels. This finding is based on the variation analysis of the sediment maximum age, which has been performed on the cores of the same length (from 70 and 98 m depths), as well as on the similar maximum age of the cores differing in length (collected at 56 and 70 m). Similar sedimentation conditions and sedimentation rates were observed at sampling stations located at 55 and 70 m depths. Moreover, increased sedimentation rates were noted in the material from recent decades. The deepest area of the sedimentary basin in the Gulf of Gdansk (98 m depth) is characterized by the least dynamic sedimentary processes.

## **EVALUATION OF LINEAR AND MACHINE LEARNING MODELS FOR DETERMINING PEDOTRANSFER FUNCTIONS**

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### **ABSTRACT**

Modelling water content and transport of water in soil have become a vital tool in simulating agricultural productivity or in solving various hydrological analyses. For instance, optimum irrigation management requires a systematic estimation of the soil-water status to determine both the appropriate amounts and timing of irrigation. That is why soil characteristics appear as an essential input in the numerical simulation of a soil-water regime. Some of the data necessary for this modelling are usually readily available (e.g., meteorological data), but hydraulic soil properties (namely water retention curve) are only rarely readily available. A critical physical property used in the description of a soil-water regime is a soil water retention curve, which shows the relationship between the water content and the water potential of the soil. The standard way of obtaining it is a relatively lengthy and complicated measuring procedure, which is difficult to apply in larger areas. In this situation are useful so-called pedotransfer functions which serve for the same purpose, but are based on the dependence of the soil water content on the more easily available soil characteristics such as bulk density, the particle size distribution of soil, etc. This paper aims to contribute to solving this deficit by evaluating pedotransfer functions by linear and machine learning methods. These methods are also called data-driven methods, and data used in this study were obtained from an area of Zahorská lowland. The Zahorska Lowland is located in central Europe in the western part of Slovakia. It is an important agricultural area situated in a warm and slightly dry zone. This region is a plain located behind mountains, so the climate is relatively drier than in the rest of Slovakia. The sandy soils occur mainly here. The annual sum of precipitation is unstable, usually between 400 and 750 mm, and precipitation is often absent for several weeks during the vegetation season. The frequent occurrence of dry years results in the necessity to construct irrigation systems in this area, so modelling water content and its transport in the soil is an important task here. This study aims to support such simulations with determining pedotransfer functions. Various machine learning methods were already used for this task. Still, authors demonstrate also advantages of some linear methods (LASSO, robust regression, best subset regression), which in comparison with advanced machine learning boosting model shows quite comparable results. Moreover, the advantage of linear methods is, as demonstrated, their better interpretability.

Corresponding Author: Milan Cisty



## **NUMERICAL SIMULATION OF THE POSSIBILITY OF SEISMIC EVENT OCCURRENCE IN HARD ROCK MINE**

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### **ABSTRACT**

This article presents the problem of seismic and rockburst hazard in underground hard rock mines. Types of rockbursts and their mechanisms as well as the causes of dynamic phenomena are discussed. The possibility of using numerical modelling to simulate the occurrence of a high-energy tremor, as a result of sudden shear rupture, is also shown. Results of numerical simulations are presented for a model mining field in a hard rock mine at high depth, in which the deposit is mined in a room-and-pillar mining system. General geological and mining conditions characteristic for Polish underground copper mines in Legnica-Glogow Copper Mining District belongs to KGHM Polska Miedz S.A. were adopted in the models. The typical lithological cross-section of the polish copper mines is characterized by rigid, high-strength rock layers in the roof, capable of accumulating elastic energy, while layers with much lower strength parameters are present in the floor. In the analyzed mining field, the remaining undisturbed rock, with a width of 40 m, was left. Numerical simulations were conducted in a plane strain state by means of Phase2 v. 8.0 software. An elastic-plastic model with softening was accepted for the rock mass. The results of numerical modelling showed that sudden (one computational step in the model) collapse of roof strata may occur over the excavated space on the edge of the remaining undisturbed rock, as a result of exceedance of shear strength, above all. This may cause a very high-energy tremor, and under the appropriate conditions, may result in the rockburst phenomenon.

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**SANATORIUM OF RAILWAYS WORKERS IN “PENHAS DA SAÚDE” (ESTRELA GEOPARK,  
PORTUGAL)**

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**ABSTRACT**

The “Penhas da Saúde” railways workers sanatorium is part of the sanatorium architecture that emerged in Portugal in the middle of the 19th century. This was a direct result of the scourge of respiratory diseases that plagued a labour population, that had moved into cities following the progressive industrialization and development of the country. The “Sanatório dos Ferroviários” (Sanatorium of railways workers), as it became known, is located in the Protected Area of Serra da Estrela Geopark, on its southern slope at an altitude of 1200 meters and about 6 km from the city of Covilhã, establishing a privileged visual relationship with it. The interest in the healing aspects of Serra da Estrela were disclosed by Doctors Sousa Martins and Serrano, professors at the medical-surgical school of Lisbon, Portugal. In August 1881, the Lisbon Geographical Society organized an expedition to “Serra da Estrela” on the initiative of these two doctors. Prior to the “Grande Hotel dos Herminios” (Great Herminios’ Hotel), the sanatorium was the work of the architect Cottinelli Telmo, following a request of “Companhia dos Caminhos de Ferro Portugueses” (Portuguese Railways Company). It was completed in 1936. The reuse of this building was diversified. It was active until the 70s, after 1975 and until 1980s, it was at the service of the IARN (Support Institute for the Return of Nationals), then it was abandoned and become a ruin. Currently, it is rehabilitated by the architect, awarded with the Pritzker Prize, Eduardo Souto de Moura, being an example of reuse and rehabilitation of senatorial architecture, which now has its place among the Estrela Geopark.

Corresponding Author: Ana M. T. Martins

**SELECTION OF MINING SUPPORT FOR SPECIAL-PURPOSE CHAMBER WORKINGS SITUATED IN A FIELD OF HIGH HORIZONTAL STRESS IN POLISH COPPER ORE MINES BY MEANS OF NUMERICAL METHODS**

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**ABSTRACT**

This article concerns the problem of selecting mining support for special-purpose chamber workings driven in a field of high horizontal stress in Polish copper ore mines. This problem is very important due to the special safety requirements for mining excavations that have been in use in mines for over a decade. The tests on three-dimensional stress pattern in Polish copper mines made in 1996, 2003 and 2012 confirmed the occurrence of high horizontal stress in the Legnica-Glogow Copper Belt (the LGCB). Conditions and rules of applying rock bolts in special-purpose chamber workings specifying minimum rock bolt length and the basic scheme of bolting the roof and side walls are applicable in Polish copper ore mines in the Legnica-Glogow Copper Belt. No procedures have been defined for proper selection of mining support for special-purpose chamber workings situated in a field of high horizontal stress, including roof bolting scheme as a function of roof class and excavation width above roof. These procedures should include, inter alia, values and directions of high horizontal stress. The finite element method (FEM) was applied to assess the stability of special-purpose chamber workings under the conditions present in the Rudna mine (one of the copper ore mines in the LGCB). Stress field parameters were determined on the basis of underground tests performed in the Rudna mine in 2012. Numerical modelling was performed by means of RS2 software in a triaxial stress state and plane strain state. Rock parameters for numerical modelling were determined on the basis of the Hoek-Brown classification. Numerical modelling was performed for two load variants: longer axis of special-purpose chamber workings was perpendicular to the direction of the maximum horizontal stress component (load variant 1) and longer axis of special-purpose chamber workings was parallel to the direction of the maximum horizontal stress component (load variant 2). The Mohr-Coulomb strength criterion was applied in numerical analyses. An elastic-plastic model with softening was applied to describe the rock medium. Based on obtained results of numerical analyses, an example of protection special-purpose chamber workings situated in a field of high horizontal stresses by rock bolts is presented.



## **CREATION OF 3D GEOMETRY IN SCAN - TO - CAD/BIM ENVIRONMENT**

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### **ABSTRACT**

Scan-to-BIM brings the documentation of existing buildings into line with the modern digital planning methodology called building information modelling (BIM). This article describes how scan-to-BIM uses 3D laser scanning to digitally capture an existing building as a point cloud, for the creation and updating of a BIM model. Renovation of an existing old lattice grid structure, out of service for more than ten years, was a real challenge for investigation, capturing geometry and determining the rest load-carrying capacity. The original structure was calculated and produced in Italy and assembled at Bulgaria during the 80s of 20th century and was covered with a single layer membrane. It was used for 30 years before it was left without service and maintenance for more than 10 years. Strong corrosion processes was investigated for some of the members and almost all applied bolts which reduce seriously the rest load-carrying capacity. Laser scanning technology was chosen for getting the complex 3D geometry of the lattice grid structure. It was a real challenge to find a software for processing the scanned data and extracting the axial geometry of structure. Investigations for determining of the applied steel class and class of bolts was done on the site and at laboratory. Different concepts for rehabilitation was discussed before choosing the double layered stressed textile membrane. Numerical FEM models was used for proofing the adequacy of chosen structural solution. Modelling is a necessary process for converting the point cloud to a useful CAD representation. It provides a complete picture of the as-built situation by filling the gaps coming from occlusions, by averaging the effects of noise and by providing the quality measures about the final results.

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**APPLICATION OF TERRESTRIAL LASER SCANNING TO DETERMINE THE DEFORMATIONS –  
PRACTICAL ASPECTS**

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**ABSTRACT**

When using laser scanning for deformation analysis of a given object, there are no pre-signalled points or identical points to compare between two epochs, so we can judge for whether an object deforms only by modelling the surface of the object. There are a number of challenges in this regard presented in the paper. First, the influence of the reflection angle and the scanning density on the accuracy of the model is analysed. The fact is that for the deformation analysis the configuration of the measurement parameters is no longer set by the surveyor-engineer by the number and position of the observed points, but from the laser scanner. Only the location of the scanner and the scanning density could be controlled. Second challenge is to find a suitable modelling surface to determine the deformation parameters that are actually unknown and probably distributed across the surface. Methods for modelling of point clouds for deformation monitoring are described. The third challenge is to expand the error model, as the surface modelling is included in the deformation process. This unifies both the metrological and the model errors that arise from the insufficient knowledge of the object and the simplification of its surface. All these challenges are oriented to the created 3D surface model. In addition, the metrological aspects of the use of laser scanners should be considered, especially for applications where the determination of the deformation requires high accuracy. A new systematization, summary and evaluation of the nature and capabilities of geospatial technology ground laser scanning has been made and the possibilities for application of the technology in the study of concrete dams are evaluated. A number of conclusions and recommendations are formulated. The influence of the factors influencing the accuracy of ground laser scanning in the deformation study of concrete dams is summarised, and the influence of the density of the points in the scanning and illumination on the accuracy of the digital model of the wall is established. An assessment of the accuracy of the separate measurement with terrestrial laser technology and of the digital model obtained from a point cloud via an approximated area has been carried out, as well as an assessment of the model by differences from control points. It is shown that for processing and analysing point clouds can be applied conventional software products, by developed and tested algorithm for working in an AutoDesk environment.

## **EFFICIENCY OF MEMBRANE ULTRAFILTRATION IN WATER TREATMENT PLANT JASNÁ**

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### **ABSTRACT**

Ultrafiltration (UF) is a membrane separation process by which the particles of mechanical nature are removed from the water. Thanks to the pore diameter that are the order of tenths nm and the material, constructional and chemical properties of UF membranes, this technology represents the final solution for a secured protection against the turbidity that is caused by content of non-soluble and colloid particles of organic and inorganic origin, bacteria and the majority of viruses. Ultrafiltration was investigated within the pilot-plant tests at the WTP Jasná during the treatment of surface water originating from the water source Zadná voda. Water treatment in this locality is focused on turbidity that is caused by storm rainfalls and snow thawing. Fully automated ultrafiltration equipment with the membrane modul UA-640 (Microdyn-Nadir) was used. On the base of filtration cycles, the effectiveness of membraned technology was evaluated. By the application of membrane technology used, the required quality of treated water has been achieved. Water was supplied to the UF-device by the pump, so the UF-flow rate was invariably maintained at the 600 L/h. Period of filtration cycle was 30 minutes. Following the end of the cycle, washing of membrane by using the back-flushing by water and air was applied. Filtered water accumulated in the tank was used for back-flushing while the air was supplied by the air-pump connected to the device. Any way of washing of the membrane did last for 30 seconds. On the base of filtration cycles, the effectiveness of membraned technology was evaluated. Turbidity removal is the major issue at the WTP Jasná. Limit for turbidity 5 NTU is set by Decree No. 247/2007 Col. Measuring data provided that the turbidity level of water treated by using the ultrafiltration device are compliant with the legal limit for drinking water. By using the ultrafiltration the decrease by 76,1% has been reached in the first experiment (average turbidity in raw water 1,55 NTU). The efficiency of turbidity removal was 95,2% that was reached by ultrafiltration of water with a higher level of turbidity (average turbidity in raw water 8 NTU). High effectiveness of ultrafiltration was reached also with the water with the turbidity 37 NTU. In all of the three experiments, the turbidity of treated water ranged between 0,37 – 0,38 NTU.

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## **TRIAZINE HERBICIDES REMOVAL FROM WATER WITH GRANULAR ACTIVATED CARBON**

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### **ABSTRACT**

The general characteristics of triazine herbicides and their negative effect on environments and human health are described in this article. Triazine herbicides currently account for more than half of all pesticide formulations. They are intensively used for the protection of field crops, orchards and vineyards, but they are also used in the removal of undesirable stands on non-agricultural land (railway embankments, playgrounds, handling areas, etc.), in water management (in coastal management, destruction of growths in irrigation canals), in forestry, etc. regular application of herbicides increases their content in the aquatic environment and agricultural products. Their occurrence in water is relatively common and it follows that these substances are used in large quantities. Residues of these substances can persist in soils for 1 to 2 years. Due to their good solubility in water, they are easily transported from the soil to aquifers. Several methods can be used to remove pesticides from water, e.g. coagulation, filtration, precipitation, ozonation, adsorption, ion exchange, nanofiltration, reverse osmosis and advanced oxidation processes. Their effectiveness varies considerably and depends mainly on the chemical nature of the pesticide being removed. This article studies adsorption on the two granular activated carbons Filtrasorb 400 and Norit 1240 W. Model solution of the pesticides, with concentration of approximately 1 µg/L, was prepared by mixing 50 mL of the pesticide's standards with approximately 5 L of drinking water. The pH of drinking water was neutral, and this solution was then properly mixed and was used in the experiments. The experiments were performed in the glass bottles with the volume of 200 mL pesticide solution. On the analytical scales weighed out 200 mg granular activated carbon was used and then it was added to the bottles. Subsequently these bottles were regularly stirred, and the samples were taken out at times 0, 30, 60, 90, 120, 180, 240 and 360 minutes. Samples were taken by pipette into the 40 ml glass vials with added thiosulfate for preservation. After the experiments, these vials were sent to the analytical laboratory, which performed the analysis of the concentration of pesticides. The performed analytical methods were consistent with US EPA 535 and US EPA 1694. Concentration was determined by liquid chromatography using an internal standard method. The triazine herbicides detection analysis results after adsorption process in drinking water spiked with standard of pesticides shows, that the efficiency of selected triazines removal and adsorption capacity for two granular activated carbons used varied. Filtrasorb F400 proved to be a better sorption material than Norit 1240. The efficiency of this material ranged from 18 to 60%, while the efficiency of Norit 1240 was significantly lower

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**HYDROGEOLOGICAL MODELLING OF THE GEOTHERMAL WATERS IN GÖLEMEZLİ (DENİZLİ) AND ENVIRONS, WESTEN ANATOLIA, TURKEY**

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**ABSTRACT**

In the Menderes Massif, the plate tectonical development results in the uplift showing dome shaped structure due to compressional tectonic features from Oligocene to Middle Miocene. From Early to Middle Miocene, the continental rift zones of the Büyük Menderes, Gediz and Küçük Menderes were formed by extensional tectonic features, which strike E-W generally and are represented by a great number of geothermal waters epithermal mineralizations and volcanic rocks of Middle Miocene to recent. The geothermal waters and epithermal mineralizations are related to faults which strike preferentially NW-SE and NE-SW and locate diagonal to general strike of the rift zones. These faults are probably generated by compressional stress which leads to the deformation of uplift between two extensional rift zones. Study area is situated in 2 km NW part of the world famous travertine deposits of Pamukkale located in the node point of the Büyük Menderes and Gediz rift zones. Geologically, there are two rocks units for reservoirs in the area: (1) the Neogene Sazak formation forms the shallow reservoir and (2) the Paleozoic Iğdecik and Ortaköy formation forms the deep reservoir and are composed of marble, quartzite and schist alternations. In addition to in-situ measurements such as temperature, pH, Eh, EC, dissolved oxygen, TDS and alkalinity values, we have collected 15 samples of geothermal waters and groundwaters in the study area for cation analyses by ICP-OES and anion analyses by IC. The geothermal waters of Gölemezli can be considered as Na-(SO<sub>4</sub>)-HCO<sub>3</sub> type waters. In comparison, the geothermal waters of Pamukkale are distinguished by dominant cations of Ca>Mg>Na+K and dominant anions of HCO<sub>3</sub>>SO<sub>4</sub>>Cl. In Gölemezli, there are dominant cations of Na+K>Ca>Mg and dominant anions of SO<sub>4</sub>>HCO<sub>3</sub>>Cl respectively. The diagram of Na<sup>1</sup>/1000-K<sup>1</sup>/100-√Ma indicates an immature water in Gölemezli and environs. The geothermal waters of Gölemezli and environs were modeled due to hydrogeological, hydrogeochemical and isotope geochemical data.





**HYDROGEOLOGICAL MODELING OF THE GEOTHERMAL WATERS IN YENİCE (BULDAN, DENİZLİ)  
AND ENVIRONS, TURKEY**

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**ABSTRACT**

This work is dealing with hydrogeological modelling of geothermal waters of Yenice (Buldan, Denizli) located in the southern shoulder of the continental rift zone of the Gediz within the Menderes Massif by hydrogeological, hydrogeochemical and isotope geochemical methods. In Yenice and environs, Paleozoic metamorphic rocks forms the basement overlain by Neogene sedimentary rocks such as Kızılburun Formation, Sazak Formation, Kolonkaya Formation and Tosunlar Formation. These rocks are overlain by Quaternary alluvium and travertine deposits. Geothermal waters in the area of Yenice are of meteoric origin and show intense water-rock interaction. These geothermal waters can be considered as Ca-Na- (SO<sub>4</sub>)- HCO<sub>3</sub> type. Moreover, geothermal waters have an order of cations of Na+K>Ca>Mg and anions of HCO<sub>3</sub>>SO<sub>4</sub>>Cl. Geothermal waters of the study area are distinguished by surface temperatures from 36 to 70 °C, pH values between 6 and 6.85 and electrical conductivity values ranging from 1950 to 5000 µS/cm. According to calculations of geochemical thermometers, geothermal waters of Yenice show reservoir temperatures between 173 and 232 °C and can be classified as immature waters.

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**SEDIMENTARY GEOCHEMICAL DISTINCTIONS BETWEEN LARGER AND SMALLER EGYPTIAN  
HAMMAMAT MOLASSE BASINS: IMPLICATIONS FOR BASIN EVOLUTIONARY MODELS**

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**ABSTRACT**

The Hammamat molasse basins of the Egyptian Eastern Desert (EED) occurred at a critical stage in the history of the Neoproterozoic Arabian-Nubian Shield (ANS). The history of these basins spans the collision stage of the proto-ANS with west Gondwana in the time frame 625-575 Ma, that resulted in the assembly of the Gondwanaland super-continent. The basins have controversial tectonic setting and significance, mainly due to the inadequacy of the present database for these basins. In this contribution we present geochemical data on the sandstones and mudstones of six of these basins, including two representatives of the “larger” Hammamat (Wadi Hammamat and Wadi Kareim) basins; and four “smaller” Hammamat basins (Esh El Mellaha, Um Tawat, Kharaza and Queih basins). The major element geochemistry reveals that the larger basins were surrounded by more deeply weathered provenance areas (probably older arc metavolcanic terrains) than the smaller basins, which were sourced by younger post-arc collision (Dokhan) volcanics. The larger basins have lower CaO and Na<sub>2</sub>O contents and lower Ba and Sr contents than small basins, consistent with the more intense breakdown of plagioclase in the weathered provenance of the larger basins. The larger basin sandstones have higher MgO and Fe<sub>2</sub>O<sub>3</sub> content, and higher Cu, Zn, Ni, Y concentrations, and lower values for Rb, Zr and Nb, compared those of the smaller basins, favouring a metavolcanic provenance over Dokhan. Provenance mixing models yield greater metavolcanic contributions for larger basins, but greater Dokhan contributions for smaller basins. These results are consistent with the common interbedding relations between Hammamat and Dokhan in the smaller basins, and restricted exposures of Dokhan Volcanics surrounding the larger basins. The geochemical results confirm the dividing of the Hammamat basins into two groups, also supported by age range differences between the larger (635-600 Ma) and smaller (595-575 Ma) basins, and distinct basin area-basin fill thickness plots for the larger and smaller basins.

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## **ACCURACY EVALUATION AND COMPARISON OF MOBILE LASER SCANNING AND MOBILE PHOTOGRAMMETRY DATA**

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### **ABSTRACT**

Mobile mapping systems (MMS) are becoming used in standard geodetic tasks more common in the last years. This paper deals with the accuracy evaluation of two types of data acquired by MMS RIEGL VMX-450, and their comparison. The first type is data from mobile laser scanning (MLS). The second type is mobile photogrammetry data. The new high accurate test point field was built in area of Advanced Materials, Structures and Technologies (AdMaS) research centre that is part of Brno University of Technology. Geodetic network and test point field were measured by Trimble R8s GNSS system and Trimble S8 HP total station. The estimate of the 3D standard deviation determined by an adjustment is 2 mm. The accuracy of MLS and mobile photogrammetry data was tested based on the differences between the coordinates of the points determined from the MMS data and determined by before mentioned high precise measurement. The resulting coordinates from photogrammetric data were determined by manual detection of targets in the images. The estimate of the 3D standard deviation is 0.017 m from the MLS data, and 0.061 m from the mobile photogrammetry data. As we supposed, the mobile laser scanning data are significantly more accurate than mobile photogrammetry data. Achieved accuracy of MLS exceeds the original expectations with respect to the GNSS/IMU positioning accuracy, which is according to the manufacturer RIEGL between 0.02–0.05 m. The same scene is often scanned with multiple scanning passes to ensure high quality of the scanned point cloud, therefore we tested the relative accuracy of mobile laser scanning data from two MMS vehicle passes in the same locality of interest. Two different data sets were evaluated, first data set contains points on roads, second data set on buildings. The standard deviation estimate does not exceed 0.008 m and the maximum absolute deviation does not exceed 0.030 m for both data sets. The difference between the two passes is not significant in comparison with the accuracy criteria required for standard mapping purposes. We also compared automatic point cloud production from photogrammetry data processed in Bentley ContextCapture to the point cloud from laser scanning. The MLS data has been used as a reference because it is significantly more accurate as mentioned before. This comparison was done only on the second data set (buildings). The standard deviation estimate is 0.16 m and the maximum absolute deviation is 0.25 m. Our evaluation contains also statistical testing of outliers and stragglers. In contrast to many authors, we don't use the simplified approach  $3\sigma$  rule, and in 1D. We use more exact approach using critical values of the statistics for significance levels  $\alpha = 5\%$  and  $\alpha = 1\%$  to stragglers and outliers test in 3D.

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**DIFFERENT APPROACHES FOR STUDY SLOPE STABILITY IN QUARRIES, CASE CHOUF AMAR  
LIMESTONE QUARRY- M'SILA, ALGERIA**

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**ABSTRACT**

The Lafarge -M'sila group's cement plant (Algeria) is supplied by the Chouf Amar limestone quarry, which allows great quarrying at the national level with annual productions of 4.2 mt / year, since several sliding in previous years have disrupted the exploitation and production of the quarry, and in the strategy of the Lafarge group increased its production up to 5mt / year in the medium term 2020-2030; a stability study is necessary to ensure production under the right conditions, the aim of our work is to study Chouf Amar stability and identify the important causes of the landslides that have influenced the site in question. We start with an empirical approach through a geomechanical characterization of the massif was put in place to highlight the instability at the level of the various rock formations. then, a stability analysis was carried out using two different approaches: the analytical approach using the limit equilibrium method (Slide 6) and the numerical approach using two methods: the finite element method (Phase 2) and the finite difference method (Flac) in the static and dynamic case considering the state of dry and wet marls. The results show an optimal state of stability on the scale of the full profile north flank of the quarry and bad stability on the scale of the benches of the different levels and the main facies of the potential slide is that of the marls.

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## **GEOTECHNICAL ANALYSES OF A MINE TAILINGS IMPOUNDMENT**

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### **ABSTRACT**

The paper presents the main issues of the geotechnical performance of a mine tailings impoundment, by describing construction, monitoring and testing activities which have been carried out during a time span of about ten years. The results of a number of stability analyses are also discussed. Tailing material is 'red mud', a side-product of the Bayer process used in refining bauxite to alumina. Pounding basin was constructed following a bottom to top technique, with external ring embankment levees. For each raising of the basin, a new ring level of embankment levees is firstly completed; then, red mud is pumped in the basin with a relatively low solid content. Red mud is characterized by quite particular geotechnical properties, some of them similar to those of fine grained soils, such as grain sizes and undrained shear strength, and other ones more appropriate to sandy materials, such as the drained friction angle. Monitoring system is constituted by settlement levelling and piezometric measurements. Geotechnical activities (in situ and laboratory tests) were carried before each step of raising of the basin in order to assess strength increases due to the ongoing consolidation phenomena. A geotechnical model has been developed in order to carry out numerical analyses aimed to the evaluation to the stability conditions of the basin as related to the rate of discharge dictated by industrial activities as well to the final decommission stage of the site. Numerical analyses highlighted the crucial role played by the short term (undrained) soil strength in the stability condition of the external ring embankment levees.

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**TYPICOCHEMICAL AND MORPHOLOGICAL FEATURES OF PLACER GOLD OF SOUTH-EASTERN PART OF SIBERIAN PLATFORM (ALDAN-STANOVY SHIELD, NORTH-ASIAN CRATON)**

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**ABSTRACT**

The Tyrkanda gold-bearing region is located in the South-East part of Yakutia within the Aldan Precambrian granulite-gneiss region and the Tyrkanda area of Mesozoic magmatism and gold mineralization of Aldan-Stanovoy shield. Despite the long history of development of gold placer deposits in the area, primary sources for some of them have not yet been founded and are not characterized. The typochemical and morphological features of native gold from placers of Tyrkanda gold-bearing region, in particular r. Bolshaya Tyrkanda, r. Malaya Tyrkanda, cr. Tumannii and cr. Tyssynchakyyt are discussed in article. Based on a comparative analysis of typochemical characteristics of native gold from this region and from placer deposits associated with the well-known deposits of the Central Aldan region, possible primary sources for such widespread placer occurrences are considered. Despite the close location of considered placers native gold in them differs by size, roundness and chemical composition. Average fineness of native gold from studied placers: Bolshaya Tyrkanda - 840‰, Malaya Tyrkanda - 850‰, cr. Tumannii - 910‰, cr. Tyssynchakyyt - 940‰. The admixtures - Hg up to 0,12% and Cu up to 1,13% are discovered using Microprobe analysis. On the plots of fineness of native gold from considered placers the two groups of gold particles were distinguished - with high, very high fineness and low and medium fineness. Native metal with high and very high fineness is close by chemical composition to gold from placers of Timplon river and P. Pinigin deposit. Native gold with medium and low fineness were commonly founded in the placers associated with well-known gold-bearing deposits of the Kuranakh and Lebedinsky types. Significant amount of gold with low and medium fineness in placers of the Bolshaya and Malaya Tyrkanda rivers probably suggests the presence in the Tyrkandinda gold-bearing region of primary sources of low-grade gold, along with sources of gold with high and very high fineness.

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## **SOIL REMEDIATION STRATEGIES BASED ON RISK ASSESSMENT APPROACH**

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### **ABSTRACT**

Anthropic activities are characterised by benefits and drawbacks for the human being and the environment. In the recent history of the humankind – last few centuries, the industrial activity increased exponentially due to massive industrialisation process. Unfortunately, this evolution increased the use of land for industrial purposes, which in turn affected the quality of soil by polluting it with high levels of chemical contaminants. On the other hand, intensive agricultural activities involve the use of pesticides and fertilisers, which at the end of the day, also contribute to the contamination of the agricultural land. Soil may be contaminated as well by accidents which occur due to human activity. In order to preserve the environment, the land quality is essential, and it is required to maintain the level of pollution within legal limits. If contaminant levels are above the legal limits, then a soil remediation action plan should take place. A phased process should be followed to determine the appropriate soil remediation strategy, starting with the right answer to these two questions: a. Is there a real threat to the environment? b. Which is the best available remediation strategy? Very high costs are usually associated with soil remediation, and the best strategy should be adopted to optimise resources and costs. A methodology to derive remedial targets has been successfully used in the USA, and also adopted and adapted in various countries inclusive in the EU. Currently, Romania has started to follow certain steps to align with international practices in regards to the management of contaminated land. Although this methodology is extensively used in western countries, its application in Romania is in its inception phase. Therefore, this paper intends to present the methodology based on a Risk-Based Corrective Action procedure, leading to the derivation of onsite remediation criteria. This multi-tiered risk assessment approach consists of the following phases: 1 – Elaboration of the Conceptual Site Model (CSM); 2 – Receptor characterisation; 3 – Performing Risk Assessment for each receptor; 4 – Option appraisal – evaluation of the feasible remediation strategies and determination of the appropriate remedial objective for the site.

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**AMPHIBOLES GEOCHEMISTRY AND MINERALOGY IN METAMORPHITE, SW-TURKEY**

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**ABSTRACT**

In the study area within the Western Anatolian Tectonic Union, there are Jurassic-Upper Cretaceous aged Yeşilova Ophiolite, Upper Cretaceous aged Kızılcadağ Melange, Cenomanian-Turonian aged İğdir Metamorphites and current alluviums. The lithological units in the study area that are active tectonically have been exposed to tectonism more or less and have developed mylonitic zones. This study explains the origin, mineralogy, petrography, geochemical properties and effective factors in the metamorphism process (heat, pressure, subduction type and ratio etc.) of the rocks belonging to the metamorphic sole beneath the ophiolite by using chemical and mineralogical data. İğdir Metamorphites, which are the subject of the study, include garnet amphibolite, normal amphibolite, amphibole schist, mica schist and mylonites. Mineralogical compositions of these rocks are generally amphibole, plagioclase, garnet, relict pyroxene, quartz, muscovite, biotite, epidote, chlorite, magnetite and sphene. According to the analyses of trace and rare earth elements, which are performed in amphibolite and amphibole schist of İğdir Metamorphites, the positive anomaly in U, Ba, Pb and Sr elements indicates local contamination. It was seen that the samples are located in the ortho-amphibolite area on the Ni-Zr/TiO<sub>2</sub> diagram. In addition, the presence of clinopyroxene and biotite with high Ti content, Mg-hornblende and  $\delta_{18}O$  value (4.2%) in garnet are other data indicating magmatic origin. In Zr-Zr/Y and Hf/3-Th-Nb/16 diagrams that are prepared by using stable elements such as Ti, Nb, Zr and Y that are not affected by metamorphism, it was seen that these samples are located within the areas of tholeiitic plate basalt, island arc basalt and alkaline plate basalt. Tholeiitic and alkaline magma are also observed in Nb/Y-Ti/Y diagrams. This diagram was also used to determine the origin of the magma which creates the amphibolites.

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**MOBILITY OF METALS, Sb AND As IN THE SYSTEM “WASTES – AIR” IN MINE SITE, KEMEROVO REGION, RUSSIA**

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**ABSTRACT**

This study evaluated the distribution of the mill waste, mobility of metals, Sb and As in the system “wastes – air”. The distribution of Cu, Zn, Cd, Pb, As, and Sb in the mineral dust taken along the wind rose is equal to that in the gas condensate and wastes. Square normalized patterns of chemical elements concentration in the solution displayed gradual decreasing of elements concentration from the sampling point situated near the dumps to the 250 m away from them. However, concentrations of these elements are higher than background level even in the last point. The total amount of water-soluble species is up to 73% - S, 9% - Cu, 21% - Zn. The main mineral phases contained discussed elements in the mineral dust are sphalerite ZnS, galena PbS, covellite CuS, antlerite Cu<sub>3</sub>(SO<sub>4</sub>)(OH)<sub>4</sub>, barite BaSO<sub>4</sub>, pyrite FeS<sub>2</sub>, Fe-(oxy)hydroxides with admixtures of As, Cu, Zn, silicates grains, fly ash. The results of mineralogical-geochemical studies of Belovo mine site revealed the complicated ways of migration of the trace elements in the mine waste surrounding area. The minerals of aerosols particles can be more strongly weathered by acid solutions, prevalent in this area in the spring when snow will be melted. Also, elements As, Cu, and Zn sorbed on Fe-hydroxides are in mobile forms. Thus, the area Belovo town is under the impact of mineral dust aerosols contamination, which is driving force of solid and dissolved transport of trace elements into the surface environment and can be considered as one more source of pollution in this area.

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**ADSORPTION OF COPPER, ZINC, ARSENIC AND STIBIUM FROM MINE WATERS USING MOSS  
POLYTRICHUM, LICHEN CLADONIA STELLARIS AND ITS MODIFIED TYPES**

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**ABSTRACT**

At the present study, we investigate the adsorption of Cu, Zn, As, and Sb from mine waters using modified and natural moss *Polytrichum* and lichen *Cladonia stellaris* collected in Siberia. FTIR, ISP-MS, and electronic scanning microscope were used to characterize the biosorbents. Results revealed the possibility of using of the biosorbents for removal of the elements under the study from mine drainage. The absorption capacity of modified sorbents differs from natural sorbents for mine water having different pH. The composition of the samples after sorption experiments carried out by IR spectroscopy showed slightly changed in the structure of biosorbents. Redistribution of certain functional groups, which showed displacement and changes in the intensity and shape of the bands shown on the interaction of sorbents with mine water. The biosorbents have different functional groups, which include carboxyl (-COOH), alkane (-CH<sub>2</sub>), amide (-NH<sub>2</sub>), amine (-NH) and hydroxide (-OH) groups. These functional groups are able to react with ions of metals and metalloids resulting in bonding of toxicants and mine waters treatment.

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**INCREASING THE EFFICIENCY OF TEM-TDEM METHOD WHILE SEARCHING FOR HYDROCARBONS  
IN CONDITIONS OF HIGH ELECTRIC CONDUCTIVITY OF SEDIMENTARY-TERRIGENOUS  
COMPLEXES' ROCKS**

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A possibility to select theoretical signal models for the observed graphs  $E_{obs}(t)$  satisfactorily is shown to be steadily absent while prospecting using the TEM-TDEM method among Western Siberia's high-electroconductive rocks. Examination of this problem showed Western Siberia's rocks have a high reactive (inductive) resistance  $L$  alongside with ohmic resistance  $R$ . At the same time, thin oil and gas beds' presence in those rocks causes an additional reactive-capacitive resistance  $C_{dep}$  appear under the influence of the applied electric field. Therefore, process of field inducing in RLC-medium is completely different from the "classic" one which is described with only specific resistance  $\rho$ . Thereupon, transit process theory, based on process modelling with equivalent loops, was applied. In practice, TEM-TDEM method's efficiency turned to be very high as the direct search characteristic – anomalous parameter  $C_{dep}$  appears. All the parameter  $c$ 's anomaly contours, predicted as hydrocarbon deposits, are confirmed as such with deep drilling with the success coefficient almost equal 100%.

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## **NATIVE IRON NODULES IN BASITES – XENOLITHS OF THE EARTH CORE**

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### **ABSTRACT**

Summary of the published data has shown that native iron nodules, which are rarely found in the basic intrusions, are characterized by a higher content of low-temperature condensates of the protoplanetary disk (Ge, Ag, Cu) and a lower content of high-temperature condensates (Os, Ir, Ru, Pt, Rh, Pd, Ni, Co, Au) compared to iron meteorites. Such meteorites have signs of formation from the fragments of the cores of minor planets. This fact and obtained evidence of hot heterogeneous accretion of the Earth, the early formation of the Earth's core compared to the mantle and the growth of the primary content of low-temperature condensates from the inner parts of the core to the outside suggest the capture and the ascent of substance of outer core by mantle plumes, and basic magmas formed in them. This explains the peculiarities of their composition, their very rare presence in basites, and sometimes a huge mass of nodules (up to tens of tons). In case of such xenogenic origin, nodules of native iron are chemically unequilibrium with basites. This is the reason of the development of reaction cohenite-magnetite and cohenite-sulfide rims on their contact and an increase of ferruginosity of olivine in basites. The formation of the lower mantle material from the earliest high-temperature condensates of the protoplanetary disk explains the decreased content of potassium, sodium, water, and other lithophile components in the nodule-containing basites. The content of volatile components lowers the crystallization temperature of melts. Therefore, the loss of them under the influence of decompression at the low-depth stages of ascent led to rapid solidification of magmas, protected the iron nodules from subsidence, and explains their location mainly in the upper parts of the main intrusions, despite the high density of iron.



**THE INSTRUMENTS FOR SPATIAL PLANNING: A COMPARATIVE ANALYSIS BETWEEN PORTUGAL AND EAST-TIMOR**

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**ABSTRACT**

After a period of administration by the United Nations, on 20 May 2002 East-Timor became one of the youngest nations in the 21st century, having become a democratic rule of law. To promote the construction of territorial cohesion, on April 19, 2017, the Basic Law on Spatial Planning was approved, which intends to translate the various principles contained in the Constitution that manage the exercise of spatial planning. Thus, spatial planning establishes the basis of public policies whose primary objective is to accomplish the territorial quality, regarding the collective culture that integrates the values of the territory and a planning culture. Being a part of the work of the ongoing doctoral thesis in Civil Engineering at the University of Beira Interior this article will focus on a comparative analysis of the land-use bases in East-Timor with what occurs in Portugal. In the Portuguese setting, territorial cohesion comprises the effort to strengthen the standardization between Interior regions and the seashore areas, organizing the territory, correcting regional asymmetries, and ensuring equal opportunities for citizens. Among other conclusions, the Bases for Spatial Planning in East-Timor are more simplified, with fewer levels of intervention, nevertheless, the similarities with what happens in Portugal are quite large, both in terms of instruments and in terms of land-uses.

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**SPATIAL PLANNING SYSTEM FRAMEWORK IN EAST TIMOR: STEPS TOWARDS SUSTAINABLE  
URBAN DEVELOPMENT**

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**ABSTRACT**

The recognized importance of the role of cities for the overall quality of life of citizens involves the preservation of the identity of the places without restricting the capacity to respond to the future requirements of societies and their territories. The current century has been pressing for the urgency of providing adequate urban policies to cities, particularly in developing countries, as is the case with East-Timor. East-Timor, which became one of the most recent independent nations in the world, in May 2002, is also one of the world's poorest. Although it is giving its first steps regarding the spatial planning system framework definition. Despite of its recent independency, East-Timor doesn't lose its time and the country has been focused in the definition of territorial policies and development strategies, in order to promote territorial cohesion and to specifically define the purposes and the fundamental principles that guarantee equal opportunities for all citizens in access to infrastructures, equipment and urban functions. Therefore, on April 19, 2017 the National Law for Spatial Planning Basis was approved by the National Assembly. This article is part of the work of the doctoral thesis in progress in Civil Engineering at the University of Beira Interior and concentrates on an evaluation of the organization of the spatial planning system framework in East-Timor, with the land-use typologies, and the national and local level instruments. Efficient public territorial management and organization is only possible with detailed knowledge of the use of its entire territory. Administrative political decisions related to the territory happen more efficiently with the existence of this knowledge. Consequently, the present National Law for Spatial Planning issues, provides for the existence of two major types of planning and territorial organization instruments: those of national scope and those of municipal or local scope. A set of several spatial planning instruments are proved to be imperative, for outlining strategic objectives for future interventions in this territory, achieving a territorial, social, economic and sustainable development. The conclusions show that these objectives towards the urban development will be supported by strategies that in turn will be materialized in actions that will enable the public sector individually or in partnership with privates. The main goal is to promote the transformation of the territory and that in a concerted and programmed manner contribute to a harmonious social and economic development supported by a fair and balanced load capacity of the natural environment.

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## **EXPERIMENTAL STUDY OF THE SHOCK WAVE ATTENUATION IN THE WATER MIST WITH AIR GAPS**

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### **ABSTRACT**

The research aims to determine the ways of enhancing the effect of attenuating shock wave in the water mist. The fulfillment of this task can significantly contribute to the perfection of technologies for protecting from accidental explosions and design of protective facilities. A series of experiments were carried out to investigate the influence of air gaps on shock wave attenuation in the water mist. A shock tube with hydraulic equipment capable of producing a 3-metre long dispersed water barrier with droplets ranging from 25 to 400 microns and total flow rate 14.5 l/s within a tube was used during testing. The paper analyzes shock wave attenuation within a tube in the water mist with and without air gaps. It has been established that in conditions when a 3-metre long water mist includes four air gaps each 30 centimeters in width, overpressure reduction coefficient is 1.10-1.15 times higher than in the water mist without air gaps.

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## **ASSESSMENT OF IMPACT AND BALLISTIC RESISTANCE OF SOME TYPES OF ORGANOPLASTICS**

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### **ABSTRACT**

The paper represents the results of experimental determination of impact resistance and the principles of assessing the ballistic resistance of organoplastics. Organoplastics are presented as a composite material consisting of unsaturated polyester resin (matrix) and a reinforcing component of organic origin, mainly aramid fiber. Reinforcing components are fabrics of various weave, canvases, and discrete fiber. Polyester resin contains an additive that provides biodegradability of the binding component. In the case of using a biodegradable reinforcing component or a mineral-based reinforcing component, the organoplastics will cause minimal damage to the environment after exploitation period. Experimental data on the impact resistance of the material were obtained on a 3 m high impact copper on the basis of fixing the work of destruction of samples of organoplastics of a certain thickness. The essence of the ballistic stability assessment was to compile a system of differential equations describing the degree of change in kinetic energy when a bullet (fragment) hits the material and the nature of the decrease in the speed of their contact in the barrier. To solve the system of equations, initial data are required: time, bullet velocity, length of the non-working part of the bullet, cross-sectional area and mass of the bullet (fragment). The solution of the problem determines the degree of decrease in the speed of the bullet (fragment) contact with the barrier. The obtained research results are suitable for protecting the object from the impact and designing light armor protection of vehicles and other means.

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**WHERE IS THERE CHANCE TO FIND DEEP PROSPECTS BELOW THE OUTER WESTERN  
CARPATHIAN THRUST BELT?**

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**ABSTRACT**

In period of 80 and 90th the intensive deep drilling and seismic profiling program in the Outer Western Carpathian belt has been realized for confirming idea about existence and opening of new promising plays beneath some of these thin-skinned belts. Many trans-Carpathian 2D seismic transects opened discussion on the understanding of the complex structure of thrust belts and its basement. The recent development of exploration, based on the new modern play concepts, has brought new light on this problem. The new 3D and the reprocessed 2D seismic sections from Czech and Slovak part of the Western Carpathian Flysch Belt disclosed several potentially new prospects, combined with the cover of the foreland of European plate. New significant reserves of hydrocarbons may occur in subthrust autochthonous and parautochthonous series buried below the frontal zones of thin-skinned thrust belts. The study of the deepest parts of the Carpathian Flysch belt has been based on the complex geochemical, structural analyses and geophysical Data reprocessing, supplied by verification along the chosen balanced sections. Four examples of 2D seismic transects, with registration up to 9-12 seconds, that present different tectonic style of structures of Flysch Belt and its platform basement, influenced by older large-scale faults, is presented from the western, northern and eastern parts of the Outer Western Carpathians. From point of view of hydrocarbon prospection, the most important features of the seismic profiles are the anticline structures of the North European Platform (NEP) below the thrust stack of the Flysch Belt. From the west to east the Týnec-Cunín, Drietoma, Orava and Zbudza elevations can be distinguished, created by passive margin of the European plate, in the second and third structure probably by parautochthonous blocks of the same plate.

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## **CHARACTERISTICS EVALUATION OF FLUORESCHEIN SODIUM AS FLUORESCENT TRACER FOR PETROLEUM WELLS**

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### **ABSTRACT**

Fluorescein sodium is an organic xanthene-derivative fluorochrome appearing as crimson powder. In the form of solution, fluorescein absorbs blue light and emits green-to-yellow fluorescence under the incidence of visible or ultra-violet light. In petroleum industry, it is normally used as fluorescent tracer to determine reservoir connectivity between injection and production wells. In this study, fluorescein concentration at 10 ppm was critical concentration that reversed relationship between fluorescence intensity and fluorescence concentration. Emission wavelength at maximum fluorescence intensity was reduced as a function of concentration until 512 nm at 1 ppm. There was no longer reduction of emission wavelength beyond this value at lower concentration. Fluorescence of fluorescein could not be observed by naked eyes at the concentration below 100 ppb, whereas its detection limit by instrument could be lowered to 1 ppb. Fluorescence spectra of fluorescein concentrations at 10 ppt and 100 ppt were similar to those of tap water, formation water, and deionized water. Therefore, detection limit of fluorescein was determined to be at 1 ppb. Fluorescein solution was photodegraded by fluorescent light up to 27% when stored inside transparent bottles and being exposed to light for 7 days and fluorescence of the solution became darker with time. On the other hand, fluorescence intensities of fluorescein solution stored inside amber-coloured bottles in both all-time concealment and normal room conditions were almost identical. Fluorescence of fluorescein solution at pH of 3 was darker than the solution at pH of 7 and 11. Fluorescence spectra of the solution at pH of 3 had lower fluorescence intensity and shorter emission wavelength at maximum fluorescence intensity than the others. In contrast, fluorescence spectra of the solution at pH of 7 and 11 were mostly identical. Fluorescence of fluorescein was not affected by temperature in the range of 30-70°C. Hence, the storage conditions for fluorescein solution was recommended to be inside amber-coloured bottle to prevent photodegradation with pH 7 or above.

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## **HYDROTHERMAL CARBONIZATION OF DIGESTATE AND LEACHATE IN A LAB-SCALE BATCH REACTOR**

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### **ABSTRACT**

Hydrothermal carbonization is a thermo-chemical process that uses water under subcritical conditions to convert biomass into a carbon-rich product known as hydrochar. Hydrothermal carbonization process takes place at relatively low temperature (generally in the 180–250°C range) under autogenous pressure. The process conditions promote the hydrolysis and dehydration reactions generating condensed aromatic structures having a high concentration of oxygenated functional group; these characteristics make hydrochar a promising candidate in several high-value applications. Hydrothermal carbonization can be applied to a number of feedstocks, ranging from simple carbohydrates (i.e. glucose, cyclodextrins, fructose, sucrose, cellulose, starch, etc.) to more complex biomasses (such as lignocellulosic biomass, agricultural residues, municipal biowaste, etc.). This study refers to an experimental campaign aimed to evaluate the role of residence time and water or leachate reaction medium on the yield and composition of hydrochar produced by using the digestate of anaerobic digestion of biowaste. The digestate was sampled after the completion of the anaerobic digestion period just before the hydrothermal carbonization test. The experimental tests were conducted utilizing an externally heated stirred batch reactor having a reaction volume of 3 litres. The reactor was filled by a mixture of digestate and water or leachate medium at a fixed ratio water/dry matter equal to 8:1 by leaving a head space of about 15%. The reaction temperature was set at 250°C. The results indicated that both reaction time and reaction medium affect the yield of the hydrochar. In particular, the yield decreases from 0.75g/g to 0.65g/g and from 0.77g/g to 0.73g/g as the reaction time increased from 2 to 6 h for both mixtures. While, the experimental tests with the mixture of digestate/leachate show a higher yield than that obtained from the tests with the mixture of digestate/water. The investigated operating parameters also affect the hydrochar composition. It was observed that the hydrochar produced during the hydrothermal carbonization tests performed with a reaction time of 6 h contain a greater amount of carbon. This indicate that, in the limited range of the investigated operating parameters, the increase of reaction time is more affective to promote carbonization reactions.

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### **3D VOLUME RENDERING OF WEATHER RADAR DATA USING WEBGL**

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#### **ABSTRACT**

Volume visualization of weather data can be done using rendering algorithms. Web Visualization of real-time volumetric atmospheric data is altogether a different challenging task because data is not received directly as an image format from radars or from satellites. The data is received as a raw format and a series of corrections and algorithms are needed to be applied on the data before it can be visualised. Weather data having information at different vertical levels acquired from either satellite, Doppler weather radar or from forecasting models have different characteristics and data values at many elevation level; hence there is requirement that the data should be visualized in such a way that it can reflect the exact measure of data values and nature of the data. Ray-casting being a Direct Volume Rendering technique can be useful for visualizing these datasets, as it can collect color and opacity. This paper uses a ray-casting algorithm and modifies it for volume visualization of weather data. We proposed the approach of first visualizing data at each elevation level then merge it for final rendering. Appropriate pre-processing steps are performed on input data to prepare it for visualization. After visualizing each elevation distinctly, the whole weather event is visualized in 3D where the intensity is shown by different colors. The geographic area on which the weather data is rendered is presented here as a 3D terrain. It represents the digital elevation model of that particular area. We can visualize the whole 3D rendered weather data of a particular event over a world map.

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## **POTENTIAL FOR METAL RESOURCE RECOVERY FROM ACID MINE DRAINAGE**

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### **ABSTRACT**

Removal and recycling of metal and metalloid contaminants and other by-products from acid mine drainage (AMD) is the subject of global research, taking into account their adverse impact on the environment. In this paper we present results and observations from several studies performed in abandoned tin/tungsten (Sn/W) mining areas of Northern Portugal. To characterize the AMD were collected samples from the galleries and from the tailings drainages. The sample stations were sampled for a year between January and November in six bimonthly sampling campaigns. The pH, Eh, temperature, electrical conductivity (EC) and bicarbonate ( $\text{HCO}_3$ ) was determined in the field. In the laboratory, the samples were processed and analyzed using current analytical methods (atomic absorption spectrometry, AAS, for Ca, Mg, Na, and K; coupled graphite furnace AAS for Fe, Mn, Cu, Zn, Cd, Co, Ni, Pb, and As; the spectrophotometric method for Cl;  $\text{SO}_4$  was analyzed by gravimetry). In general, the AMD of studied mines exhibited chemical characteristics that reflect the leaching processes of mineralized masses that contain sulphides. Therefore, these waters are acidic, with low pH and significant concentrations of  $\text{SO}_4$  and metal(loid)s (As, Fe, Mn, Zn, Cu, Pb, Cd, and Ni). Using a classification for water from mines and mineralized areas (based on variations in the levels of Zn, Cu, Cd, Ni, Co, and Pb in the solution as a function of pH), it is possible to determine the AMD typology. According to this classification, the AMD samples are divided into different typologies, varying between “high metals” and “acid” to “low metal” and “acid” or “near neutral.” The results clearly show the influence of sulphated facies of the studied water. The influence of seasonal fluctuations on the composition of AMD is also evident in most of the results achieved, to the extent that there are significant variations in most of the analyzed parameters. The lower pH and higher EC and metal concentrations were recorded in a dry period. Hydrochemical processes and the environmental impact on the study sites point out to possible issues for potential resource recovery from AMD (eg, iron or other metals) and appropriate strategies to mitigate AMD and prevent pollution. Following are planned surveys and investigations into several selected alternatives such as application of filter materials and using modular bioreactors aiming to develop a viable metal recovery process.





**SEQUENCE OF HIGH-MAGNITUDE FLOW EVENTS: IMPACT ON THE SUSPENDED SEDIMENT CONCENTRATION IN A HUMID TEMPERATE CATCHMENT**

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**ABSTRACT**

The study aims to evaluate the impact resulting from a succession of heavy flow events on the suspended sediment concentration in a rural catchment located in NW Spain under humid oceanic climate. Mean rainfall in the monitoring area is about 1100 mm y<sup>-1</sup> and the annual mean temperature is 13 °C. The vegetation cover is mainly forest, followed by pastures and to a lesser extent cultivated land. The suspended sediment were collected during a period of cyclogenetic storm events taking place in the winter of 2013/2014, which due to persistent rainfall caused saturation in catchment soils. Large amounts of sediment were transferred in the catchment in response to flow events. A high variability in suspended sediment load during these was also observed in the catchment, which is attributed to variation in rainfall characteristics, magnitude peak discharge, antecedent conditions controlling sediment availability. The results also showed that the close sequence of storm-flow events in the study period caused a deterioration in water quality, as mean suspended sediment concentration reached values higher than 25 mg L<sup>-1</sup>.

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## **ALUMINUM POOLS AND CLAY MINERALS IN AGRICULTURAL SOILS DERIVED FROM BIOTITIC SCHISTS**

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### **ABSTRACT**

Understanding both the concentration and distribution of aluminum in agricultural soils is essential to provide a benchmark on the productivity of such soils. This study aims to assess the aluminum fractionation in agricultural soils derived from biotitic schists in NW Spain. The mineralogy of the fine fraction of these soils was also studied by X-ray diffraction (XRD). The topsoils of the monitoring area are characterized by moderately acidic pH, an organic matter content of about 6%, and silt and silty loam textures. Aluminum fractionation in the topsoils samples was carried out by using a sequential extraction method that it allows to extract six fractions defined operationally: soluble/exchangeable/ specifically adsorbed, bound to manganese oxides, associated with amorphous compounds, bound to oxidizable organic matter, associated with crystalline iron oxides, and residual fraction. The results showed that aluminum is mainly in the residual phase, which represents aluminum incorporated in the lattice minerals, and consequently unavailable to plants and animals. The XRD results showed the presence of hydroxy-Al interlayered vermiculites and kaolinite, accompanied by small amounts of goethite, mica and quartz.

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**MAGNETOMETRIC AND ELECTROMETRIC INVESTIGATIONS IN THE BEROE SUBMERGED  
ARCHAEOLOGIC SITE**

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**ABSTRACT**

In ancient times, Dobrogea was known as *Schythia Minor* or *Mikra Skythia*. In the 1st century BC, the respective territory was under the influence of the Pontic kingdom of Mithridate the VIth Eupator. From 28 BC it was integrated in the Roman province of Moesia Inferior by Emperor Augustus. Most Roman-Byzantine fortresses have been established by the Romans on the site of former Getic settlements: *Tropaeum Traiani*, *Capidava*, *Carsium*, *Beroe*, *Troesmis*, *Arrubium*, *Dinogetia*, *Noviodunum*, *Ibida*, *Durostorum*. The Roman-Byzantine fortress of Beroe-Ostrov grew around the Roman castrum of Beroe, where the Vth Legion was stationed in the 1st and IInd centuries. One can find here the partially unearthed ruins of a Roman and Byzantine fortress, dating back to the 1st-VIth and Xth-XIIIth centuries, and nearby, those of a Paleo-Christian basilica, dating back to the Vth-VIth centuries. The latter is situated aside from the former cemetery, which has been used between the 1st -XIIIth centuries. As a result of conflicts between the Dacians of Dobrogea (the Comati) and the Romans, the fortress was destroyed, and was re-inhabited once the Byzantines returned to the Lower Danube, under Emperor Ioan Tzimiskes. The Roman and Byzantine fortress from Beroe is located 3 km to the South of Ostrov village, in North Dobroudja, the north side of Moesia Inferior province. We carried out magnetometric and electrometric measurements in the Beroe archaeological site, located in the Dobrogea region of Romania. We analyzed the results to see if we could find the orientation of the walls or any other evidence of a former human presence within a limited area submerged beneath the Danube River. We showed the estimated depth of the site and the possible orientation of a wall. The geophysical data was acquired on the water (Danube River) within the submerged zone using marine equipment designed for that purpose (G822 device with cesium) with a gradient array and AGI ministing electrometer with 100 m length. The area of investigation was 100 by 50 meters, and it was located in the NE part of the site, having a grid density of 10 by 10 meters. The data we obtained in this study indicates the possible presence of submerged artefacts. Magnetic susceptibility measurements indicate a possible magnetic contrast between the regional geological background (local limestone rocks used in the construction of the fortress walls, mortar, etc.), characterized by low, sometimes even diamagnetic magnetic properties and artifacts such as bricks, backed (fired) adobe, ceramic fragments, showing relatively high magnetic susceptibilities.



**MINERALS EXPLORATION OF A SHEAR ZONE IN THE METAMORPHIC SOLE OF THE SEMAIL  
OPHIOLITE, WADI HAM, UAE**

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**ABSTRACT**

The ~96 Ma Semail (Oman) ophiolite includes a relatively intact thrust slice of Tethyan oceanic crust and upper mantle formed above a NE-dipping subduction zone. At the end of the Cretaceous the ophiolite was detached from the overriding plate and obducted SW-wards onto the Arabian continental margin. The 'normal' metamorphic sole of the Semail ophiolite comprises a highly condensed sequence of hornblende + plagioclase ± garnet amphibolites with small enclaves of garnet + clinopyroxene granulites immediately beneath the mantle sequence peridotites, and tectonically overlying a series of epidote amphibolite and greenschist facies lithologies. In the northern Oman mountains, the Bani Hamid thrust sheet is a 1.2 km thick tabular mass of isoclinally folded granulite facies rocks enclosed in mantle peridotite. It was exhumed by late-stage out-of-sequence thrusting. The Bani Hamid rocks comprise two-pyroxene quartzites and amphibolites with localised partial melting, and is intruded by hornblende pegmatites. The Bani Hamid granulites represent metamorphosed cherts and calcareous turbidites probably equivalent to the distal Haybi complex and Oman Exotic limestones with their alkali basaltic substrate. Differentiation of mafic and ultramafic magmas deep within the spreading centers also concentrate chromite and minor sulfides and these processes are important to the formation of ore deposits within the oceanic crust. There are some hydrothermal Fe Cu sulfide deposits in the Bani Hamid area which are quite distinct from magmatic massive sulphide deposits typical of ophiolites. This presentation concerns the minor hydrothermal ores found in the Bani Hamid area. The ores of chalcopyrite, pyrite and pyrrhotite are disseminated along two north-west trending shear zones in a series of psammitic, semi-pelitic and pelitic schists of the Bani Hamid metamorphic group. The shear zone occurs within an area of generally north-west trending faults that are collectively known as the Wadi Ham Fault Zone, a complex tectonic zone with early mylonitization and later brittle reactivation of faults. XRD analysis of the ore materials reveal additional phases pentlandite, spinel, barite, magnetite and hematite. AAS analysis of ore samples gives average concentrations of Fe at 15.6 %, Ti at 0.3 %, Cu at 0.8 %, S at 0.4 %, Cr , Mn at 0.1%, Sb 6.5ppm, Mo ?ppm, Ag). Whereas ICP analyzed samples show high values of Cu, Zn, Ag, Ni, Mn, Fe, Au, Hg, Cr, S, Mo, Pb and Co.

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## **IMPACT OF BIOCHAR ON SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY DURING 2 YEAR FIELD EXPERIMENT**

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### **ABSTRACT**

Water contained in soil increases the size of agricultural production and decide about its condition. Knowledge about physico-chemical parameters such as water content, conductivity and temperature enable to carry out analysis of water resources, content of plant nutrients and their shift in the soil profile as well as assessment of thermal capacity of soil. Adjustment of soil parameters to plant needs of big agricultural areas known as precise farming requires optimal selection of the above parameters. Thanks to suitable dosing of fertilisers, economic effects are obtained but also environment is protected since excess of fertilisers, that would have permitted to ground water and as a result contaminate water reservoirs and rivers, is prevented. Control of the water content in soil has recently become a significant issue in the light of reduction of water resources. In the presence of increasing weather anomalies related to water excess or its long-term lack, the control of its content in the surface layers of soil and in the soil profile has started to play a decisive role which enables modelling and verification of model and provides information necessary to interpret satellite imagery. The aim of provided research is to use time-domain reflectometry (TDR) method to measure soil humidity and electrical conductivity. The purpose of the recent analysis is to validate and to clarify the limits of TDR method for long-term moisture and electrical conductivity measurements in continuous field experiment (2-year study). A relation between biochar dose and water content of soil was observed. It was concluded that with fields, doses of 5-10 Mg·ha<sup>-1</sup>, the water content maintained at a similar level during whole experiment. The second group with similar parameters of the water content consisted of fields with the dose of 30-50 Mg·ha<sup>-1</sup>, and the third group were fields with the dose of 60-100 Mg·ha<sup>-1</sup>. For group 1, average water content was 8.52% for group 2 - 9.68% and for group 3 - 11.96%. During field measurements and after statistical analysis it was observed that water content was in the same level. The experiment showed also that biochar content in soil don't have statistical importance for soil electrical conductivity. Statistical analysis showed that an average dose of biochar from group 1, 2 and 3 should be accepted for further research in order to limit the amount of biochar dose in further research.

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## **IMPACT OF BIOCHAR ON SOIL TEMPERATURE DURING 2 YEAR FIELD EXPERIMENT**

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### **ABSTRACT**

Current research proved that the key role in shaping thermal conditions of soil plays a balance of solar radiation and field exposure. The soil temperature, especially, its ground layer, in a daily course is characterised by great changes. These changes are the most often concurrent with air temperature shifts and radiation balance. Knowledge of thermal conditions of the soil surface is significant for the proper cultivation process. The temperature of soil has a significant impact on the dates when biological processes in environment begin and end. It decides on the intensity of respiration processes and biochemical changes, that are particularly material in the vegetation period. Water content of soil depends on the soil temperature, which decides *inter alia*, on the speed of germination and health of plants. The objective of the research is to determine the relation of the temperature course in the superficial layer of soil in relation to the applied biochar dose in continuous field experiment (2-year study). A relation between a biochar dose and the temperature of soil was reported. It was concluded that with field doses of 5-8 and 100 Mg·ha<sup>-1</sup>, temperature was at a similar level. In other cases, it was reported that the increase of the biochar dose by 10 Mg·ha<sup>-1</sup> causes the increase of the temperature of soil by average 0.5-1.0°C. It was also observed that after 2 year of cultivation described difference between biochar doses was reduced ca. 54% in comparison to measurements provided at the beginning of experiment. During field measurements and after statistical analysis it was observed that water content was in the same level. Analysis of the data used in the paper confirmed the regularity that the scope of daily changes of superficial layers of soil is higher than the range of air temperature changes. It is important, however, to include the temperature of soil delay in relation to the air temperature which is emphasised by *inter alia*.

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## **IMPACT OF BIOCHAR ON WATER RETENTION IN SOIL DURING 2 YEAR FIELD EXPERIMENT**

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### **ABSTRACT**

Water is the most important substance which occurs in nature. As a soil solution it is a basis of life for plants, both as an indispensable element of plant tissues as well as a carrier of mineral salts collected by plants through root hair. Ability to collect water by plants depends on the power of its binding with soil and thus on the quality of soil and amount of water. Presence of water in soil determines all its essential functions. Thus, knowledge of water soil properties is a basic condition for understanding and description of its remaining functions. Physical properties of cultivation soil are variable in the vegetation season because they depend not only on the textural group, mineral composition of soil and content of organic matter but also on agri-technical treatments, species of cultivation plants and meteorological conditions. Unfortunately, results of the research on physical properties are often difficult to compare due to a choice of various dates of the research, application of various research methods and various measurement units. The objective of the research is to determine the relation of water retention in the superficial layer of soil in relation to the applied biochar dose in continuous field experiment (2-year study). The highest value of full water capacity  $0.49 \text{ m}^3 \cdot \text{m}^{-3}$  was observed for soil where  $30 \text{ t} \cdot \text{ha}^{-1}$  of biochar was applied. The full water capacity calculated to soil capacity (in  $\text{m}^3 \cdot \text{m}^{-3}$ ), theoretically is equal to general porosity and is often assumed as such in many papers. One should remember that the range of potentials corresponding to pF 2.2 - pF 3 concerns the amount of water grouped in soil pores which is easily available for plants and within the range of pF 3 - pF 4.2 difficult to access by plants, while the value of pF 7 (corresponding to capillary potential  $-10\ 000\ 000 \text{ hPa}$  or  $-10\ 000 \text{ bar}$ ) means water content 0. During field measurements and after statistical analysis it was observed that soil water retention was at the same level. It was reported that the curve for control soil where no addition of biochar was used indicates a slightly lower water content at a field water capacity in comparison to the soil where biochar was added which indicates that biochar influences the amount of water available for plants which the investigated soils were able to store.

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## AUTHIGENIC BARITE IN THE BOTTOM SEDIMENTS OF THE SEAS AND OCEANS: CRYSTAL MORPHOLOGY, COMPOSITION, INDICATOR PROPERTIES

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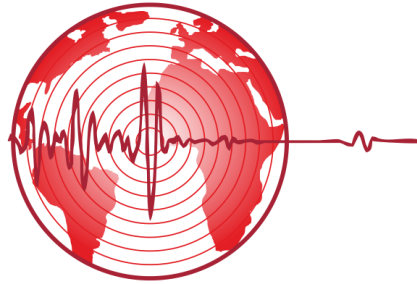
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### ABSTRACT

Authigenic barite is formed in the bottom sediments of the seas and oceans due to hydrothermal sources, sedimentary chemogenic processes, and diagenesis. Authigenic barite can also be associated with biomineralization during ferromanganese nodule (FMN) formation (Shulga, Reykhard, 2018; Reykhard, Shulga, 2019). The properties of authigenic barite, such as the chemical composition, size, and crystal shape, can be used in paleo-oceanological reconstructions as indicators of biological productivity, sedimentation conditions, and the genesis of FMN. The aim of this research is to study the authigenic barite response to various processes in the seas and oceans to clarify the barite indicator properties. Barite was studied in surface bottom sediments of deep-water zones in the Caspian Sea (sampling depth 1000 m) and the Black Sea (sampling depth 2120 m), as well as in FMN from surface bottom sediments of the Pacific Ocean (Clarion-Clipperton ore province, sampling depth 4130 m). Sediment and FMN samples were investigated using optical and scanning electron microscopy, electron probe microanalysis, X-ray diffractometry, inductively coupled plasma mass spectrometry. Analytical data showed that authigenic barite is part of the paragenetic mineral associations specific to each sedimentary basin. It was found that the chemical and morphological properties of barite are associated with the lithological and geochemical characteristics of bottom sediments. Thus, in calcareous pelitic ooze of the South Caspian Basin barite was found in paragenetic association with authigenic gypsum, kutnagorite, Mg-calcite, calcite and framboidal pyrite. Barite is present in the form of rare lamellar crystalline microaggregates up to 5x5 microns in size, which contain 5.8% Sr. In coccolithic ooze of the Black Sea, barite was found in paragenetic association with gypsum, framboidal pyrite, low-Mg calcite and baritocalcite. Barite forms numerous collomorphic aggregates of irregular shape up to 3x4 microns in size, as well as clusters of flattened microcrystals of isometric and irregular shape up to 2 microns in size. The Sr content in barite varies from 0% to 0.6%. In the FMN of the Pacific Ocean, barite is in paragenesis with authigenic busserite and birnessite. Barite is found in the form of numerous clusters of lenticular, subspherical, polygonal microcrystals, up to 5 microns in size, rarely with holes of various shapes. A primary analysis of our results shows that the barite authigenic mineralization is a product of the interaction of hydrological and biological processes in the water column and biogeochemical processes in the bottom sediments of the seas and oceans. These processes control the physical and chemical conditions of sedimentation and diagenesis in each studied basin. These conditions are documented in paragenetic associations of authigenic minerals, and in the properties of barite mineralization, such as chemical composition and crystal morphology, which can be used as indicators of various processes in the seas and oceans.

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