

**WMESS 2018**

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# World Multidisciplinary Earth Sciences Symposium

Eco-friendly Symposium - WMESS



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the more you get wealth*



## ABSTRACT COLLECTION BOOK

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## Preface

This Abstract Collection consists of the abstracts of papers presented in the “World Multidisciplinary Earth Sciences Symposium” in the city of romance Prague (Czech Republic) during 03-07 September 2018. 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 2018 was the 4th 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 – **SIG**, 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 2018 from 50+ different countries all over the world for their interests and contributions in WMESS 2018. We wish you enjoy the World Multidisciplinary Earth Sciences Symposium – WMESS 2018 and have a pleasant stay in the city of romance Prague. We hope to see you again during next event WMESS 2019 which will be held in Prague (Czech Republic) approximately in the similar period.

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Eva Ružinská, Lukáš Polanecký, Daniel Kučerka

## THE 2017 AYVACIK (ÇANAKKALE) EARTHQUAKES, NW TURKEY

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### ABSTRACT

Ayvacık earthquake activity, which started at 14 January 2017 (Mw: 4.4) and reached its highest level in February and lasted for approximately three months, have been on the biggest scale of the Biga Peninsula. The Ayvacık earthquake was mainly on the E-W trending, southward slope and on the Tuzla Fault of 30 km length. It has been determined that some surface ruptures that occurred after the earthquake along ancient fault where Tuzla geothermal system found. In this activity, 6 earthquakes were occurred with a magnitude greater than M: 4.9. Ayvacık earthquake activity was continued southward from Tuzla Fault in the north to Kocaköy and Babakale normal faults in the south during March-April period. Approximately 5.000 shakes recorded in the region during three months. According to the inversion of the focal mechanism solutions of the earthquakes, it was determined that the direction of the extensional regime is approximately N-S (N4°E). On the other hand, in the northern and central parts of the Biga Peninsula, inversion of the focal mechanism solutions of the earthquakes that took place in the last century yields a strike-slip faulting stress regime represented by a WNW-ESE (N 85° W) compressional direction stress axis ( $\sigma_1$ ) and NNE-SSW (N 17° E) extensional direction stress axis ( $\sigma_3$ ). The southern sections (Ayvacık-Edremit Gulf) seems to be influenced by the complex geodynamic process of the African Plate and the Aegean extensional system while the northern and central parts of the Biga Peninsula are exposed the lateral displacement due to the westward movement of the Anatolian block.

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## GEOPHYSICAL RESEARCHES (GRAVITY AND MAGNETIC) OF THE SE ANATOLIA IN THE EASTERN MEDITERRANEAN REGION

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### ABSTRACT

The gravity and magnetic maps of the area covering Adana–Kahramanmaraş–Hatay provinces (SE Anatolia) were produced from a compilation of data gathered during the period between 1973 and 1989. SE Turkey, seismically active, is located in the eastern corner of the Eastern Mediterranean region. Reduced to the pole (RTP) and Pseudo-Gravity Transformation (PGT) methods were applied to the magnetic data, while derivative ratio (DR) processing was applied to both gravity and magnetic data, respectively. Bouguer gravity anomaly values change from -118 to +74 miligal. The magnetic anomaly values calculated from RTP values vary between - 648 and 701 nT. The negative values correspond to the low density sedimentary rocks while positive values indicate relatively high structures. The PGT image shows a concentric-shaped of an anomaly about 100 km in diameter centered in the Ceyhan (Adana Basin) area. This wide structure, which corresponds to the long wavelength anomalies, is reflected in the deep structure probably indicating the ophiolites beneath the young rocks. Bouguer, RTP and PGT maps show the image of a buried structure corresponding to ophiolites under undifferentiated Quaternary deposits in the Adana depression and Iskenderun Gulf. DR maps show two important faults which reflect the tectonic framework in the study area: (1) the Karatas–Osmaniye Fault extending from Osmaniye to Karatas in the Adana depression and (2) Amanos Fault (southern part of East Anatolian Fault) in the Hatay region running southward from Turkoglu to Amik Basin along Amanos Mountain forming the actual plate boundary between the Anatolian block (part of Eurasian plate) and Arabian plate.

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## SITE EFFECT ESTIMATION USING MICROTREMOR AND REMI DATA IN ANTAKYA SOIL, HATAY PROVINCE, SE TURKEY

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### ABSTRACT

SE Turkey, seismically active, is located in the eastern corner of the Eastern Mediterranean region. The city of Antakya (Hatay Province) is located at SE Turkey is at seismic risk because of strong earthquakes occurring in the area, and different soil conditions that can produce variation of the ground motion amplification. The housing and centres of population are situated on the periphery of Asi River, which flows through Antakya in Samandag district, from Syria to the Mediterranean Sea. Microzonation of cities provides a basis for site-specific hazard analysis in urban settlements. In particular, seismic microzonation can be provided by means of detailed seismic assessment of the area, including earthquake recordings and geological studies. In this paper, we propose a preliminary microzonation map for the city of Antakya, based on the variation of the dominant periods and shear velocities of the sediments covering the area. The periods are retrieved from microtremor measurements conducted at 69 sites, using the horizontal-to-vertical spectral ratio technique. The results of microtremor analysis were compared with data obtained from refraction microtremor (ReMi) measurements at four profiles crossing the studied area. According to the classification of dominant periods, Antakya city can be divided into five zones, probably prone to different levels of seismic hazard. The shorter natural periods are in inner Antakya and both the sides of Asi River (i.e., northern and southern parts). The eastern and western parts of Antakya have maximum dominant periods. The  $V_{s30}$  values were calculated by using the ReMi method along the profiles. Antakya city has  $V_{s30}$  values in the range of category C of the national earthquake hazard reduction programme site classification.

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**GEODETIC SIGNS OF THE RECENT KINEMATICAL AND GEODYNAMICAL DEFORMATION OF THE CARPATHIAN ARC**

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**ABSTRACT**

Up to now, 4 to 5 models have been presented describing the development of the Carpathian-Pannonian region in terms of subduction processes that took place during the tertiary. All these models end in the development of the period between the paleocene and the pliocene. None of these, however, explains the quaternary and recent phenomena in relation to the post-subduction phase. Several neotectonic models refer to the development of basaltic volcanism in the southeastern Pannonian basin. However, the latest geodetic measurements based on GNSS monitoring show a significant kinematics of the internal Carpathian blocks and considerable vertical movement tendencies in the Transylvania, Moldavian and Romanian parts of the platform. The question is what causes these phenomena and how they relate to earlier processes of subduction. The answer can be found in a comprehensive analysis of geodetic and geophysical data. The main reason for this is the apparent effort to isolate the residual segment of the subduction plate located under the Transylvanian region. The article presents some geodetic data and derived models in combination with geophysical data, which explain the current tendencies of movement in the eastern and southern Carpathians.

Corresponding Author: Dalibor Bartonek

## **PHYSICAL-MECHANICAL CHARACTERIZATION OF ROCKS FROM ANGOLA AS DIMENSION STONES?**

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### **ABSTRACT**

Angola territory is composed by a wide diversity of rocks, with the predominance of recent sedimentary rocks, in the East provinces, and metamorphic and igneous rocks in the Western region. The exploitation of dimension stone is a relevant industrial sector for the country, corresponding to thousands of cubic meters of stone produced each year; being a large percentage exported to countries all over the world. Europe and Asia constitute important markets and Angola stones are highly appreciated and used as cladding, masonry and paving. Due to these applications, stones are exposed to adverse environmental agents such as humidity/moisture, temperature fluctuations, salts, atmospheric contaminants and living organisms (fungi, algae, lichen, etc). Stone decay takes many different forms. Stone deterioration takes many different forms, either aesthetically (e.g. staining, discoloration), either in terms of physical-mechanical modifications (e.g. increase in porosity, water absorption, loss of mechanical strength) compromising the life cycle of the materials. The selection of dimension and ornamental stones is therefore dependent on both their aesthetic features and also physical-mechanical properties bearing in mind the specific application. Nowadays, several international standards have been published for regulation of the stone's characterization and performance evaluation tests in order to make a better and conscious stone selection. In the present work, six types of Angola's igneous stones from the provinces of Cuanza Norte, Benguela, Huíla and Namibe were selected to determine some physical and mechanical properties according to CEN standards. These rocks are commercially named as "granites" although, based on the chemical and petrographic composition, they are classified as granite, granodiorite and gabbro. The laboratory tests performed aimed characterization of colour, porosity, water absorption by total immersion/capillarity, unit volume, ultrasonic pulse velocity, dynamic elastic modulus, linear thermal expansion coefficient, flexural strength under concentrated load and uniaxial compressive strength. The results obtained show that all the rocks show high unit weight, have low porosity, high dynamic elastic modulus and show high mechanical strength values which indicates that they have adequate properties to be used as ornamental stones.

Corresponding Author: Isabel Fernandes

## **PETROGRAPHIC ANALYSIS OF ROCKS FROM ANGOLA AS DIMENSION STONE**

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### **ABSTRACT**

The use of dimension stone for decorative purposes in construction is dependent on a number of characteristics related both to aesthetic properties and physical/mechanical durability. When used as ornamental stone, the rocks should be resistance to the agents related with the adverse physical and chemical environmental conditions. Features such as colour, homogeneity and possible defects condition the aestetic selection while the texture, the presence of secondary minerals due to weathering and fractures may influence the performance of the stone in different types of decorative or monumental applications. Dimension stone is a major industry in Angola where large volumes of mainly igneous rocks are produced every year. Statistics from 2006 refer that the reserves of crystalline rocks to be produced as dimension stone are practically immense possible reserves. These crystalline rocks outcrop mainly in the provinces of Huíla and Namibe and the exploitation is of great economic importance to these areas. In the present study, six samples of igneous plutonic rocks from Angola were analysed aiming at the petrographic characterization as dimension stone. The analysis was performed according with the EN standards, as Europe is one of the potential markets for these products. The petrographic characterization was complemented by the bulk rock chemical analysis of major oxides and X-ray diffraction, in order to obtain the correct designation of each sample, according to the igneous rocks international nomenclature, using TAS diagram. It was concluded that half of the samples correspond to coarse-grained melanocratic basic rocks (gabbro) whilst the other three present a more acidic composition that correspond to leucocratic granite and mesocratic granodiorite. The samples observed both on hand specimen and under petrographic microscope show homogeneity in colour, composition and appearance. The rocks are compact and there are rare microcracks. Only one of the samples contains secondary minerals which result from hydrothermal alteration, exhibiting a pink-reddish tonality. The characteristics observed indicate that these rocks have adequate properties to be applied in blocks, slabs, sheets or other construction elements with specific sizes.

Corresponding Author: Isabel Fernandes

## **DMAIC METHOD IN QUALITY IMPROVEMENT OF GROUND WORKS PROCESSES - CASE STUDY**

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### **ABSTRACT**

Ground works are processes that are strictly related to erecting structures. There are several aspects like the types and layers of soil, level of underground water that influence the types and solutions for foundations at the design phase of construction. Proper foundations are the base for the construction objects, and their appropriate plan and execution is the key for the long and impeccable utilization of the entire structure and might effect on the future expenses of the possible repairs (particularly when ground water level is high, and there is no legitimate water protection made). Article presents the introduction Lean Management tools for quality improvement of the process of ground works with the use of DMAIC scheme. It is based on the analysis made on the construction site of block of flats located in Konin, Poland. Detail processes assessment is made using different tools and techniques, as well as different perspectives of 3 main people directly involved in the process holding different position at the construction site. There is also analysis shown of potential problems that might occur during this type of works, showing possible solutions and actions to be taken to avoid unwanted situations. Utilizing Lean Management reasoning in building sector is a smart thought to streamline practices and procedures in organization, dispose of continually repeating issues, and along these lines enhance the efficiency and nature of executed works. Performed investigation demonstrated that distinctive gatherings of individuals have altogether different thought and feeling on the issues associated with executing a similar procedure – groundworks. What is more it also demonstrated that having ready to action procedures can result in the future waste reduction in form of saved time and resources on the construction site.

Corresponding Author: Piotr Nowotarski



**INFLUENCE OF FLY ASH ON THE ENGINEERING PROPERTIES OF SILTY CLAY AND HEAVY LOAM  
IN SHANGHAI**

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**ABSTRACT**

To compare the engineering properties of different fly ash modified soil, pH, Atterberg limits and compaction properties were investigated in this study, and several performance indicators were compared, such as liquid limit, plastic limit, maximum dry density and optimum water content of Shanghai silty clay and heavy loam mixed with fly ash. The test results were as follows. The addition of fly ash improved pH of the silty clay and heavy loam. The liquid limit and plastic limit of two types of soil decreased with the increase of fly ash, the maximum reduction rate of silty clay was 7.1%, 4.9%, while the heavy loam was 5.8%, 2.4%. The influence of fly ash on liquid limit and plastic limit of silty clay was higher than that of heavy loam. The plasticity index and the maximum dry density were reduced, specifically, optimum water content of the silty clay increased with the fly ash added more, while heavy loam was the opposite. The experiment provided a useful reference for modification research of different soil textures and the rational utilization of fly ash.

Corresponding Author: Jili Qu

**COLLISION RESPONSE AND VULNERABILITY ANALYSIS OF THE ADJACENT RC FRAME STRUCTURES BASED ON OPENSEES**

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**ABSTRACT**

Under the action of earthquake, adjacent structures due to significant differences in the dynamic characteristics and do not have enough seismic distance between joints, easy to make the structure subjected to severe collision damage or even collapse. This study used simplified Hertz-damp collision model to simplify the adjacent structure for the band gap of the non-elastic rod unit, made a research on the collision response of the main-podium and adjacent contour RC frame structure with the aid of OpenSees software, to study the seismic collision impact on the performance of adjacent RC framework and its seismic collision factors under the condition of different clearance ratio and mass ratio. Finally, this article used incremental dynamic analysis (IDA) and selected the literature analyzed the structure collapsed instance as an examples, to do anti-seismic collapse vulnerability analysis based on OpenSees software, and made a comparative analysis of structural fragility curve fitting with the literature to test. Research shows that: the clearance ratio and mass ratio are the two important effect actors of collision between adjacent RC frame structure, and IDA vulnerability analysis method and OpenSees software have strong applicability to the adjacent structures collision vulnerability analysis.

Corresponding Author: Kui Zhou



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**Multidisciplinary Earth Sciences Symposium**

**SIMULATION ANALYSIS OF SUPPORT BRACKET IN INDOOR DEMOLITION AND RENOVATION PROJECT**

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**ABSTRACT**

Demolition and reconstruction is a complex process in the interaction between the main structure and the temporary support. It is crucial to perform accurate and reasonable numerical simulation of the unloading process. Taking the Hangzhou International Expo Center indoor demolition renovation project as an example, it is faced with problems such as the influence of surrounding structural errors on the surrounding structures, difficulty in controlling the processing precision, the small space around the operation area, and the difficulty in structural installation and installation. In order to prevent structural instability, Before the reinforcement, the reinforcement steel beam needs to be supported, and the original structure is reinforced with a supporting tire frame. By analyzing the various factors that affect the bearing capacity, the bearing capacity values for a given tire frame parameter are obtained, which provides reference for similar projects.

Corresponding Author: Weidong Liu

**DETERMINATION OF SOIL STIFFNESS PARAMETERS FOR POZNAN FORMATION CLAYS AS A CONSTRUCTION SUBSOIL FOR WARSAW UNDERGROUND**

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**ABSTRACT**

Analysis of soil-structure interaction demands properly determined parameters for a particular calculation method. In the case of deformation modulus determination, it is essential to take actual construction activities into consideration. It means that these modules should correspond to stress-strain range of a particular construction. The use of numerical methods, allowing for more realistic soil-structure interaction, compatibility of displacements, as well as to account for the stiffness of the structure and the soil, may provide more realistic prediction of displacements. The article concerns the methods of stiffness parameters determination including all factors that should be taken into consideration in geotechnical design. The article characterizes clays of Poznań formation, a subsoil for many structures in almost 75% area of Poland. Investigations conducted for clays in Warsaw were used as a background with the focus on an underground Metro station. Direct measurements of the unloading of the bottom of the excavation in clays were taken. Finite Element Method (FEM) was used to verify stiffness parameters and their determination methods. The correctness of obtained results was verified by comparison with deformation measurements of station construction and displacement measurements in the adjacent area. As a conclusion the article shows that the type of a construction and its character should be taken into consideration in geotechnical parameter determination. The analysis with stiffness parameters determined in a small-strain range of deformations allows to obtain displacement values approximate to real ones. In the case of an underground station, large area of soil interacts with a structure, and in this case, the deformations are small, which should be taken into account in a design analysis.

## RMQR CLASSIFICATION SYSTEM APPLICATION AND COMPARISON WITH RMR AND Q-SYSTEMS

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### ABSTRACT

Rock mass classification systems are used, in design of rock structure, prediction of geo-mechanic properties of rock mass and design of excavation/support systems for engineering purposes. Rock Mass Rating (RMR) and Q-Systems are the most common rock mass classification systems used in underground excavation design. In this study, Rock Mass Quality Rating (RMQR) classification system was used and it was compared with RMR and Q classification systems. The data was obtained from two tunnels and the same data was re-evaluated by using RMQR classification system. Buldan Dam Yenicekent Tunnel (Denizli-Turkey) and Karaçay Dam Derivation Tunnel (Hatay-Turkey) routes data was used in this study. The data for each tunnel, were collected from separate structural regions depending on geological, structural and project conditions. Structural regions, were evaluated for the best, worst and average conditions. As a result, the data obtained by using RMR and Q systems were reclassified, and compared with that of RMQR system.

Corresponding Author: Nazmi Sengun

## **SLOPE STABILITY OF DAM EMBANKMENT: GUMUSHANE LIQUID WASTE CONTAINMENT PROJECT**

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### **ABSTRACT**

In this study, stability analyzes were carried out on the upstream and downstream sides of the dam, which will be constructed as rockfill type in order to deposit the wastes of Lead-Zinc-Copper Flotation plants without harming nature. Within the scope of the study, the data of the 6 bore holes were used. Experiments were carried out on the samples collected from the bore holes. In addition, experiments were carried out on suitable filling materials that will be obtained from the foundation-abutment excavations. In addition, the shear strength parameters of the waste material have been determined in order to evaluate the impact of the waste material on dam body. The models were constructed separately for post-construction static condition, post-construction pseudo-static condition and full reservoir condition. The desired safety factor for the static condition assumed as 1.3, and the desired safety factor under the earthquake effect assumed as 1.0. According to the results of the analyses, the safety factor of the dam body in both upstream and downstream slopes has exceeded the desired values for all conditions and it has been revealed that there will be no stability problem in the dam body.

Corresponding Author: Selcuk Alemdag



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**Multidisciplinary Earth Sciences Symposium**

**IMPACT ON THE TOTAL COSTS AND CONSTRUCTION PERIOD OF RESIDENTIAL BUILDINGS IN  
PRAGUE**

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**ABSTRACT**

Optimization is a common and very often necessary process performed for economic reasons during the realization of construction projects. This report presents the optimization of a residential project at the beginning of the construction process. It describes detailed modifications made to concrete reinforcement construction that have brought cost savings, while at the same time taking into consideration the risks and costs that result from project modification.

Corresponding Author: Martin Hejl



## **THE CREATION OF GEOCHEMICAL BARRIERS ON THE BASIS OF SANDY SOILS**

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### **ABSTRACT**

Due to unusually high rates of urbanization a large number of usually inactive hazardous substances become mobile. Sorption barriers with strictly specified properties must be created and used to protect the environment. Promising to create a geochemical barrier can be modified carbamide resin sand soils, because such resin polymerizate, and irreversible in acidic or slightly acidic environment. Lead was chosen as the substance with respect to which the absorption capacity of modified sandy soils was studied. The modified sand soils were prepared on the basis of sand fractions of different dispersion: coarse, coarse and medium-grained. Then sand in volume proportion 1:1, 1,5:1, 2:1, 3:1, mixed with urea resin. The obtained modified soil without preliminary compaction was placed in a filtration plant through which a solution of lead nitrate with a concentration of 0.1 h with pH=2.0 was filtered. The experiments were carried out at 3 filtration rates: 10-6 cm/s, 10-5 cm/s, 10-4 cm/s and the pressure gradient  $l=10$ . After the end of the experiment, the soil composites were subjected to post-stage extraction by conventional methods and analyzed using a binocular. Thus, the best results were obtained from soils on the basis of medium-grained sand with a ratio of resins: sand 1: 1.5, a decrease or increase in the amount of resin in modified soils leads to a decrease in the sorption capacity of the latter. Apparently, due to the application to the smaller particles of sand, a thinner layer of resin is formed, rather than "clots", filling large pores, as in coarse-grained Sands. Accordingly, the resin, polymerizing, as it envelops the particles of sand. As a result, the soils are formed sufficiently large vitreous aggregates (up to 2 cm in diameter), in which the sand grains are cemented by polymerized carbamide resin, which is confirmed by binocular studies. Moreover, the lower the filtration rate, the more aggregates, which can be explained by the increase in the interaction time. After the experiment, some samples were subjected to post-stage extraction by conventional methods. As in the experiments on pure urea resin, it was not possible to extract any amounts of lead from the ground composites, which once again confirms the thesis of rigid embedding of lead in the resin structure. The conducted experiments show convincingly the efficiency of using carbamide resin to create a modified sandy soil with a high sorption capacity in relation to lead. In General, based on the results of the analysis of all modified soils, it can be said that with a decrease in the size of the sand particles in the systems, the amount of resin can be reduced, while the sorption capacity of the modified soils increases. This can be explained by the fact that the wetting coefficient of medium - grained Sands is greater than that of coarse-grained and coarse-grained, respectively, the filtration of the lead solution is more evenly in the volume of soil. The amount of lead sorbed by soils based on medium-and coarse-grained sand depends on the filtration rate, the lower the rate, the greater the amount of lead is sorbed by soil composites. In soils on the basis of coarse sand such dependence is not observed that, apparently, due to the quality of the samples in the filtration plant. The sorption capacity of all soil composites is in the range from 50 to 495 mg/cm<sup>3</sup> of the sample and depends on the filtration rate, the size of sand grains, the ratio of resins: sand, and the quality of the modified soil laying.

Corresponding Author: Irina Rodkina

**USING A HYDRAULIC CONDUCTIVITY APPARATUS FOR DETERMINATION OF THE PERMEABILITY OF LOW PERMEABLE SOILS ON THE EXAMPLE OF CLAY FROM KLESZCZOW**

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**ABSTRACT**

The paper presents the results of the laboratory tests of the permeability coefficient of clay carried out in the originally constructed apparatus. This device is intended to test the permeability of low permeable soils. To verify the instrument and the reliability of the obtained results, tests on clay samples originating from Kleszczow Rift Valley were performed. In order to better identify the soil sample, its basic physical parameters and grain-size distribution curve were presented. The permeability tests were performed on three undisturbed samples of the same soil at four different pressure gradients. The diameter and the height of the sample were  $d = 40$  mm,  $h = 30$  mm, respectively. The hydraulic conductivity was determined based on the constant head tests results. During tests the penetrating liquid was water. The full permeability test of a single sample was relatively short and lasts from 10 to 12 days. For tested clay the void ratio was equal to 0.53, and the permeability coefficient varied between  $4.7 \cdot 10^{-10}$  to  $6.2 \cdot 10^{-10}$  [m/s] in function of the hydraulic gradient. The values of the permeability coefficient obtained in this work correspond well with results presented in the literature. This shows that the constructed device proved itself for determining the permeability coefficient of clays. Thus, the constructed apparatus and the applied test method are a good and simple tool for testing the permeability of low permeable soils.

Corresponding Author: Eugeniusz Sawicki

**A STUDY ON THE PERFORMANCE OF LIME COLUMN TECHNIQUE FOR TREATMENT OF A Na-BENTONITE CLAY**

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**ABSTRACT**

Lime column technique is one of the common methods which are used in order to treat swelling soils. The improvement mechanism of lime columns is based on reactions between lime and clay as a result of ion migration from the column. In this study, the performance of lime column technique on treatment of a Na-bentonite clay was investigated. For the purpose of the study, a laboratory model study was conducted. In the model, the column diameter was chosen 50 mm and a curing time of 60 days was considered. At the end of the curing time, free swelling tests were performed on the specimens extracted from different distances to the column in order to determine the changes on swelling behaviour of the bentonite. According to test results, a treatment distance of 50 mm was achieved and an improvement of 46.36% was obtained within the distance of treatment. The results of this study show that the most appropriate soils for lime column technique are the soils which have high permeability and contain a considerable amount of tree-layered clay minerals (such as Na-smectite).

Corresponding Author: Derya Toksoz

**NUMERICAL MODELING OF SLOPE STABILITY IN OPEN PIT PHOSPHATE MINES, ALGERIA: A COMPARATIVE STUDY**

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**ABSTRACT**

The aim of our work is to investigate the comparative performance of three different software packages. Slope stability of an open pit phosphate mine was studied using numerical methods, finite element (FEM) and finite difference methods (FDM). More specifically, the widely used geotechnical software FLAC 2D of Itasca Consulting Group Inc., PLAXIS 2D of Plaxis bv and Phase2 of Rocscience Inc. are used by applying the so-called shear strength reduction (SSR) technique under Mohr-Coulomb constitutive models. The scope of the work is to compare the solutions obtained for the exact same problem from the three software packages and to discuss the comparative similarities and differences among them.

Corresponding Author: Mohamed Fredj

**PREDICTION AND ANALYSIS THE RESULTS OF THE BENCH BLASTING FOR ENHANCED THE FRAGMENTATION OF ROCKS: CASE OF JEBEL MEDJOUNÉS QUARRY**

Mohamed Fredj <sup>1,2</sup>, Abdallah Hafsaoui <sup>1,3</sup>, Riadh Boukarm <sup>2</sup>, Abderazzak Saadoun <sup>1,2</sup>, Mohamed Saoudi <sup>2</sup>, Ibsa Tighilt <sup>2</sup>

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**ABSTRACT**

Algeria is one of the richest countries in natural and industrial materials thank to its potential in mineral substances necessary for all industries. The most minerals are extracted by the open pit (quarry) method. The latter more used in our country because it is a very profitable method. In the quarry of Ain El-Kebira (Setif), the fragmentation of the rocks is done by blasting. The primary purpose of blasting is to fragment rock, and there are significant rewards for delivering a fragmentation size range. Various models have been put forward over the years, attempting to predict the size distribution resulting from particular blast designs. The Kuz–Ram model is possibly the most widely used approach to estimating fragmentation from blasting, and the most important function of Kuz–Ram is to guide the blasting engineer in thinking through the effect of various parameters when attempting to improve blasting effects. The aim of this work is to reduce the rate of oversized blocks, which increases the efficiency of the entire technological process, from loading and transport to the finished product.

Corresponding Author: Mohamed Fredj

**STUDY EFFECT OF GEOLOGICAL PARAMETERS OF THE SLOPE STABILITY BY NUMERICAL MODELING: CASE LIMESTONE CAREER OF LAFARGE-M'SILA (ALGERIA)**

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**ABSTRACT**

The stability of slopes in open pit mines is an issue of great concern because of the significant detrimental consequences instabilities can have. The stability of open pit is controlled by several geotechnical and geological factors, the most important cracks in the rocks as well as various and homogeneous of layers. In the case of study presence of a tensile crack is the most critical case in the calculation of factor of safety because of the possibility of the presence of waters in this crack that influence negatively on the stability of the open pit with traction crack, Than the mechanical characteristics of the crack filling material are more degraded than those of the marl layer between the layer of limestone open pit LAFARGE. With the differences both methods possess, sensitivity analyses and comparisons of result were done using Slide ,Flac and Plaxis software for the analysis of sliding and stability of open pit .These evaluations has been performed by the limit equilibrium method through the SLIDE software, the finite element, finite difference methods through PLAXIS and FLAC respectively.

Corresponding Author: Abderrazak Saadoun

**NUMERICAL MODELLING OF THE REINFORCEMENT OF THE TUNNEL FACE BY FINITE ELEMENT METHOD**

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**ABSTRACT**

The digging of the tunnel requires a stabilization study which has a very important interest, the movements that are induced at the face level have led to the innovation of several reinforcement techniques that are particularly important in unfavorable geological conditions. The purpose of this paper is to numerically study the stability of a section of tunnel of Constantine in Algeria. The modelling concerns the methods that were used during the tunnel digging work such as NATM (New Austrian Method) and ADECO RS (analysis of controlled deformation in rocks and soils). The modelling consists in comparing between the NATM which is based on the sequential excavation and the method ADECO RS. The results of the finite element numerical modelling using the Plaxis 3d calculation code have proved the effectiveness of the ADECO RS method compared to the NATM.

Corresponding Author: Abderrazak Saadoun



**THE EFFECT OF ACTIVE MINING IMPACT ON PROPERTIES WITH ENGINEERING STRUCTURES –  
FORECAST AND FINAL RESULT DISCREPANCIES**

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**ABSTRACT**

Discussed is one of the stages of an ongoing research study analyzing the form and area of active mining impact on properties which include engineering structures. A general back analysis has been applied to the cause and effect method for defining the causes of empirically determined structural damage. The calculation model and numerical model of engineering structure and the environment with different influence are created on all basis data what are known from the project and documents. One of the aspects of the research study analyzed here explores the current assumptions for mining damage forecasts for areas affected by a mine over a planned operation period. Considering that mining forecasts specify the quantity, impact duration, as well as the form of static and dynamic forces responsible for stresses and deformations resulting from active mining, the information is most critical for the construction and industrial sectors. The mining plans for the analyzed areas are based on the final information supplied by the forecasts, and show active mining areas clearly outlined; thus making it possible to delineate the active mining impact areas when preparing guidelines for building and structure construction permits. The mining damage area parameters determine the design and construction requirements for individual projects which must comply with engineering structure foundation specification for areas exposed to other than standard and highly damaging active mining impact. Mining forecast data allow for designing adequate structural, material, and geothermal safeguards which will stabilize the soil and reduce forces negatively impacting soil serviceability limit states. Owing to the high number of problems attributable to discrepancies between the mapped mining damage areas, the calculations and assumptions used in mining forecasts, and the actual conditions, this study aims to analyze the problem. Based on the information supplied and the author's own observations supported by empirical investigations, the following conclusions have been developed.

Corresponding Author: Monika Gwozdz - Lason

**THREE-DIMENSIONAL DIGITAL MODELLING BY THE METHOD OF FINITE ELEMENTS OF THE EFFECT SIZING OF A TUNNEL. CASE: DRAA EL MIZANE'S MOTORWAY TUNNEL "TIZI-OUZOU"**

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**ABSTRACT**

The main objective of this work is to find a solution to the problem of the realization of the tunnel crossing Draa El Mizane's mountain relief on the motorway penetration connecting the city of Tizi Ouzou with the East-west highway of a distance of 48 kilometers. The latter can be realized only by the control of its stability towards its digging. This stability cannot be reached without analysis of the parameters; a. structure of the massif, b. physical properties and mechanics of the rock mass, c. dimensions of the work, d. other natural factors. In this work we proceeded to a three-dimensional analysis by the method of the finite element modeling and estimation of the movements and deformations caused by the effect of the tunnel digging of Draa el Mizane "Tizi-Ouzou" diligently of the software 3D Plaxis, relative to the evaluation of its stability. The ultimate objective of this study consists in obtaining an accurate safety factor and the proposal a model to typify the digging the tunnel aroused above.

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**PRELIMINARY SUPPORT DESIGN OF TUNNEL EXCAVATION BY CONVERGENCE-CONFINEMENT METHOD AND THE FINITE ELEMENT METHOD**

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**ABSTRACT**

The aim of our work is to verify the support design and the stability during excavation tunnel work in the rock mass of Kherrata (Tunnel 3), connecting the cities of Bejaia to Setif (Algeria), by an analytical method: the convergence-confinement method, and a numerical method: The Finite Element Method (FEM). The characterization methods through the Q system (method of Barton), and GSI (Geological Strength Index) allowed us to conclude that the quality of rock mass is average in limestone, and poor in fractured limestone. Then comparison between the stability established by modelling of excavation phase using the finite element method (Phase 2 Software) with parameters from the recommendations of classification: average stand up time, span dimension, cohesion of rock mass and angle of internal friction of rock mass; and method convergence-confinement (Roc support software); allowed us conclude that the use of convergence-confinement and Finite Element Methods can be considered reliable in preliminary design of support.

Corresponding Author: Riadh Boukarm

**APPLICATION OF DISTRIBUTED OPTICAL FIBRE SENSOR FOR STRAIN AND TEMPERATURE MONITORING WITHIN CONTINUOUS FLIGHT AUGER COLUMNS (CFA)**

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**ABSTRACT**

Distributed optical fibre technology provides new possibilities in structural health monitoring in comparison with traditional spot measurements, because it allows to measure selected physical quantities continuously over structural member length (*Samiec 2012*). The spatial resolution can start from as fine as 5 mm while using advanced optical reflectometers based on the principle of Rayleigh scattering (*Barrias 2016*). The quality of information obtained about structural condition is especially important for geotechnics issues because there are many uncertainties regarding the theoretical model describing cooperation between the foundations and the substrate as well as including the values of physical parameters. Moreover, the geometry of structural members (e.g. the diameter of the piles) can be very different from design assumptions and vary along the depth depending on technology of execution. In presented case study the analysis of continuous flight auger (CFA) column was described based on the strain and temperature measurements carried out continuously over the length of 12 m. CFA columns are one of the most widely used foundation solutions because of its many advantages, but deep and precise knowledge about their structural behaviour is still insufficient and requires further research with advanced measuring tools. Distributed sensor consisted of composite rode with strain and temperature measuring optical fibres was elaborated and implemented during the pilot application within CFA column. The measurements were done during the load tests, but also in the early-age concrete, when thermal-shrinkage strains appear. The way of installation and exemplary results from selected phases of the research were presented as well as data interpretation was described and discussed hereafter. The conclusions as well as literature investigations clearly indicate that distributed optical fibre measurements, because of their many advantages and versatility, will be increasingly used in the near future in geotechnical and civil engineering applications.

Corresponding Author: Rafał Sieńko

**PERFORMANCE EVALUATION OF PAVEMENTS CONSTRUCTED ON EPS GEOFOAM BACKFILL  
USING REPEATED PLATE LOAD TEST**

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**ABSTRACT**

EPS Geofoam is an appropriate lightweight material for reducing dead load of road embankments and hence, mitigating settlements of pavements constructed over poor ground conditions. Although, it has been used successfully in many projects during the last 50 years, there are still drawbacks regarding its application and design, requiring deeper investigations. A serious problem is related to development of rut and crack on the pavement surface. This paper presents the results of repeated plate load tests, describing the influence of EPS density and EPS layers' thickness as an important factors affecting the performance of these embankments. In practical applications, two layers of EPS with different densities are used and the density of the bottom layer should be minimized in order to reduce overall cost of the pavement along the road. It has been observed that incorporating layers of EPS geofoam with inadequate thickness and densities lower than 20 kg/m<sup>3</sup>, significantly reduces the ability of such pavements to tolerate against rutting. Lower EPS densities also show a less reliable response with a noticeable number of loading cycles.

Corresponding Author: Omid Khalaj

**DAMPING RATIO OF FOUNDATION BED WITH MULTILAYERED RUBBER-SOIL MIXTURES**

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**ABSTRACT**

In this paper, a series of plate load tests on a sandy soil bed containing multiple layers of granulated rubber-soil mixture (RSM) under incremental cyclic loading was performed. Incremental cyclic loading in five steps with amplitudes of 140, 280, 420, 560 and 700 kPa were applied to the loading plate to evaluate the settlement behavior and damping ratios of foundation bed. The results show that both the total and residual settlements of the loading plate decrease with increase in the number of RSM layers, regardless of the level of applied cyclic load, but the rate of reduction in both settlements reduces with increase in the number of RSM layers. There is also an appreciable improvement in the value of the damping capacity with increase in the number of RSM layers as the damping ratio increases by 4-5% beyond the value of 12-15% obtained on untreated sand. On the basis of the study, the concept of using multiple RSM layers not only is a very attractive material to achieve vibration attenuation for machine foundation and railway track beds, but also, the environmental impacts of waste tires are attenuated by using as composite materials in geotechnical applications.

Corresponding Author: Omid Khalaj

**STUDY OF THE INTERACTION OF THE ROCK MASSIVE-SUPPORTING COUPLE OF A TUNNEL BY  
THE CONVERGENCE-CONFINEMENT METHOD : CASE OF ALGIERS METRO**

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**ABSTRACT**

The study of the interaction between an excavated massif and its support is approached here by the convergence-confinement method. The main goal of the method is the study of the conduct of an underground structure and to dimension its support. Our investigation allowed us, by the application of methods established by researchers, to determine the factors intervening during the interaction of the rock-structure and to establish a flowchart for the conduct of the tunnel design in the conditions Algiers metro. In this work two methods of computational convergence-confinement analytical method and numerical method by software plaxis (2D) were used to determine the factors of the interaction of the rock-retaining mass and to choose the support used.

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**THE INTERPRETATION OF CPTU, PMT, SPT AND CROSS-HOLE TESTS IN STIFF CLAY**

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**ABSTRACT**

The paper presents comparative results of CPTu, PMT, SPT and CH (cross-hole) tests performed in stiff, heavily overconsolidated clay at a test location in Zagreb. This clay exhibits very high pore pressures generated during CPTu penetrations despite significant overconsolidation and relatively high values of shear strength and stiffness in its undisturbed, natural state. The clay is classified using the CPTu and CH test results in recently published soil classification charts based on the soil behaviour in (S)CPTu penetrations. The results of classifications indicate that the clay tested probably has a pronounced microstructure that is likely a consequence of the geological processes of cementation and aging. Effects of cementation and aging are manifested on very high shear wave velocities, as measured in cross-hole seismic tests, and consequently very high values of the small-strain modulus. The collapse of the soil structure at higher shear deformations results in volume contractions and softening behaviour after reaching the peak shear strength. The study shows a relatively good agreement between CPTu, PMT and SPT parameters and adequate correlations have been established between the cone resistance (CPTu), limit pressure (PMT) and number of blows (SPT). The in situ state and parameters of strength, stiffness and compressibility of the clay tested are estimated based on the in situ test parameters as well as comparative laboratory test results obtained on undisturbed soil samples. Existing empirical correlations developed for the interpretation of CPTu test results are mainly from young and uncemented soils without microstructure and therefore, the results shown here are important for better understanding of the structured soil behaviour characteristics (stiffness, strength, and compressibility)..

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## **INTENSIFICATION OF THE ASH IMPOUNDMENT AND ITS STABILITY ANALYSIS**

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### **ABSTRACT**

The paper presents specific example of method of intensification of ash impoundment. The impoundment for permanent bedding of ashes is situated on the left side of the Danube river. Part of the dam system of impoundment is based upon the original flood bank of Danube river. At the selection of materials for elevation of the impoundment, the decision was made primarily according to two indicators with an economic aspect – the transportation distance and the increase of the accumulation volume of the impoundment. Finally, the decisive criterion was the occurrence of the failure rate of the ash dam systems in comparison with the dams built from loess soils. As the impoundment is situated in the immediate vicinity of the Danube river, safe and failure-free operation has the priority. There is compared the geotechnical characteristics of the loess soils in the original deposition and the loess soils compacted at optimum water content by Proctor Standard compaction test. The proposed method of intensification of ash impoundment is analyzed. The stability analysis provides an example of the utilization of the results of the monitoring of the geotechnical properties of the materials forming the impoundment's body and the surrounding rock mass.

Corresponding Author: Ivan Slávik

**ANALYSIS OF SOIL SUSCEPTIBILITY TO INTERNAL SUFFUSION IN SELECTED SITES FOR  
IMPOUNDMENT OBJECTS**

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**ABSTRACT**

In recent years, in Slovakia the construction of hydraulic structures focused on impoundment objects, which role is to utilize hydropower potential of watercourses by small hydropower plants. Construction and operation of the hydraulic structure requires to deal with issues connected with flow of seeping water and groundwater. One of the safety and reliability problems of hydraulic structures is to ensure the filtration stability of the geological environment. The most common problem with these structures is internal suffusion. Internal suffusion is defined as the transport of fine particles of soils in the porous environment due to hydrodynamic forces of seeping water. These processes can endanger the stability and serviceability of earth structures and solid structures of impoundment objects. A sufficient level of safety against internal suffusion can be ensured only by geological survey and analysis of the mechanical properties of the soils. Proposed paper is focused on internal suffusion. In our paper we analysed the geometric criteria of filtration stability for gravel soils for selected hydraulic structures according to the latest knowledge. By comparing several criteria and several samples of gravel soils with different mechanical properties we derived dependencies related to the filtration stability of gravel soils.

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**STRESS – DILATANCY OF SANDS WITH INHERENT FABRIC ANISOTROPY FOR DIRECT SHEAR**

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**ABSTRACT**

Granular materials deposited under gravity pressures inherent fabric anisotropy. The mechanical properties of such materials depend on the angle between shear plane and bedding plane perpendicular to gravity direction. For presented in literature data of direct shear of glass beds, Fujian and mica sands the stress-dilatancy relationships are analysed basing on *Frictional State Theory*. *Frictional State Theory* was developed for isotropic soils but may be used for soils with anisotropy. At large displacement the initial fabric anisotropy in shear band is fully erased and the angle of friction is independent of the initial fabric anisotropy. This angle is a critical frictional angle ( $\Phi^\circ$ ). The two other *Frictional State Theory* parameters  $\alpha$  and  $\beta$  are functions of the angle between shear and bedding planes. It is shown that these parameters are different for pre-peak and post-peak stages of shearing contrary to isotropic sand behaviour. The external values of  $\alpha$  and  $\beta$  are obtained for the values of angles between shear and bedding plane equal  $90^\circ$  and  $0^\circ$ . It is also shown that Taylor's and Bolton's relationships are almost for parallel bedding and shear plane. It is also shown that similar influence of inherent fabric anisotropy may be observed for very different three sands: glass beads, Fujian and mica sands, therefore *Frictional State Theory* can successfully describe the influence of initial fabric anisotropy on stress-dilatancy relationships for sands.

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**INFLUENCE OF SOLAR ACTIVITY ON TOTAL ANNUAL PRECIPITATION IN POLAND**

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**ABSTRACT**

The relationship between total annual precipitation and solar activity were studied based on annual precipitation data from 25 weather stations in Poland from 1966 to 2016. The correlation between yearly sunspot number and total annual precipitation were analysed by sinusoidal regression analysis. The 5 year smoothed sunspot number and total annual precipitation for each weather station were taken for final analysis. The parameters of sin curve were calculated by the least square fit method. It is assumed that the frequency of annual precipitation and solar activity are equals. The amplitude and phase for each weather station were calculated. The difference of phases between each weather station and solar activity is assumed as quantification parameter. It has been shown that for most weather stations the total annual precipitation is strongly related to solar activity. For some weather stations this influence is not so strong. There are some weather stations for which the total annual precipitation is not influenced by solar activity. This observation may be of some use to many branches of engineering activity.

Corresponding Author: Zenon Szypcio

## **STRESS – DILATANCY OF ROUNDED AND ANGULAR ROCKFILL MATERIALS**

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### **ABSTRACT**

Inherent flexibility, capacity to absorb seismic energy and the possibility of using local available materials make rockfill dams an optimal solution. Rockfill materials consist primarily of angular to sub-angular particles obtained by blasting rock or extracting rounded to sub-rounded particles from river beds. The stress-strain behaviour of rockfill materials is affected by mineralogical composition, particle grading, size and shape of particles and stress level. Particle breakage and crushing have an effect on strength and stress-strain behaviour of rockfill materials during shear. Basing on a triaxial test data of modelling different rockfill materials shown in literature the stress-dilatancy relationship is analysed with use of *Frictional State Theory*. It is shown that stress level, breakage and crushing influence the stress-dilatancy relationship more significantly for angular than rounded rockfill materials. For the analysed triaxial shear tests, the relationships between shear angle and dilatancy angle are nonlinear contrary to linear for sands. It is also shown that critical frictional state angle ( $\Phi^\circ$ ) may be treated as independent of stress level (breakage), but two other parameters of Frictional State Theory ( $\alpha$  and  $\beta$ ) may correctly express influence of stress level on stress-dilatancy relationship. The stress-strain behaviour of rockfill materials obtained by blasting and rail ballast are similar, whereas extracted from river beds are similar to gravel.

## TECHNOLOGY AND THE THERMOMECHANICAL CONDITIONS OF EXPLOITATION OF DEPOSITS OF PERMAFROST ZONE

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### ABSTRACT

The Republic of Sakha (Yakutia) belongs to the most important mineral and raw materials and mining regions of Russia and is a leading place in the extraction of diamonds, gold, stannum, antimony, and also has huge reserves of peat. The analysis of the state of disturbance of lands in the conduct of mining operations is performed. Studies of the thermomechanical state of rocks of the active layer have been carried out. It is established that the complete freezing of the seasonal layer occurs in October-November, which is taken into account when developing new, earth-saving mining technologies. For the study of the thermomechanical state of permafrost, year-round thermometric studies of a mass of frozen rocks through wells were used. To assess the disturbance of lands by mining works, the laser scanner HDS-8800 was used. It allows to obtain a 3D model of quarries, dumps, can measure the volumes of excavations and dumps. This allowed us to establish the scale of the disturbance of the landscape by mining and dumping. The obtained temperature graphs show that in the first case the deforestation depth of the active layer is 2-2.5 m, in the second one 1-1.5 m. In the area of continuous propagation of permafrost, the transition to negative temperature of the massif begins at the end of September and October, and stable negative temperature is set in October at  $-5^{\circ}\text{C}$ , and in November to a depth of 2 to 2.5 m, a constant temperature of  $-10$  to  $-15^{\circ}\text{C}$  is established. In the second half of November, the frozen layer freezes completely, the seasonally frozen layer is frozen with an array of permafrost rocks, in which loose sediments and underlying permafrost rocks are converted into a monolithic massif, acquiring a high strength and stability, ensuring processability of environmentally safe mining. Based on the studies carried out, environmental protection technologies for the open development of permafrost deposits with internal heap were developed with the formation of large blocks of overburden. Also, the technology of development of deposits with the filling of the worked-out area with the whole-breed ice was proposed. The idea of the recultivation method in the cryolithozone conditions is that, in order to significantly reduce the cost and intensify the work, the filling of the worked out space is made by the ice-breeding material produced on site. The technology of creating an ice-material is to water the water in the internal dump during the winter, covered further by a heat-insulating layer of overburden rocks, a thickness that ensures the stability of the negative temperature. A method for open development of permafrost placer deposits with internal heaping with separation of the career field into blocks is also proposed.

Corresponding Author: Maria Budikina

**NUMERICAL PROBLEM OF THERMO-CONSOLIDATION OF POROUS MEDIA WITH RHEOLOGICAL SKELETON WITH THE VARIABLE AMBIENT TEMPERATURE**

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**ABSTRACT**

The study presents the results of the numerical calculations of the temperature impact on the two phase medium deformation described with the usage of Biot equations of consolidations with the rheological Kelvin - Voigt skeleton at the example of thermo-consolidation of flotation waste landfill "Żelazny Most" under influence of its dead weight, filtration and temperature gradient. 3D geometrical model of the landfill is based on the geometric measurements of the area and its neighbourhood. A starting point for the calculations was the calculated water table of the underground waters in the landfill area. The data referring to the effective parameters of the model were partially obtained via laboratory tests of the materials coming from the landfill. The rest of the data was taken from the literature related to the mediums with similar characteristics. The results of the stress state in the landfill allow to define the sensitivity of the model's parameters in the temperature changes.

Corresponding Author: Monika Bartlewska-Urban

**CONSTITUTIVE RELATIONS FOR THE THERMOVISCOELASTICITY OF A DIPHASE MEDIUM  
WITH A KELVIN-VOIGT RHEOLOGICAL SKELETON**

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**ABSTRACT**

Constitutive relations for a diphase medium consisting of a viscoelastic Kelvin-Voigt skeleton and a compressible Newtonian liquid filling the pores of the medium were derived from the equations of irreversible thermodynamics, assuming the thermos-viscoelasticity process to be non-isothermal. The rate of change in internal energy in the two phases of the diphase medium was determined from the first law of irreversible thermodynamics. Physical relations for the solid phase and the liquid filling the pores of the medium, and an equation of entropy were determined using Helmholtz free energy and the second law of thermodynamics for open systems. The temperature of the medium's two phases in the heat conduction process was assumed to be identical for the representative elementary volume (REV). Stresses, related to the total surface of REV, for the diphase medium solid phase and liquid phase, were defined according to the Darcy-Biot consolidation theory. The derived constitutive relations and the heat conduction equation are linear since the expansion of the function of Helmholtz free energy into a Taylor series was limited to the second order. In reality, however, as the temperature increases, the model becomes nonlinear. Therefore, the applicability of the proposed model is limited to certain intervals of change in the temperature of the solid body and the liquid. The constitutive relations for the elastic skeleton come down to relations for the thermal consolidation of the Biot-Darcy body.

Corresponding Author: Monika Bartlewska-Urban



## **STABILIZATION OF A TROPICAL SOIL USING GEOPOLYMERS**

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### **ABSTRACT**

Construction waste is generated from various sources during the process of project execution; the brick is one of the most used materials in construction, making it one of the largest waste generators, both in the demolition and construction. The reuse of these wastes can reduce costs as well as the environmental and social impacts of construction projects. These aspects can increase the profitability for the construction companies. An alternative for intensive use of these wastes, is to incorporate them as cementing agents in soil stabilization for the improvement of unpaved roads. This is particularly interesting for developing countries, which usually have many unpaved roads. However, the use of brick dust as a binder agent has the limitation of reducing the dust to sizes below 35  $\mu\text{m}$ , which generates a high energy consumption. For this reason, in this work the evaluation is presented as a binder agent for thicker brick powder activated with  $\text{Na}(\text{OH})$  and waste from the lime industry. Simple compression tests (USC) were carried out on cylindrical specimens through a designing experiments, the best proportions of these elements were established to form an alternative binder material. The developed binder was used for the preparation of stabilized soil samples and its behavior was evaluated through USC tests. A silty soil (MH) taken from a region in northwestern of Colombia was used. The effect of humidity, temperature and age of curing, type of alkaline activator and the amount of stabilizer were evaluated. The results show that there is a statistically significant increase in the strength of the soil added with brick dust compared to the unstabilized soil, with an increasing greater than 100%.

Corresponding Author: Fredy Alexander Muñoz Cano

## MECHANICAL AND HYDRAULIC BEHAVIOR OF UNSATURATED RESIDUAL SOILS

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### ABSTRACT

Although earthquakes, floods, tornadoes and other natural disasters are considered the most catastrophic events, mass movements and floods are the most severe natural hazards responsible for a great number of socioeconomic and life losses. The control of such events became a priority to public administrations of cities in mountain regions all over the world. Nevertheless, the lack of an organized urban development with clear, rational delimitation of the zones susceptible to mass movements results in occupations in inadequate areas, creating a high-risk scenario to life and material goods. This is particularly noticeable in developing countries located in tropical zones due rain action. The negative effect of rains on the stability of the slopes is a problem that, added to anthropic factors and population settlements, currently generate not only material but also human losses. Therefore, the evaluation of threat by mass movements has become a first order problem. However, one of the aspects that presents the greatest uncertainty in these evaluations is the effect of soil saturation. This paper presents a methodology for evaluating the effect of rainfall by estimating the probability of soil saturation using the Richards equation and the first order and second moment method-FOSM. The methodology was applied considering materials from the area of northwestern Colombia named Aburra valley. As a result of the accelerated and most of the times disordered occupation of the Aburra Valley territory, as well as taking into account the geological and geomorphologic complexity of this region, mass movements have been recurrent, countless and tragic in this densely populated area. In the last decades, these events caused hundreds of deaths and millions of dollars in economic losses. For this purpose, a characterization of each material was made, evaluating the variability of shear strength parameters and hydraulic parameters. Subsequently, infiltration models were made using the CHEMFLO software with a historical rain event that occurred between October 27 and November 13, 2010, which exceeded the failure thresholds established for the Aburra Valley and generated several landslides. The advance of the wet front was evaluated and the probability of saturation was determined. It was found that, in all the evaluated soils, full saturation reaches depths between 600 and 4000 mm and the probability of saturation is greater in granular soils.

Corresponding Author: Melissa Arango Torres

## **COMPARISON OF SPREAD FOUNDATION DESIGN IN CASE OF INHOMOGENEOUS SUBSOIL**

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### **ABSTRACT**

The paper deals with designing spread foundation on inhomogeneous subsoil by PN-81/B-03020, by procedure often applied in Slovakia and Meyerhof and Hanna. The approach using substitute foundation, the approach using shear surface and the approach using punching shear failure are introduced. Three approaches were applied to design foundation on inhomogeneous subsoil for two cases: stronger soil underlain by weaker soil and vice versa. In case stronger soil underlain by weaker soil, PN-81/B-03020 prescribes to determine size of substitute foundation based on soil kinds (cohesive or cohesionless), distance from foundation base to the weaker soil top and also width of real foundation. Meyerhof and Hanna prescribe to determine adhesive force and passive force per unit length of the vertical planes crossing foundation sidewall. By Meyerhof and Hanna, adhesive force depends on cohesion of stronger layer and also on ratio between bearing capacity of stronger soil and weaker soil. Meyerhof and Hanna also introduce punching shear coefficient, depending on angle of internal friction of stronger soil and ratio between bearing capacity of stronger soil and weaker soil. In case weak layer underlain by strong layer, PN-81/B-03020 prescribes to ignore bearing capacity of strong layer, Meyerhof and Hanna prescribe to determine bearing capacity of both layers. Meyerhof and Hanna prescribe to take into account distance from foundation base to the stronger soil and also depth of failure surface beneath the foundation in the thick bed of the upper weaker soil layer. The procedure often applied in Slovakia does not differ above mentioned two cases and prescribes for both cases to found probably shear surface, to determine average values of subsoil shear strength parameters and unit weight, based on which a bearing capacity of inhomogenous subsoil will be determined. The results show that in the case stronger soil underlain by weaker soil, foundation sizes obtained by three approaches are different. Results also show that in case weaker layer underlain by stronger layer, neglecting the stronger layer leads to uneconomical design.

Corresponding Author: Giang Nguyen

## EFFECTIVENESS OF GEOTEXTILE ROPES IN SLOPE EROSION PROTECTION

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### ABSTRACT

Paper deals with application of geotextile ropes in erosion protection of slope of gravel pit in Nieboczowy, Poland. For protection of the slope the segments formed from thick ropes were applied. The ropes with the diameter of 120 mm were produced by the Kemafil technology. Ropes were made from strips of stitch-bonded nonwoven produced from a mixture of recycled natural and synthetic fibres and strips of wool needle-punched nonwoven. The protected slope had the length of 4 to 6 m, slope inclination from 1:1 to 1:1.8 and total area of approximately 150 m<sup>2</sup>. Generally, slope surface in protected section is without rills and gullies. This case also shows that plants are very good anti-erosion measure. Thanks ropes installed on the slope, favourable conditions for plants growth are created and maintained. Effectiveness of the ropes in slope erosion protection will be shown by the actual mean annual soil erosion rate  $E_A$  and potential mean annual soil erosion rate  $E_P$  for two cases: slope with the ropes and slope without the ropes. Values of  $E_A$  and  $E_P$  were calculated applying Universal Soil Loss Equation (USLE). Values of parameters of the USLE: rainfall erosivity factor  $R$ , soil erodibility factor  $K$ , topographic factor  $LS$ , cover management factor  $C$  and erosion control practice factor  $P$  were determined. The rainfall erosivity factor  $R$  was determined based on rainfall records. The soil erodibility factor  $K$  was determined based on soil properties (grain size distribution, organic matter content, soil structure code and water permeability class). Topographic factor  $LS$  was determined based on slope length and slope steepness. The values of cover management factor  $C = 0.01$  in slope part with ropes and  $C = 0.22$  in slope part without ropes were applied. Since slope steepness was larger than 25 %, the value erosion control practice factor  $P=1$  was applied. The obtained value  $E_A = E_P = 0.81$  (t ha<sup>-1</sup> year<sup>-1</sup>) in slope part with ropes shows that there is no erosion in this part at present and also in future. The value of  $E_A = 17.85$  (t ha<sup>-1</sup> year<sup>-1</sup>) in slope part without ropes shows that there is strong erosion in this part at present. The value of  $E_P = 81.14$  (t ha<sup>-1</sup> year<sup>-1</sup>) in slope part without ropes also shows that there will be strong erosion in this part in future.

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**POTENTIALLY AFFECTED STRUCTURES BY TUNNELLING IN AN URBAN AREA: CASE STUDY OF ALGIERS SUBWAY**

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**ABSTRACT**

The growing demand for public transport in metropolitan cities requires innovative solutions. A subway system represents the optimal choice because the fact that it does not occupy any surface. The underground excavations are built in uncertain conditions and lead inevitably to ground movements that distort and, in severe cases, damage overlying buildings and services. The interaction between tunnels, soil and structures is governed by the modification of initial stress field condition appearing clearly as surface settlement. It is widely accepted that it has a form of Gaussian error function. A reliable prediction of transverse surface displacements is function of profound site characterization and the adopted analyses approaches. The degree of certainty in initial data increases with the number of in-situ and laboratory tests performed before and during construction. Most existing models adopt an analytical approach that is suitable only for Greenfield conditions, or a numerical one with shortcomings due to the insufficient information based on its assumption. The case study is “Metro d’Alger” subway that is chosen according to the amount of data in field characterization, the modern instruments used in displacement measurement and the particularity of being under construction. The analysis and simulation defines preliminary a suitable method for each segment of the tunneling site and a particular attention is paid to the structures potentially affected by tunnelling. To validate the findings of the work, it is compared to the in situ measurements carried out. From the outcome of our investigation, it is possible to conclude that the predicted values from models have the same form of the Gaussian function as monitoring data with different values. A parametric study is still necessary before obtaining a definitive answer to variables governing surface settlement trough form.

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## INVESTIGATION OF PROPERTIES OF WASTE STONE POWDER COATED MORTARS UNDER FREEZING-THAWING EFFECT

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Today, sustainable production is vitally important in consideration of limited raw materials and an environmental welfare. Sustainable production encourages the use of several industrial wastes as raw materials in different fields. Water and aggregate are among the most consumed items on the earth. Waste dusts, with a size of 75  $\mu\text{m}$  or less, formed during the aggregate production process affect both the environment and human health negatively. For sustainable aggregate production, it is important that the waste dust generated during the aggregate production phase is used in the concrete industry. Limestone, basalt and dolomite are commonly used as concrete aggregate. In this study limestone, basalt and dolomite waste powders were replaced with fine aggregate (sand). Reference samples (0 %) and 20% -30% waste stone dust produced by replacing standard sand with mortar. The freeze-thaw effect (40 cycles ) on compressive strength, tensile strength, ultrasonic pulse wave velocity, weight loss and the effect of water absorption are analysed. For this purpose, a total of 105 (21x5) 40x40x160 mm prism samples were produced. Under the influence of freeze-thaw cycles, the loss of weight in samples produced by replacement of standard sand and waste stone powders is less than that of the reference samples. The water absorption value generally increases as the number of cycles increases while it decreases slightly at low displacement rates, and increases slightly at high displacement rates. The impulsive wave velocity tend to increase in general as the number of freeze-thaw cycles increases. The bending tensile strength rises as the displacement rate is increased, and after the freeze-thaw cycle, a slight decline is observed. The compressive strength values decrease as the displacement rate is increased. It decreases at the end of the 10th freeze-thaw cycle but the variability tend decrease at extending cycles (20-40).

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## **GROUND PENETRATION RADAR IN GEOTECHNICS**

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### **ABSTRACT**

The use of the Ground Penetration Radar (GPR) in geotechnics presents great potential, but also relevant difficulties. This technique allows the acquisition of field data in a fast and versatile way, facilitating the interconnection between the geological studies, the geophysical characterization, the mechanical exploration and the geotechnical zoning. The depth and accuracy of data acquisition easily adapts to various situations ranging from a few centimetres to several tens of meters, changing to antennas with lower frequency. This near surface and non-destructive test method can be used almost anywhere. The continuity of the information obtained with the GPR complements the discreet and localized information obtained with the mechanical exploration. The validation of the local geological conditions using direct mechanical exploration together with the GPR imaging allows the confirmation of the parameters obtained by techniques of different nature, that once validated can allow the interpretation of areas and volumes with improved accuracy. In favourable conditions the use of the GPR can greatly help the direct mechanical exploration but the interpretation must always be done with great care and based on a good knowledge of the site characteristics. The interpretation of the GPR has in most cases many uncertainties. The research developed aimed at increasing the geotechnical characterization efficiency, using complementary techniques in order to reduce the costs and the time required to perform the geotechnical studies, ensuring that the information obtained is suitable and sufficient for the intended purposes. In a few case studies the GPR was used conjugated with trenches and the Dynamic Probing Super Heavy (DPSH) test, and allowed to enhance the individual information of each technique, increasing reliability, taking into account the importance of the geology of each site. In the geotechnical study for the rehabilitation of an ancient Villa, requiring the construction of a small auditorium in the basement and an underground garage in the garden, the GPR and the DPSH successfully allowed to define the geotechnical zoning of the surface soils and of the depth of the sandstone bedrock, as the local information obtained by the DPSH allowed to validate the GPR imaging. The presence of buried pipes and of an underground water tank were also identified by a GPR grid. In karst areas the interpretation of the GPR can be complex due to the irregular geological interface between the limestone and the residual soils filling the dissolution zones. In aeolian sands the layer's structure and the change in grain size are usually well identified with the GPR imaging, which can be validated by the geological reconnaissance and the mechanical exploration. Besides the natural variation of the electromagnetic properties of the ground mass, unexpected causes like tree roots, uncontrolled fill or even previous excavations can difficult a clear interpretation of the GPR data.



## **STUDY OF A DEEP EROSION IN AEOLIAN SANDS**

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### **ABSTRACT**

The rupture of a pressurized water conduit generated a deep ravine erosion on aeolian sands, cutting off the street Aníbal Bettencourt, in São Pedro de Moel, Portugal, and destroyed the existing infrastructures, removed walls support and endangered nearby buildings, requiring the intervention of civil protection and the rehabilitation of the site. This incident occurred in the vicinity of other two previous, but smaller erosions, occurred in 2002 and 2016. In the area, the base formations are dated of the lower Jurassic, consisted by Toarcian (J1g) limestones, overlaid by a sandy cover of the undifferentiated Plio-Pleistocene (P) and of the Modern including alluviums and sand dunes. The erosion had an extension of 30 m, a maximum width of 10 m, and a geometry in gutter deepening towards the north, to a maximum of 9 to 10 meters deep. The erosion removed about 1000 m<sup>3</sup> of aeolian sands from the street, since level 29 m, to about level 20 m, which accumulated partially over the Plio-Pleistocene until the bottom of the valley. A detailed study of the conditions that led to the deep erosion, was carried out. In addition to the surface geological reconnaissance, Georadar with 500, 250, 100 and 50 MHz antennas were used in order to investigate the structure of the terrain. Four interpretive cross sections were considered and calculations were performed using the Slide stability program. It was concluded that the main cause of the instability is the easy surface erosion of the aeolian sands along the slope, greatly aggravated by the increase in the water flow over the slope. The concentration of large amounts of water at a lower point generated a concentrated runoff over the aeolian sands. Superficially the eroded aeolian sands corresponded to a landfill built during the urbanization of the site or during the construction of the street, which increased the angle of the slope and reduced its erosion resistance. The main conclusions are: a. In the aeolian sands, slopes dipping above 30° are unstable; b. The instability is aggravated by saturation or an earthquake, leading to deeper slides; c. In the area where the erosion occurred, the use of a 24° inclination ensures long term stability; d. The application of a “Reno” mattress mask, substantially improves stability and erosion resistance; e. The north zone of the ravine is unstable. The south zone of the ravine is mainly stable. It is necessary to implement efficient drainage in the street and to replace the existing water supply system to avoid future failures. The eroded materials accumulated in the bottom of the valley must be removed and reused in the re-profiling of the slope, and the area recovered so that the natural conditions of the valley are restored.

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## NON-INTRUSIVE PROCEDURES TO STUDY THE SLOPE STABILITY AT KARIMBALA ROAD IN MAUBARA, EAST TIMOR

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### ABSTRACT

East Timor has a rough topography and a complex geology contributing to the occurrence of a large number of slope stability problems, which are aggravated by recent road construction activities aiming to improve the old roads. The large number of cuts, sometimes with a considerable high are a frequent cause of a number of failures that require a detailed study. The study area where the research on Slope Stability Analysis (SSA) was done, is located in Maubara, in the Municipality of Liquiça, along the Karimbala road, which links the Liquiça and the Bobonaro Municipalities. It was verified that slope failures have occurred systematically throughout the years, but the most recent ones occurred in January 2018. The general objectives of this research was to study the slope stability problems and to compute the Factor of Safety (FoS), using non-intrusive procedures. For the characterization of the slope material and determine its geomechanical classification the slope was mapped to define the outcropping materials, the discontinuities were characterized and the strength of the rock was evaluated using the Schmidt hammer. Based on the field data, the RMR and the SMR geomechanical classifications were applied to the slope. The evaluation of the stability conditions was also done using the Rocscience software (RocTopple, Slide, Rockfall, Swedge) suitable for each individual slope failure. The Rockfall Hazard Rating System (RHRS) classification guidelines to rate each occurrence was also used. The types of failures identified were rockfall, toppling, debris fall, plane failure and wedge failure. Rockfalls and debris fall are frequent on all slopes from TzPt1 to TzPt6, as contrast to the wedge failure, which only occurs in TzPt2 and TzPt6. The two main causes for slope instability are the geological discontinuities with unfavourable orientation and the intense rain, adding weight and inducing high water pressure in the slopes, increasing the potential for rockfall and debris fall occurrences. The FoS computed is always lower than 1.5, that can be considered insufficient for a long term stability. The RHRS results computed are greater than 300. Therefore, it can be concluded that slopes TzPt1 to TzPt6 are vulnerable to additional slope failures. Mitigation must be urgently implemented to reduce damages in the road and to drivers. It is highly recommended to develop proper technical design of the slopes considering a FoS suitable for long term stability, using improvement techniques adjusted to the local conditions such as: reduction of slope height (reduction of overburden stress), reduction of face angle (reduction of instability forces), drainage improvement (reduction of pore water pressure), reinforcement of slope (increase of shearing resistance of slip surface).

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**World**

WWW.MESS-EARTH.ORG 03-07 September, 2018 – Prague (Czech Republic)

**Multidisciplinary Earth Sciences Symposium**

## **EARTH MORPHOGENESIS: SIGNS AND INTERPRETATIONS**

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The Man, since his first appearance on earth, acts on the earth's crust by continuously interpreting and reorganizing the laws of nature. The analytical line that connects it to modern man is the use of an endless reflection on the interpretations of the signs that the *physis* has transmitted over the centuries. This slow process of transformation gives space a complex meaning, triggering a continuous cross-reference between sign and drawing. Man, breaking the kidneys of time, undertakes a long journey characterized by multiple actions that observe the past for the future, re-signifying formal relationships between signs, promoting the encounter between semiotics and aesthetics.

**SMALL CONSTRUCTION LIFT MECHANISMS SELECTION: COMPARATIVE METHOD BASED ON  
STRUCTURE VOLUME AND TIME SCHEDULE**

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**ABSTRACT**

Construction technology preparation is a very important part of the construction process. Rigorous preparation is very often neglected for small constructions in practice even though three fifths of construction companies in the Czech Republic are operating at a price below the threshold of a safe price. For small scale buildings this ratio is even more pronounced. This fact can be understood as the price of construction is undervalued in such a way that it also has negative impact on construction safety. On the other hand, the selection of the lifting mechanism is based on the sense of the construction manager, mostly based on a locally available variant, where the total lifting mechanism costs are disproportionately high and the lifting mechanism oversized. The proper selection of the main lifting mechanism depends on many factors and criteria such as crane position, load characteristics, economic criteria or time schedule possibilities. For the effective selection of small lifting mechanisms it is essential to compare candidates in particular the economic and technological criteria established during their deployment on the real construction. This paper presents own approach to assess the suitability of a small lifting mechanism for small construction based on an automated time schedule in combination with the volume characteristics of the structure. Case study comparing small self-erecting tower crane and hydraulic manipulator to prove the utility of this method is presented. The results are represented by graphical representation of the comparison of the advantage of the chosen mechanism. Cost curve with the transition point demonstrated on series of six small constructions different volumes is listed. At a volume of 6030 m<sup>3</sup>, a transition point was found.

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**PAVEMENT MAINTENANCE MANAGEMENT USING VISUAL SURVEY AND NON DESTRUCTIVE TEST  
(FWD)**

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**ABSTRACT**

Pavements are always influenced by weather and environmental conditions and traffic loadings during their life span, which cause erosion and deterioration in the road. Therefore, pavement maintenance planning is inevitable. Because of the budget limitation and cost-effective treatment selection, maintenance operations must be implemented within the framework of an engineering management system, which can be found in a Pavement Management System (PMS). Pavement structural evaluation is an essential approach for assessing pavement condition in PMS. To evaluate the pavement structure, non-destructive tests (NDT) are desirable and accurate methods, the most common of which is the Falling Weight Deflectometer test (FWD), capable of simulating traffic loads applied to the surface of pavement. In this research, the FWD test and visual survey was carried out for 116 Km of arterial roads in Kermanshah province, Iran. The data obtained from the structural assessment have been analyzed based on the AASHTO 93 method. It is considered from the results that the structural evaluation does not necessarily reflect the overall condition of the pavement, and factors like pavement age and distresses, which are obtained by construction history and visual survey, are effective as well. Therefore, in this paper, using a combination of structural and visual assessment is considered to provide a comprehensive pavement maintenance management.

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**A 3-D NUMERICAL DAM-BREAK WAVE MODEL BASED ON SMOOTHED PARTICLE  
HYDRODYNAMICS METHOD**

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**ABSTRACT**

The paper presents numerical simulations of free surface flows induced by a dam break water flood wave. Smoothed particle hydrodynamics method (SPH) was used as a tool for numerical simulation of the problem. Smoothed particle hydrodynamics is a Lagrangian meshless particle method. It is one of the best method for simulating violent free surface flows in fluids and solving large fluid deformations. Dam breaking is a typical example of these problems. The basis of SPH was reviewed, including some techniques for governing equation resolution. A three dimensional analysis of fluid-structures interaction were carried out demonstrating acceptable agreement of the numerical simulations with published experiments. These results provide a good foundation to evaluate the accuracy and stability of the SPH implementation for modeling the interaction between free surface flow and structures.

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## **VALIDATION SMOOTHED PARTICLE HYDRODYNAMICS METHOD FOR FLUID DYNAMICS**

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### **ABSTRACT**

Smoothed particle hydrodynamics (SPH) is a popular meshfree, Lagrangian method with attractive features in modeling liquid sloshing dynamics which is usually associated with changing and breakup of free surfaces, strong turbulence and vortex, and “violent” fluid-solid interaction. A weakly compressible fluid flow  $\delta$ -SPH model was employed in this paper to investigate liquid sloshing phenomena in rectangular tank under the harmonic motion excitation. Liquid sloshing in cubic tank was investigated numerically in detail under different external excitation conditions. Fairly good agreements were obtained from the comparisons between the present numerical results and the experimental data.

Corresponding Author: Sergey Buruchenko

**MODELLING MULTI-PHASE LIQUID-SEDIMENT FLOWS USING SMOOTHED PARTICLE  
HYDRODYNAMICS DUALSPHYSICS CODE**

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**ABSTRACT**

Smoothed particle hydrodynamics (SPH) is a mesh-free numerical method originally developed in the 1970s for astrophysical analysis. In the recent decades, it has been applied to a wide range of research fields, including fluid and solid mechanics, hydrodynamics and coastal and geotechnical engineering. Two-phase flows are encountered in a wide range of industrial and natural situations. The present paper is devoted to the computation of two-phase flows using weakly compressible Smoothed Particle Hydrodynamics. The absence of a mesh in SPH is ideal for interfacial and highly non-linear flows with changing fragmentation of the interface, mixing and resuspension. The numerical SPH scheme is based on the explicit treatment of both phases using Newtonian and the non-Newtonian Bingham-type Herschel-Bulkley-Papanastasiou constitutive model. This is supplemented by the Drucker-Prager yield criterion to predict the onset of yielding of the sediment surface and a concentration suspension model. Aiming to illustrate the capability of the multi-phase model two calculations were performed. Modeling two dimensional waves caused by dam break over a movable bed in two dimensions show acceptable accuracy with comparison to experimental data. The second example illustrates the formation of a wave as a result of a landslide.

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**IMPACT OF CLIMATE CHANGE ON THE HYDROMETRIQUE REGIME IN THE NORTHWEST OF ALGERIA**

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**ABSTRACT**

Global climate change affects the temperature and precipitation. These changes have a serious impact on the flow regime on a regional basis. The Algeria is located in the Mediterranean basin, is expected to be adversely affected by the damaging effects of global climate change, especially in terms of hydrological regime. It is important to understand country conditions in terms of water scarcity induced from climate change anthropogenic or natural origin to provide rational measures for adapting to climate change. This article examines the effect of climate change on the flow regime in the North West region of Algeria, taking into consideration both of past 'of a reference period thirty year's observations and projections of future flows. The effects of climate change on precipitation and temperature in Algeria, the effects of climate change on water resources potential, sea levels and the floods in Algeria, examples different areas of the country and the adaptation measures effects of climate change were studied.

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## FLOOD QUANTILES AND FLOOD-DURATION-FREQUENCY CURVES-APPLICATION IN NORTHWEST REGION OF ALGERIA

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### ABSTRACT

The QdF approach (flood-duration-frequency) was initiated by the Institute of Hydrology, Wallingford (NERC, 1975) for floods and known for developing multiple Cemagref: the reference basin approach (Galéa and Prudhomme, 1997) and recently the converge model in flood and low flows. Whatever the approach, QdF curves can be used to construct hydrographs with characteristics common frequency, a typology of regime flood or low flow, to validate hydrological characterization output model and to identify changes in the river flow regime of high water (Sauquet, Javelle and al 2003). The objective of this study is to apply a statistical model in the north-west region of Algeria by the probabilistic convergent QdF approach. And after the statistical study we removed all characteristic flows of all the stations where the maximum is registered at the station Djdiouia Cheliff, with a value of 2060m<sup>3</sup>/s, Secondly, it is the station Ponteba Defluent presenting a maximum flow of 1300 m<sup>3</sup>/s, Furthermore, the most remarkable events are observed during the 70s for stations Colonel Bougara, Ghrib upstream Arib Cheliff Lahlaf Djdiouia and we report here that the floods of autumn characterized the 90s and 80s for the winter floods.

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**ASSESSMENT OF SEISMIC HAZARD IN RELATION TO ROCK-BURST PREVENTION MODIFICATIONS  
IN KGHM POLISH COPPER JSC POLKOWICE-SIEROSZOWICE MINE, POLAND**

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**ABSTRACT**

The Polkowice-Sieroszowice mine is one of three underground copper ore mines in Poland. These three mines belong to KGHM Polish Copper JSC, excavating one of the largest copper ore deposits in the world. The deposit is situated in the south-western part of Poland in the Lower Silesia province. Due to the specific and difficult geological-and-mining conditions in the three mines, seismic events occur which often result in an excavation serious damage defined as the rock-burst or elastic recovery. Such the dynamic phenomena have been occurring since 1972 and have posed the most dangerous natural threats in underground workings. Therefore, the mining technology has to take the account of seismic hazard prevention. Numerous preventive measures adjusted to the conditions prevailing in the given operating field have to be applied so that the hazards can be mitigated, fought or limited. The appropriate choice of prevention activities must be preceded by measurements and observations, which constitute different methods for identifying, predicting and assessing the condition of the rock mass as well as for evaluating the protection effectiveness. In the Polkowice-Sieroszowice mine the rock-burst prevention involves: assessment of rock mass state and active, technological, and organizational-technical methods for combating the hazard. The active prevention consists in blasting works which provoke the rock mass to distress itself and thus to reduce its capability to accumulate elastic energy. The technological prevention embraces yielding the edges of the walls and pillars in the place of development, the extraction of the deposit with a wide opening of the front and the adjustment of the size of the technological pillar to the local geological and mining conditions. The organizational-technical measures introduce after-blasting waiting time and high hazard zones where the number of employees should be reduced. The influence of changes and improvements in the prevention activities on the seismic hazard was analysed and determined. The effectiveness of prevention methods was assessed in connection with their modifications, which concerned certain elements of active methods, the pillar size changes and alterations in the frequency of rock mass observations. Most of these modifications resulted from the operational progress and had a little impact on the seismic activity. Nevertheless, the effectiveness of such alterations was calculated. The research was carried out for one mining division in the Polkowice-Sieroszowice mine over the period of 2013-2015 years. The increase in the effectiveness of seismic/rock-burst prevention in most cases resulted in reduction of seismic activity.

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## INTEGRATION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS IN GEOLOGICAL FAULTS DETECTION IN CRETE ISLAND, GREECE

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### ABSTRACT

Fracture systems are of great importance in the field of structural geology. Faults commonly afford easy passage to groundwater and fluids such as hydrothermal fluids and magmas (mineral entrapment over the years) or even contribute in earthquake hazard monitoring. For a geologist it is not always easy to discern such morphotectonic structures at close range (i.e. heavy overgrowth of vegetation). Both remote sensing techniques and spatial modeling (GIS) permit the recognition and better understanding of the brittle tectonics in an area. This study was an effort to delineate the tectonic structures (i.e. fault system) on the Crete Islands by combining Sentinel-2 satellite data and spatial data. For the enhancement and better discrimination of photolineaments primarily recognized on satellite imagery, a variety of enhancement techniques have been applied. The evaluation of a photolineament as a potential fracture zone was based on several factors; the DEM of the study area, the shaded relief, the slopes and corresponding aspects, the drainage network, the geology and general observations on vegetative coverage appearance. The application of these methods revealed several fracture zones, which we recommend being certified by field investigations. Fault-mapping results may be used for a variety of purposes. Indicative places of large concentration of groundwater are of vital importance for subsequent exploitation by areas of need. Furthermore, because the well-known Anatolian fault zone extends over the Northern part of Crete, the present work may provide useful information for further analysis by geophysicists and seismologists

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## **PROPOSAL OF PREVENTION MEASURES AGAINST DROUGHT IN URBAN AREAS**

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### **ABSTRACT**

The creation of the adaptation strategy on impacts of the climate change in urban area comes out from assumption that the adaptation is not just a single shot but a cyclic dynamic process which has to be systematic and coordinated taking into account the necessity and effectiveness. Those cities which are or will be able to integrate the adaptation into planning process will better resist to reality which is affording the new period of climate change. One of those cities is the Trnava City in Slovakia. The analysis of the present climate change in the Trnava City and its surrounding assumes growing trend of temperature increase during the year and especially the increased extremeness. The combination of temperature and precipitation trends will affect the soil moisture and changes of run-off regimes of rivers.

The main goal of proposal of water retention measures on the Trnavka River flowing through the city is the improvement of the water level by retaining the water what should attract public places and to cool down the air in the residential area of the city. The research was concentrated on evaluation of possible realisation of such water retention measures from water quantity and quality point of view. The solution consisted in design of several inflatable rubber weirs, its analysis and prognosis of water level and discharge regime in the Trnavka River using mathematical modelling connected with field measurements and updated detailed geodetic survey.

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**POSSIBILITIES OF DESIGN OF FLOOD PROTECTION MEASURES IN URBAN AREAS**

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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.

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**HYDROGEOLOGICAL CONCEPTUAL MODELLING OF GEOTHERMAL WATERS IN PAMUKKALE,  
WESTERN ANATOLIA, TURKEY**

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**ABSTRACT**

The study area of Pamukkale, located in the eastern part of the continental rift zone of the Büyük Menderes within the Menderes Massif, western Anatolia, is composed of Paleozoic metamorphic rocks, in the area, Mesozoic limestones and Eocene via Pliocene to Quaternary sediments. Paleozoic marbles, quartzites and carbonate schists, Mesozoic limestone, Pliocene sediments and Quaternary alluvium and travertine serve as permeable rocks for the geothermal waters. The geothermal waters in Pamukkale and environs with outlet temperatures of about 35 °C and reservoir temperatures up to 250 °C can be considered as Ca-Mg-SO<sub>4</sub>-HCO<sub>3</sub> type waters. The formation of the travertine deposits in Pamukkale is one of the world's wonders, directly connected with decreasing temperatures and CO<sub>2</sub> partial pressures. The formation of travertine deposits depends upon the solubility of CaCO<sub>3</sub> controlled principally by CO<sub>2</sub> partial pressure, temperature and pH values, in which reaction equilibriums play an important role. Moreover, the travertine deposits, which show a U-series age of at least 400 ka form one of the important world wonders. The geothermal waters of Pamukkale, with its high sulfate contents up to 650 mg/l and Rn concentrations up to 20 Bq/l, were modelled hydrogeologically from conceptual schematical points.

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## HISTORY AND PRESERVATION OF TRAVERTINE DEPOSITS IN PAMUKKALE, WESTERN ANATOLIA, TURKEY

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### ABSTRACT

The study area is located in the eastern part of the continental rift zone of the Büyük Menderes within the Menderes Massif, western Anatolia, and are composed of Paleozoic metamorphic rocks, In the area, Mesozoic limestones and Eocene via Pliocene to Quaternary sediments. Paleozoic marbles, quartzites and carbonate schists, Mesozoic limestone, Pliocene sediments and Quaternary alluvium and travertine serve as permeable rocks for the geothermal waters. The geothermal waters in Pamukkale and environs with outlet temperatures of about 35 °C and reservoir temperatures up to 250 °C can be considered as Ca-Mg-SO<sub>4</sub>-HCO<sub>3</sub> type waters. The formation of the travertine deposits in Pamukkale is one of the world's wonders, directly connected with decreasing temperatures and CO<sub>2</sub> partial pressures. The formation of travertine deposits depends upon the solubility of CaCO<sub>3</sub> controlled principally by CO<sub>2</sub> partial pressure, temperature and pH values, in which reaction equilibriums play an important role. Moreover, the travertine deposits, which show a U-series age of at least 400 ka form one of the important world wonders. The formation of travertine deposits depends upon the solubility of CaCO<sub>3</sub>, controlled principally by CO<sub>2</sub> partial pressure, temperature and pH values, in which reaction equilibriums play an important role. Recent travertine deposits form the modern carbonate precipitations consisting of aragonite. In the study area, the travertine can be considered as terrace, ridge and channel type travertine. Additionally, the geothermal waters of Pamukkale have high sulfate contents of up to 650 mg/l and Rn concentrations of up to 20 Bq/l. These features are connected with the decay of uranium minerals in the metamorphic rocks of the Menderes Massif as in which the high sulfate contents are associated with sulfide contents such as pyrite as well as gypsum minerals in reservoir and cap rocks.

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**HYDROGEOLOGICAL MODELLING OF GEOTHERMAL WATERS IN URGANLI AND ENVIRONS,  
WESTERN ANATOLIA, TURKEY**

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**ABSTRACT**

The study area is located in the western part of the continental rift zone of the Gediz within the Menderes Massif in western Anatolia and consists of Paleozoic schists, intercalation of carbonate schists, mica schists and phyllites and marbles, Mesozoic carbonate rocks and ophiolites, and Cenozoic sediments such as travertine and alluvium. The impermeable mica schists form the basement rocks in the area hydrogeologically. The Paleozoic marbles form a reservoir for geothermal waters and aquifer for groundwaters especially. The Pliocene to recent rocks play an important role as impermeable cap rocks for the formation of geothermal waters. The geothermal waters in Urganlı, with surface temperatures of 75 °C and reservoir temperatures of 180 °C, can be considered as Na-HCO<sub>3</sub> type geothermal waters rather than Ca-Mg-HCO<sub>3</sub> type groundwaters. In the area, the geothermal waters were modelled hydrogeologically. The Kula volcano located in the rift zone of Gediz within the Menderes Massif, with a last eruption age up to 18,000 years, might be considered as a heat source for the formation of geothermal waters in the study area.

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**A NEW THERMAL MINERAL WATER FROM ÁGUAS (PENAMACOR, CENTRAL PORTUGAL):  
HYDROGEOCHEMISTRY AND THERAPEUTIC INDICATIONS**

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**ABSTRACT**

Thermal mineral waters are a potential resource in the local and economic development of a region. The thermal area of Termas das Águas is in the inner region of central Portugal and its grant will enable the exploration and exploitation of this water resource for medical and therapeutic purposes through a thermal medical SPA. In Portugal, the classification and legalization of a thermal unit must provide a natural mineral water resource, recognized by Portuguese Energy and Geology General Directorate and integrated in a concession granted by the Portuguese Government. For this purpose, it will be necessary to have available mineral water, with physic-chemical and microbiological, temporal stability, ensuring water's high quality. The purpose of a certified mineral water includes a detailed geomorphological, geological and hydrogeological characterization of the survey area, as well as the water's compositional temporal stability. Only after the recognition conferred by the national agency as a natural mineral water, it is possible to start a medical-hydrological study, for this resource. This process follows an experimental period of 3 years, during which it is implemented the different and specific balneotherapy techniques associated with the therapeutic features of the mineral water. A final report, to be submitted to Portuguese General Directorate for Health, will gather the main results and conclusions, regarding the benefits of this natural resource on human health, and allow its inclusion as an official medical thermal SPA in the Portuguese Normative Decrees. The main subject of this research is the geological and hydrogeological characterization of Termas das Águas aquifer, as well as the mineral water quality study (AM4 – well). The main topics for the medical hydrological study, mainly related to rheumatic and respiratory diseases, is also presented to the medical SPA of Termas das Águas.

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**HYDROGEOLOGICAL MODELLING OF GEOTHERMAL WATERS IN ÇEŞME AND ENVIRONS,  
WESTERN ANATOLIA, TURKEY**

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**ABSTRACT**

The geothermal fields of Çeşme are located in the western part of province capital of Izmir and can be considered as important tourist resorts with a great number of thermal hot springs which are used for thermal bathing since several years. Nowadays, the geothermal waters in the fields are used for district heating and greenhouses. In the area of Çeşme, there are sedimentary and volcanic rocks predominantly. The basement rocks are of Devonian age and consists of intercalations of sandstones, greywackes and limestones overlain by Upper to Middle Triassic carbonate rocks with intercalations of sandstones and claystones. These rocks are overlain by Neogene volcanic and terrestrial sedimentary rocks. In 1995, we have measured in-situ parameters in many locations of groundwaters and geothermal waters with collection of a great number of samples for these waters. The geothermal waters are of Na-Cl, Na-(Cl)-HCO<sub>3</sub>, Na-Ca-Cl, Na-Mg-(Cl)-HCO<sub>3</sub>, Na-Mg-Ca-(Cl)-HCO<sub>3</sub> and Ca-Na-Mg-(Cl)-HCO<sub>3</sub> type waters during the groundwaters display Na-Cl, Na-HCO<sub>3</sub>, Na-Mg-(Cl)-HCO<sub>3</sub>, Na-Mg-HCO<sub>3</sub>, Na-Mg-Ca-(Cl)-HCO<sub>3</sub>, Mg-Ca-Na-(Cl)-HCO<sub>3</sub> and Mg-Ca-Na-(Cl)-HCO<sub>3</sub> type waters. The Na-Cl type waters are originated from deep reservoir during the others can be considered as diluted Cl-HCO<sub>3</sub> water type. The plot of  $\delta^{18}\text{O}$  versus  $\delta\text{D}$  shows that the geothermal waters are enriched in  $\delta^{18}\text{O}$  and  $\delta\text{D}$  and located on the mixing trend between groundwaters and seawaters indicating mixing of these both different waters. The proportion of seawaters in geothermal waters seems to be very higher than groundwaters. The shift in the  $\delta^{18}\text{O}$  values are related to  $\delta^{18}\text{O}$  exchange between the deeply circulating meteoric waters and reservoir rocks in the area. The increase of  $\delta\text{D}$  is related to the contribution of seawaters. The geothermal waters in the area fall into fields of immature to partially equilibrated waters. In general, the reservoir temperature of the area of Çeşme is estimated to be 80 to 120 °C.

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**ANALYTICAL SOLUTION OF THE ADVECTION- DISPERSION EQUATION USING ASSYMETRICAL POLLUTION DISTRIBUTION**

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**ABSTRACT**

Solution of the pollution spreading in rivers is an engineering task, which could be solved by very different ways. For the simulation of the hydrodynamic dispersion in river (pollution spreading) can be 1D, as well 2D or 3D approach used. 2D (eventually 3D) approach requires much more data – physical proportions and model boundaries, velocities and dispersion parameters for two (or three) dimensions. Such data are not always available and it can be very difficult, time and money consuming task to collect necessary data. Because of this, simple analytical solution, derived for simplified initial and boundary conditions are very often used in the practice. These analytical solutions, describing the 1D substance transport in streams, have of course many limitations and factors, which determine their accuracy. One of the very important factors is the assumption, that the pollution cloud (in case of an instantaneous pollution injection) is spreading symmetrically downstream and upstream. But in reality, almost in all streams are present the transient storage areas (dead zones), deforming the concentration distribution of the transported substance (pollution). For better adaptation to such real conditions, a simple 1D approximation method is presented in this paper. The proposed approximate method is based on the asymmetric probability distribution (Gumbel's distribution) and was verified on three streams in southern Slovakia. Tracer experiments on these streams confirmed the presence of dead zones in various extents, depending mainly on the vegetation occurrence and extent in each stream. Statistical evaluation confirms that the proposed method approximates the measured concentrations significantly better than methods based upon the symmetrical Gaussian distribution.

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**ELEMENTS OF NUMERICAL MODELLING AS A CONTRIBUTION TO KNOWLEDGE OF THE  
GEOHYDRAULIC MODEL OF THE SULPHUROUS SUBTERRANEAN WATER OF THE DÃO RIVER  
BASIN, IN PORTUGAL**

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**ABSTRACT**

The Dão River is a tributary river on the right bank of the Mondego River, which is the longest river located exclusively in Portuguese territory. The Dão River Basin, which covers an overall area of 1,378 km<sup>2</sup> and forms an almost ellipsoidal shape contained within a 62 km by 22 km rectangle, is situated in the Central Iberian Zone, the lithology of which consists essentially of elements of a granitic massif dating back to the Hercynian period. The downstream area features schistous rocks (Schist-Greywacke Complex) dating back to the pre-Ordovician period, which are understood to serve as a barrier to the flows that percolate in the granitic massif. Within the Dão River hydrographic basin, the sulphurous waters occur in an upstream to downstream direction, with the following names: Caldas da Cavaca, Sezures, Termas de Alcafache, Caldas de Sangemil and Granjal. The sulphurous waters are special because they have applications in thermalism, contributing to the area of public health and tourism, and can also be used while hot for geothermal installations, both in the environmental heating of buildings and the heating of their water supply. They may even be used in electricity production, if collected at temperatures higher than 80°C. Thus, knowledge of the geohydraulic model of this kind of subterranean water is an absolute necessity, in order to make the hydrogeological prospection and collection of this kind of resource more efficient. In an effort to gain the greatest possible knowledge of the geohydraulic model of that water, various studies were carried out to that effect, including geomorphologic, geological, hydrogeological, geochemical and isotopic studies, as well as others, namely numeric models based on finite element software. Thus, in addition to showing the basic elements of some of the aspects used in gaining knowledge of the geohydraulic model of the sulphurous water of the Dão River Basin, this article also presents in particular the contributions obtained from the use of finite elements.

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## **OPTIMAL FLUORIDE CONTENT IN DRINKING WATER AS A FUNCTION OF CALCIUM CONCENTRATION**

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### **ABSTRACT**

Fluoride ( $F^-$ ) in drinking water is an important ion for the development of teeth and the bones. Fluoride deficiency ( $F < 0.5$  mg/l) promotes susceptibility to dental caries, but excessive content ( $F > 1.5$  mg/l) leads to toxic effect as dental fluorosis. The optimal  $F$  concentration in drinking water varies between 0.7 and 1.2 mg/l, depending on the average regional temperature. The lower levels of fluoride are recommended for warmer regions. Drinking water, usually obtained from groundwater, is the primary source of fluoride intake. Thus, the occurrence of fluorides in groundwater has drawn worldwide attention, including Estonia. Estonian aquifer systems differ from each other in distribution, bedding conditions, hydraulic parameters and chemical composition and fluorides are released into the groundwater mostly through water-rock interaction. Fluoride concentration in Estonian groundwater ranges within extensive limits. According to Estonian groundwater monitoring database used in this study fluoride concentration in 4404 water samples ranges from 0 to 6.71 mg/l. Values higher than 1.5 mg/l were detected in 8 % of samples, mostly in Silurian-Ordovician aquifer system. However, permissible fluoride concentration set by the Estonian as well as EU and WHO requirements (1.5 mg/l) are exceeded in all aquifer systems. Low fluoride area in southern Estonia coincides with the outcrop of Devonian sedimentary rocks, where the major source of drinking water is terrigenous Middle-Devonian aquifer system. The highest fluoride concentrations are detected in areas, where Silurian and Ordovician limestones and dolomites occur and the only drinking water source is Silurian-Ordovician aquifer system. The occurrence of fluorides is closely correlated to variations in groundwater chemical type, which is the function of the proportional content of main cations and anions. Groundwater in Estonia is mainly Ca-Mg- $HCO_3$ -type and owing to the high  $Ca^{2+}$  contents, quite low amounts of  $F^-$  may be mobilized. The highest  $F^-$  values prevail in wells, which produce the water with low  $Ca^{2+}$  content. Generally, the  $Na^+$  and  $Cl^-$  contents increase with depth and the groundwater changes towards Na-Cl- $HCO_3$  chemical type. Accordingly, geochemically favourable conditions for high dissolved  $F^-$  in groundwater dominate in deeper portions of aquifer systems. Thus, the content of calcium ions in groundwater has an important effect on fluoride concentration, insofar as Ca is an element that removes F from water through  $CaF_2$  formation and precipitation. Generally, in terrigenous aquifer systems consisting of sand- and siltstones the optimal fluoride content (0.7-1.2 mg/l) is achieved at the calcium concentration within 30-120 mg/l. Silurian-Ordovician aquifer system composed of limestones and dolomites exhibits high bicarbonate and calcium values. Calcium content which provides the optimal fluoride amount in carbonaceous aquifer system is higher – 150-340 mg/l. Consequently, the excessive fluoride contents could be found in Estonian terrigenous and carbonaceous aquifers with  $Ca^{2+}$  content below 30 and 150 mg/l, respectively. The  $Ca^{2+}$  content determined within routine water quality analyses is a simple indicator to assess the probable fluoride content in water and hence the potential effect of drinking water on human health.

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**HYDROGEOCHEMICAL STUDIES OF A GROUNDWATER WITH A VIEW TO ITS CLASSIFICATION AS MINERAL WATER FOR A NEW MEDICAL SPA IN PORTUGAL**

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**ABSTRACT**

Natural mineral waters are a high quality underground water resource and are becoming increasingly scarce. According to Portuguese legislation this resource is organized into two main types: bottled water and thermal waters. There are some cases where the same water due to its singularities is used in both situations. It is important to stress that groundwater to be considered a natural mineral has to comply with very demanding technical requirements and only after a considerable number of studies and procedures can it be proposed superior to the state to recognize this resource as mineral water. The present work corresponds to a recently licensed natural mineral water, with application in thermal activity, in classic thermalism and wellness thermalism, and that after its licensing it was designated "Termas de São Miguel", in the municipality of Fornos of Algodres, in the district of Guarda, in Portugal. It should also be pointed out that there was no pre-existence of thermal baths, neither from Roman times, nor from any other period. It was all done from scratch. Thus, in this article, the main aspects that lead to the licensing of the new natural mineral water are summarized, giving greater emphasis to the hydrogeochemical studies that were absolutely central in the whole process. Thus, in a first phase the geomorphological, geological, hydrogeo-environmental and hydrogeological aspects are presented and, in the whole, led to the elaboration of the geo-hydraulic model of the resource. In a second phase, the elements on the stability of the quality in terms of hydrogeochemicals, the respective classifications in chemical terms, are presented in detail, and their characteristics are compared with mineral waters of other Portuguese spas. Finally, some final considerations are made on the potential applications of the water under study, and the main conclusions are presented.

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**CHARACTERIZATION OF THE SPATIAL STRUCTURE OF THE PRECIPITATION THROUGH THE USE OF 'SPATIAL MOMENTS' IN A TROPICAL BASIN: CASE STUDY OF SUAREZ RIVER BASIN**

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**ABSTRACT**

Characterization of basin response based on the spatial variability of precipitation is relevant both for the advancement of the understanding of natural processes and for applied research. In the first place, it seeks to understand how the spatial variability of precipitation propagates to the basin outlet and secondly tries to involve this knowledge in the development of improvement strategies for rainfall runoff models that currently exist and are used for prediction of flood events in watersheds of interest. Given the particular characteristics of the tropics, where there are periods with very intense rainfall and concentrated in space, it is important to understand the relationship between this spatial distribution and the response of the basin, especially in Colombia where there have been several events in which they have registered loss of life and economic losses. In these events, a good flow prediction based on rain records could have reduced losses or even avoided them. In literature there are some indices to determine the spatial variability of rainfall, with the purpose of characterizing the influence of spatial organization on the shape and characteristics of the output hydrograph of the basin. The works of these authors are developed in European basins. In this paper we propose characterization of the spatial distribution of precipitation through the indexes proposed in the literature, based on actual flood events recorded in the Suarez river basin. The contribution of this research to the solution of the problem is focus on the availability of simultaneous events that allow to validate in the tropics the existing indices for other non-tropical regions, and a first attempt to characterization of the hydrological response according to the spatial distribution patterns. The basin under study is located in north-eastern Colombia with an approximate area of 15,000 km<sup>2</sup>. There are around 20 precipitation gauge stations in which rain records are recorded at hourly scale since the start of operation of the Sogamoso power plant. In the closure of the Suarez river basin, a limnigraph station is located that allowed the identification of rain events and discharge of the Suarez river basin. Two consecutive years of records were analysed, and about 50 events of this type were identified, from which, from a refinement of the simultaneous rainfall and flow records for the events, 20 were chosen in which the indices were implemented. Analysis of the indices obtained from each event showed several storm patterns in the area, which, when related to the characteristics of the basin's response, allowed to separate said response according to these patterns. Additionally, a sensitivity analysis of the indices was made in order to relate them with the precipitation field generation method.

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## THE COMPUTATION OF DISCHARGE CAPACITY IN COMPOUND CHANNELS

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### ABSTRACT

The problems in concern with flood modeling which Engineers face, originate from predicted from level of water and flood forward speed basically as a function of base of river and basin topography. But increasing flows which due to probable rain shower originated from global climate change and urbanization cause to increase calculation difficulties. On the other hand hidrolic models explain the water level to get reached in given in a flow, morphologic results of floods and flood spreading. However the basic difficulty is complication of current flooded from main river bed to floodplain. In spite of calculation of water level is a simple problem response given flow in channel with single section, the problem gradually gets complicated with water flooding from main channel to flood plain. Flood plains don't only work as retard pool, also due to they carry flow the complication of current originated from this. There are several flow calculation methods in a main channel, a compound sectioned channel consisting of one or more flood beds. In this study, the discharge computation is carried out using Single Channel Method (SCM) and Divided Channel Method (DCM) known as classical methods. These methods have been applied to a compound channel given in literature. The computed discharge values were compared with the experimental discharge values, and the validity of these classical methods is investigated. The He method in the DCM method in compound channel gave better result than V (vertical) and D (diagonal) methods. However, since the SCM method gives fewer errors than the DCM method, it has been concluded that the SCM method is better suited to use in calculation of flow of the composite sectioned channels.

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## **SURFACE WATER QUALITY IN A CONTRASTED LAND USE RIVER CATCHMENT**

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### **ABSTRACT**

To evaluate the current state quality of the surface water resources in a river catchment near the city of Leiria (Central Portugal), a water sampling programme was designed and has been carried out since September of 2017. The land uses of the basin area were also studied. The three sampling sites are located in the river Lis catchment, downstream from the river spring to the city of Leiria, and in the Ribeira do Sirol tributary. The sampling programme was performed according to ISO 5667 standards. At each sampling site and twice a year, the field parameters, the concentration of dissolved gases (O<sub>2</sub> and CO<sub>2</sub>) and the alkalinity were measured in the water. As the Lis river discharge is widely variable, flow parameters were also measured. The composition of surface water was determined in dissolved and particulate material, being the samples filtered at site. The major and minor constituents, cations (Ca, Mg, Na, K, NH<sub>4</sub> and Fe) and anions (HCO<sub>3</sub>, Cl, SO<sub>4</sub>, PO<sub>4</sub>, F, NO<sub>3</sub> and NO<sub>2</sub>) were analysed. Preliminary data of the winter campaign show that the hydrochemical facies of Lis River water are mainly Ca-HCO<sub>3</sub>. The chemical species are mainly in dissolved forms and there is no evidence of nitrites, phosphates or fluoride in the surface waters. The concentration of Na, K and Cl, Mg and SO<sub>4</sub>, increase downstream, after the Ribeira do Sirol tributary, whose basin is mainly of agricultural land use. The water of River Lis in the urban area of Leiria shows evidence of a mixture of the spring water and of the Ribeira do Sirol water, with little contributions of other water sources in the urban area, pointing to a greater concern with respect to sanitation and good environmental practices in the city of Leiria.

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## **POST-FIRE WATER QUALITY ASSESSMENT IN A PORTUGUESE WETLAND**

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### **ABSTRACT**

The Ervedeira lake is located near the village of Ervedeira, in the Leiria district (Central Portugal), in a forest catchment area, named Pinhal do Rei. During the forest fires that occur in October of 2017 in Portugal, all the surrounding area was burnt. High intensity forest fires could release substances from soils, organic matter and vegetation. The first autumn rainfall runoff transports these dissolved substances and suspended matter, ashes included, downstream to soils and water bodies, changing the surface water composition with potential impacts to the ecosystems and human health. To study the effect of forest fire in the surface water of Ervedeira Lake a water sampling programme was designed. At the sampling site the field parameters (T, pH, Eh, EC), the concentration of dissolved gases (O<sub>2</sub> and CO<sub>2</sub>) and the alkalinity were measured. The sampling of water was performed according to ISO 5667 standards. The composition of surface water was determined in dissolved species, being the samples filtered and preserved *in situ*. The constituents analysed were Ca, Mg, Na, K, NH<sub>4</sub>, Fe, HCO<sub>3</sub>, Cl, SO<sub>4</sub>, PO<sub>4</sub>, F, NO<sub>3</sub> and NO<sub>2</sub>. The water levels in a piezometer near the lake and the surface water levels were also taken into account. The Ervedeira lake fresh water is alkaline, oxidant and has a mixed Na – Ca – HCO<sub>3</sub> – Cl hydrochemical facies, with values for NH<sub>4</sub>, PO<sub>4</sub>, F, NO<sub>3</sub> and NO<sub>2</sub> below the quantification limits. The results point to a decrease in the pH values and nitrates and an increase in iron.

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## MODELING OF BASINS USING DIFFERENT MAPS AND FLOOD DISCHARGE ESTIMATES WITH DSI SYNTHETIC (SUPERPOSITION) METHOD

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### ABSTRACT

Natural influences such as meteorological, geographical and geological conditions and artificial influences such as increasing population and urbanization, global warming and etc. are found between the causes of floods which cause loss of life and property and which is one of the natural disasters. Flood discharge calculations are a process that begins with modelling recharge areas (basins) using 1/25000 scale topographic maps, aster images and etc. This process continues with current / precipitation analyzes using data from current monitoring stations (gauge) on the river or using data from precipitation monitoring stations in the absence of current monitoring stations. and it is a process that is finished by applying various flood discharge calculation methods such as DSI Synthetic (Superposition) and Mockus. In this work were conducted to compare the possible flood discharges of Eskipazar River, which has no flow observation station using 1/25000 scaled digitized topographic maps and ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) GDEM (Global Digital Elevation Model) images, with 30x30 m resolution developed jointly by Japan's Ministry of Economy, Trade and Industry (METI) and the United States National Aeronautics and Space Administration (NASA). First necessary corrections on maps and images made using the netcad program and especially the program's Nethydro module and main and sub basins (recharge areas) were modeled according to a selected downstream point using TauDEM algorithm in geographic information system. According to this, the basin area using the 1/25000 scale topographic maps is calculated as 660.346 km<sup>2</sup> and the basin area obtained using the aster images is 670.12 km<sup>2</sup>. It has been observed that Eskipazar<sup>(17641)</sup>, Gerede<sup>(17642)</sup>, Karabük<sup>(17078)</sup>, Ovacık<sup>(1097)</sup> and Çerkeş<sup>(17646)</sup> stations were affected by these basins according to the calculated influence areas. In both flood calculations, the mean flow curve number 76 was adopted based on the hydrogeological properties of the basin according to the DSI Synthetic (Superposition) method after rainfall analysis. As a result of the calculation made using 1/25000 scale map, the possible flood runoff for the 2-hour precipitation in the 100-year return interval was calculated as 39.45 m<sup>3</sup>/s while the result was calculated as 30.18 m<sup>3</sup>/s using the aster images.

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**ANALYSIS OF THE JOINT IMPACT OF SYNCHRONOUS DISCHARGES IN ESTIMATING THE FLOOD RISK: CASE STUDY ON HRON RIVER**

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**ABSTRACT**

The paper presents the methodology of bivariate statistical analysis of the joint impact of synchronous discharges in estimating the flood risk on Hron River and its tributary Slatina in Central Slovakia. Basic statistical analysis approach gives satisfactory results in the case of simple systems, for example, where the main river does not capture major tributaries. These conventional approaches may not give satisfactory results for the evaluation of flood risk in situations where floods occur on two or more rivers and join together at the same time. As input data mean daily discharges were used. Some Archimedean copula functions as a mathematical tool for joint as well as conditional probability distribution calculation of the synchronous variables were used. This class of copulas is popular in empirical applications for flexibility, easy construction and includes a whole suite of closed-form copulas that covers a wide range of dependency structures, including comprehensive and non-comprehensive copulas, radial symmetry and asymmetry, and asymptotic tail dependence and independence. The first part of the paper presents the preparation of the input data and choice of appropriate marginal probability distributions. The next part, presents the testing and selection of the appropriate copula function for the bivariate joint statistical analysis of the synchronous discharges. Tested Archimedes copula functions have achieved relatively equal calculated distribution probabilities. Probabilities calculated using the Gumbel-Hougaard copula function achieved the least error of the estimation. This copula function has been selected as the most appropriate for illustrating the joint distribution probability and consequently to determine the joint probability of occurrence of the synchronic discharges. The results showed that the joint probability of maximum discharges is relatively low, but not unlikely. In the context of climatic extreme events, statistical techniques such as event coincidence analysis will be relevant for investigating the impacts of anthropogenic climate change on human societies and ecosystems worldwide. The results obtained by the bivariate analysis of the variables which characterize the hydrological regime can contribute to a more reliable assessment of the flood risks.

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**STATISTICAL ANALYSIS OF HYDROLOGICAL REGIME OF THE DANUBE RIVER  
AT CEATAL IZMAIL STATION**

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**ABSTRACT**

In the present study, we focused on the statistical analysis of changes in the characteristics of the minimum, average annual and maximum flow rates of the Danube River at Ceatal Izmail water gauge. We have processed the series of annual average series during the whole water stage observation period 1840-2015, as well as the average daily discharge over the period 1921–2015. Firstly, we have identified changes in commonly used hydrological characteristics (such as annual averages, minimum annual discharge, maximum occurrence of extremes, etc.). In the second part we divided the annual hydrogram into individual flow events / waves and we calculated their number and their duration in each year. Specifically, we have calculated the numbers and characteristics for extremely dry periods, as well as for small and large floods. The analysis of the discharge series of the Danube River evaluated at Ceatal Izmail shows a number of facts: the long-term average discharge of the Danube River in the closing profile does not change. Annual regime has slightly changed - spring discharge peaks occur in the past years about 40 days earlier. From the statistical discharge analysis, we still do not know clearly whether this is the result of higher precipitation sums due to climate change or due to the channel training - reducing flood areas and draining acceleration. In the past, fluctuations in the Danube River flow were even higher than at present, in both directions - minimum and maximum discharge were more extreme. Therefore, it is necessary to focus on historical hydrology and analyse as many observations as possible. Statistical attention to the discharge, as well as precipitation and air temperature series needs to be continued.

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## CHARACTERISTIC OF WINTER STORM XAVIER AND EXAMPLE OF ITS EFFECT ON POLISH COAST IN THE LIGHT OF FOLLOWING SMALLER STORM EVENTS.

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### ABSTRACT

Winter storms are an important factor shaping the Polish coast. Short-term water level variations caused by them significantly alter the coast in the non-tidal Baltic Sea, where extreme water levels depend largely on the volume of water flowing in from the North Sea. If Baltic does not have the time to 'fill in', even high wind speeds or wave heights are not enough to cause major damage. Although these phenomena have been widely covered by literature, no studies for Western Polish coast have as yet documented comprehensively the behaviour of a coastal profile covering both foreshore and nearshore sections of the coast. In this paper we describe the meteorological and hydrological conditions of the severe storm "Xavier", which traversed the Polish coast between 5th and 7th December 2013, as well as its impacts on an example of bathymetric and topographic profiles made along the pier in Międzyzdroje. Changes of shoreline caused by Xavier storm are compared with the effects of smaller events which occurred afterwards, in year 2014. Achieved results show that Xavier storm completely rebuilt the profile of the coast. The foreshore was eroded as beach elevation was reduced by about 0,5 m on average. Accumulation is observed in vicinity of the water line down to the depth of 1 meter. Furthermore, erosion processes dominate in the nearshore section with an average value of 0,27 m and a maximum of 0,62 m, with a small exception at the depth of 2 meters. Although the rates of erosion caused by Xavier are significant it is observed that in some sections they are comparable to effects of short and much weaker storms that affected investigated area in the following year.

Corresponding Author: Paweł Terefenko

**EVOLUTION OF ROCK FALLS BEFORE AND AFTER THE 2008 MOVRI EARTHQUAKE (ILIA, GREECE)**

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**ABSTRACT**

The evolution of rock falls affected both by climatic or structural parameters is considered as a useful and reliable tool to document and study primarily rock falls for assessing the rock-fall hazards in Greek mountainous slopes that are affected by earthquakes through time. Investigating the rock falls associated with the Movri earthquake ( $M_w=6.4$ ) that caused a series of failures in northwestern Peloponnese, is critical because especially rock falls in this earthquakes had an impact on a residential area. The main scope of this study is the determination of the landslide state of activity and geometry. By using aerial photographs and surface mapping in Skolis Mountain, the influence of the 08 June 2008 Movri earthquake has been estimated. In total 88 rock fall sites were selected in the western flank of the Skolis Mountain in order to estimate their evolution over the period from 1945 until 2016. In this period we recognized that there was an increase either in rock fall width, called hereinafter as inflation, or in their length, called as enlargement or in both. The terms of width and length are defined along strike or down slope the Skolis Mountain respectively. After the rock fall evaluation an outline of generating rock fall hazard map based on rock fall inventory and GIS was performed. The creation of the rock fall inventory based on multi-year aerial photographs estimates also the mass movement hazard and the morphological changes as a result of the seismic activity occurred in the last 70 years in Skolis Mountain region.

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**STREAM DEFLECTION IN THE SOUTHWEST COAST OF THE GULF OF CORINTH (GREECE):  
IMPLICATION FOR ACTIVE FAULT'S PROPAGATION**

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**ABSTRACT**

Areas experiencing rapid tectonic deformation represent a fine example for the application of geomorphic indices. In this paper we analyze the neotectonic activity of an area, such as the Gulf of Corinth, based on the geomorphological records of fault-controlled landscapes. As a sensitive index recording tectonic forcing on a landscape we consider the drainage pattern evolution and in particular rivers cutting at fault traces at high angles. River cutting through fault traces change their courses over time due to the tectonic movement of typical E-W trending normal faults in the Gulf of Corinth. Four significant geomorphic indices were applied in the footwalls of large fault segments hosting high to medium seismicity in the western part of the gulf. These are the valley floor to width ratio ( $V_f$ ), the drainage basin shape (Bs), the asymmetry factor (AF) and the stream length–gradient index (SL) applied on 60 drainage basins flowing perpendicular to the active almost 20 km long Helike fault. These indices were estimated by DEM based maps with resolution of 5 m. Thereby, the correlation between active tectonics and erosional processes is even analyzed and the classification of fault's tectonic activity becomes unambiguous. The value range for each index is 0.06-5.83 for  $V_f$  index, 1.22-7.07 for Bs index, 29.01-78.48 for AF index and 10-1740 for SL index. These estimated values show deep valley floor erosion in the area's drainage pattern, mostly elongated basins with high asymmetry either tilting towards east or west and steep slope morphology near the active fault front. However, there is a tendency indicated by all geomorphic indices that along the western segment the erosional processes dominate over the tectonic activity. Thus, tectonic activity is less vigorous towards west. Nevertheless, the distribution of geomorphic indices illuminates that tectonic activity at both west and east Helike fault tips remains high and primarily concentrated along the range front fault strand.

Corresponding Author: Ioannis Koukouvelas



**ROCKFALL SITES BOUNDED BY ACTIVE FAULTS IN THE WESTERN PART OF THE GULF OF CORINTH: THE EXAMPLE OF MAMOUSSIA AREA (GREECE)**

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**ABSTRACT**

The structural geology of an area has a significant influence on the occurrence of landslide phenomena. As a part of landslide hazard assessment both lithologic, climatic and structural information must be incorporated. The western part of the Gulf of Corinth, hosting impressive fault arrays, suffers landslide occurrences through time. The majority of the landslide phenomena are rockfalls. Mamoussia area located in the southwest coast of the Gulf of Corinth is bounded by almost 20-km-long active faults, Helike and Mamoussia and is drained by antecedent Kerynites River. Kerynites River has a westward rotation just after crossing perpendicular the Helike fault zone. It is regarded and area of well known and intense seismicity according to historic records. The slopes lying between Helike and Mamoussia fault zones display westward orientation and have generated more than 500 rockfalls. The deflection of the drainage pattern of the area due to the activity of the faults emphasizes that faults are controllers of the deposition and sediment transportation. This case study shows that also gravitational phenomena can contribute to the deposition and sediment transportation in the area. The area affected by rockfalls is almost 400000 m<sup>2</sup> and its maximum travel distance of rock debris from the active slope exceeds 1000 m. Both reach and shadow angle is calculated at 25° and 24° respectively, showing similar values to the Skolis Mountain values. Skolis Mountain western flank experienced extensive rockfall failures after the strong earthquake M6.4 of June 2008, highlighted the possibility that the 1995 Egion earthquake M6.5, may also impact this rockfall site that is lying almost 12 km southeast from the earthquake epicenter.

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## **FRIENDLY ENVIRONMENT SOLUTION FOR A SUFFUSION CASE**

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### **ABSTRACT**

The paper describes about solving the phenomenon of suffusion in the foundation ground of a block building. The soil was investigated with direct and indirect methods (drilling and dynamic penetration, electric tomography, seismic refraction). The filling of the cavity was made with a low permeability or practically impermeable material, homogeneous in granularity, with approximately the same stiffness as the surrounding soil.

**PROSPECTIVE STUDIES FOR THE IMPLEMENTATION OF A REMOTE ACCESS EARTHQUAKE  
DAMAGE DETECTION SYSTEM FOR HIGH-RISE BUILDINGS IN ROMANIA**

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**ABSTRACT**

The rapid increase of the number newly-erected high-rise buildings in Romania during the last two decades brought up the importance of the continuous monitoring of their state. This is essential not only from the point of view of the comfort and serviceability requirements, but also for safety reasons. In the first case, the changing of monitored parameter values could trigger automatic or human intervention for restoring normal values (e.g. for HVAC and security systems). In the second case, if occupants' safety could be affected (as in fires or earthquakes), the monitoring system could trigger the evacuation alarm. For seismic actions, a post-event modification of the dynamic characteristics of a building can provide a rapid indicator about its potential damage. If such information from several buildings is gathered and made available to decision factors through a data transmission system, this can substantially increase the efficiency of their post-earthquake reaction, directing interventions towards the most affected buildings and also helping identify associate effects, as road blocks due to fallen building debris. Long-term building monitoring can provide as well important data on structural degradation accumulation, such as that caused by material property modification due to aging, climatic actions etc. The paper presents the methods, procedures and steps by which a system providing online remote access to data resulting from building vibration monitoring could be implemented and used for buildings in Romania. The system would allow rapid identification of building damage, based on the processing of recorded data. Identified issues, as well as potential bottlenecks are presented, together with the proposed solutions. The system is planned to be implemented by using the infrastructure available at NIRD URBAN-INCERC, Romania. This includes several digital accelerometers, installed both on instrumented buildings and in free field conditions, totalling 56 stations, of which 10 in Bucharest and the other distributed all across the country. The paper also presents a case study concerning the structural health monitoring of a multi-story reinforced concrete building, carried out by the project team.

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**LANDSIDE SUSCEPTIBILITY ALONG IMPORTANT COMMUNICATION ARTERIES IN EUROPE – AN EXEMPLE OF SECTION OF THE EUROPEAN ROAD E371 (DOMARADZ-ISKRZYANIA, PODKARPACKIE VOIVODESHIP)**

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**ABSTRACT**

Landslides are one of the most dangerous natural disaster. They threaten of people, buildings and infrastructure. This global problem is existing in Poland, especially in Carpathian mountains. On of the most human activity in environment are roads. First step of prediction of landslide hazard is inventory. The second is susceptibility. On the base of unpublished world geodatabase (on the basis of articles in reputable journals) of landslide hazard, the author distinguished factors and method that are most commonly used to asses to landslide susceptibility along the important roads. The most frequent are lithology, land cover, soil depth, slope, aspect, drainage denisty, road buffer etc. At the Polish part od Carpathians stategical and international significance is the national roade Number 19 – part of the European Road- E371. This road is part of the international route Via Carpathia, which is run through Lithuania, Poland, Slovakia, Hungary, Romania, Bulgaria to Grece. Thi paper presents section from Domaradz village to Iskrzynia. This region is really interesting in geological site, because intersect two nppe- siesian nappe and subsilesian nappe. This region is rich of landslides, because in 500 m buffer from the road in dostances over 20 km is cover by more than one hundred landslides. Toestimation of susceptibility was used Landlilde Index Method. The software which is helpful in this project is Esri produt (ArcGis), and freeware software Ilwis. Input data is HRDEmM in 1m cel, Datailed Geological Map of Poland and other sources. Output map is a map in four categories, which is helpful to management in prediction i hazard along this road.

**STAGES OF GEOLOGICAL DOCUMENTATION ON THE EXAMPLE OF LANDSLIDES LOCATED ON THE SLOPES OF THE DAM RESERVOIR "ŚWINNA PORĘBA" (POLAND)**

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**ABSTRACT**

In the Polish part of the Carpathians there are 14 retention reservoirs that accumulate around 1200 million m<sup>3</sup> of water. The last larger hydrotechnical structure is the Świnna Poręba reservoir, capacity: 160 million m<sup>3</sup>, built on the Skawa river. The reservoir has a very varied coastline, within which there are many landslide areas (including the Ostałowa landslide region). Hydropower disasters are known from the history of hydrotechnical objects, the reason for which was the insufficient identification of the geological structure of the reservoir bowl. Documentation of landslide in such areas is therefore an issue of great importance for the safety of not only the hydrotechnical object itself, but also people inhabiting the area of the water reservoir. At particular stages of documenting landslide areas, it is important to: recognize the mechanism that activates the landslide, assess the possibility of securing a slope or escarpment, indicate the optimal method of stabilizing the landslide, determine the geotechnical parameters necessary to develop a landslide protection project and its monitoring. In the article, the key elements of the documentation for the protection of the Ostałowa region were presented against the background of the legal regulations in Poland. The content of landslide document sheets, the scope of the geological work project and the scope of geological engineering documentation for the landslide protection project were characterized. The key elements of the geotechnical design are presented, including slope stability calculations and the proposed protections are presented. Surveying monitoring of the Ostałowa area constituting a continuation of geological works is carried out on a network of sixteen benchmarks controlled in relation to four benchmarks of the reference network. This monitoring should also be continued after the protection of the landslide, as it is the basic measurable way of determining land displacements. Measurement results indicating soil displacement are the basis for possible prevention actions.

**NEWSPAPERS AND GIS FOR FLASH FLOODS: CASE OF FUJARIAH, UAE**

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**ABSTRACT**

Understanding flash flood needs historical data from which pattern can be deduced and in many situations newspapers reports represent valuable source of information. Although of their drawbacks they provide information that are sometimes not available elsewhere. In this study, newspapers are used to trace flash floods in Fujairah for 21 years (1995-2016). Remote Sensing and GIS are used at various phases of flood. Input data from remote sensing and GIS are used to generate flood hazard map. The hazard map is based on topographic and socio-economic factors. This map may help various departments such as planning, heritage preservation, transportation, emergency, relief, and insurance to take preventive measures and minimize flood impact. The study showed the importance of integrating various data to have a holistic view about flash floods.

Corresponding Author: M. M. Yagoub

**RESERVOIR ROCK GENETIC TYPES USING LOG CURVE SHAPES: ABU-MADI FORMATION, OFF SHORE NILE DELTA- BALTIM GAS FIELD, EGYPT**

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**ABSTRACT**

Recognizing of deltaic rock genetic types in Abu-Madi Formation using log curve shapes techniques is the main object of this research work. Abu-Madi Formation has been drilled in The Baltim gas field, offshore Nile Delta, and is deposited in a fluvio-marine environment which exhibits complex lithofacies. It is composed mainly of sandstone intercalated with siltstone and shale interbeds. The Abu Madi Formation is considered as the main gas producing reservoir rock in the Baltim gas field. Facies analysis and reconstruction of facies patterns for Abu-Madi Formation were performed using Log curve shapes interpretation. The constructed vertical profiles of three borehole logs data against lithologic intervals of the Abu-Madi Formation define the depositional history and the prevailing different rock genetic types. Two main rock genetic types were recognized indicating deltaic sedimentation. They are: 1. Distributary channel and 2. Stream Mouth bar deposits. They are exhibited either by a single unit of distributary channel or a complex superimposed on a stream mouth bar unit. Generally, they are representing lower deltaic plains and deltaic fringes sediments respectively. These rock genetic types are considered as the main gas producing zones in the Baltim field.

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## **EFFECT OF FLUID SATURATION ON ACOUSTIC WAVE VELOCITY FOR SANDSTONE RESERVOIRS**

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### **ABSTRACT**

Compressional and shear velocities were measured at room temperature and ambient pressure on cylindrical samples. The p-wave and s-wave velocities have been measured at ultrasonic frequencies of 63 kHz and 33 kHz, respectively. Compressional and shear waves have different behavior in rocks depending on difference in porosity, fluid saturation, fluid viscosity, rock density, lithologic laminations, fracturing, clay content, mineralogy, compaction and pore space framework. The velocity ratio of compressional and shear waves ( $V_p/V_s$ ) varies in crystalline and metamorphic rocks within a very narrow range (from 1.7 to 1.9). In sedimentary rocks, it varies in a wider range from 1.5 to 14.0 due to the very low shear strength of highly porous rocks ( $\phi > 25\%$ ). The technique used to measure acoustic wave velocity is the pulse first arrival technique, in which the travel times are determined for a pulse of compressional and/or shear waves to pass a known measured thickness of the rock (sample length). P-wave and s-wave velocities values (at different saturation) have been determined on a subset of 67 sandstone core samples. Only 26 sandstone samples are belonging to the upper Cretaceous in age (Baharyia Fm, Egypt) and the rest of samples belongs to the Miocene, Lower Pliocene and Upper Pliocene in age (Szolnok Fm, Hungary). The p-wave and s-wave velocities were measured with the sample fully saturated with air (dry,  $S_w = 0$ ) and partially saturated with brine water ( $S_w = 25\%$ ,  $50\%$  and  $75\%$ ) and fully saturated with brine water ( $S_w = 100\%$ ). The effect of sandstone sample water saturation either partial or fully water saturation on acoustic parameters were investigated. Some empirical approaches in obtained data analysis are developed based on both Wyllie and Raymer equations in order to predict seismic velocities ( $V_p$  and  $V_s$ ) and poisson's ratio for either dry or saturated sandstones.

Corresponding Author: Abdel Moktader A. El Sayed



**SOURCE ROCK CHARACTERISTICS, DEPOSITIONAL SETTING AND HYDROCARBON GENERATION POTENTIAL OF UPPER MIOCENE COAL BEARING UNIT FROM PARÇIKAN FORMATION, MALATYA BASIN, TURKEY**

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**ABSTRACT**

With this study, the source rock characteristics, depositional setting and hydrocarbon generation potential of Upper Miocene coal bearing unit from Parçikan Formation in the northern district of Malatya province were evaluated with the aid of organic geochemical data. According to organic geochemistry and coal quality data investigated coal is actually a high-ash, high-sulfur subbituminous B/C in rank. The total organic carbon (TOC,%) values of the samples are between 2.61% and 43.02% and the hydrogen index values (HI) are between 73-229 mgHC/g TOC. Pyrolysis ( $T_{max}$ , PI), huminite reflectance ( $R_o$ , %), and biomarker ratios (CPI, Pr/Ph ratio, Ts/Ts+Tm ratio,  $C_{32}$  homohopane ratio ( $22S/22S + 22R$ ) and  $C_{29}$   $\beta\beta/(\beta\beta + \alpha\alpha)$  sterane ratio) show that the organic matter of the studied samples are thermally immature. According to the organic geochemical characteristics, the paleodepositional environment which formed the investigated coals developed more mixed forest marsh where the herbaceous and reed-crop plants cover wide areas, the water level decreases and the trees are concentrated in more distant areas. Peatification proceeded in a fresh water environment under variable redox conditions, from anoxic to slightly oxic. When all these data are considered together, this coals are suitable for hydrocarbon generation, especially gas, in terms of organic matter type (Type III and Type II/III mixed), organic matter amount (> 10 wt. % TOC), however, low liptinitic macerals (<15-20%), low hydrogen index (<200 mg HC/gTOC) and low thermal maturity values inhibit the hydrocarbon generation.

**HYDROCARBON SOURCE ROCK CHARACTERISTICS OF CARBONIFEROUS-TRIASSIC UNITS OF SW KONYA AREA, CENTRAL TAURUS REGION, TURKEY**

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**ABSTRACT**

This study aims to determine the hydrocarbon source rock potential of the Carboniferous Çelmeçiler, Permian Karadağ and Triassic Bartlı Formation in the SW of Konya by organic geochemical and organic petrographical analysis. The area is located in the Western - Central section of the Taurus Belt. The study area mainly consists of two units which are Upper Cretaceous Sülek complex at the base, and Middle Devonian-Quaternary sediments overlying the Sülek complex with a tectonic contact. Çelmeçiler formation consists of shale and limestone. Karadağ limestone contains thick bedded biolithoclastic and biomicritic limestones. The total organic carbon (TOC) values range from 0.09 to 0.81 wt.% with an average of 0.20 wt.% for the Çelmeçiler formation and formed by marine organic material. Average vitrinite reflectance is 2.36 %. The unit is on the methagenesis stage and may rarely product the gas. For the Karadağ limestone, TOC values range from 0.03 to 1.17 wt.% with an average 0.17 and Ro 1.20 %. The values show the catagenesis stage and major organic materials in the units are marine origin. TOC values range from 0.05 to 0.11 wt.% with an average of 0.08% and Ro 0.46 % of Bartlı Formation. Hydrogen index (HI) values were very low (8.6 to 29 mg HC/g TOC) for all formation samples and generally, genetic potential values are lover 2 mgHC/g rock. The dominant organic matter observed in this formation is algal amorphous organic matter. TAI, SCI and  $T_{max}$  evaluations indicate that maturity of the unit is between diagenesis and the early mature zone.  $T_{max}$  is less than 435 °C in all the samples indicating pre-oil window stage; however this is not corroborated by the  $R_{omax}$  values. Organic matter type in the formation consists predominantly of Type III and II kerogen. According to TOC and Rock-Eval pyrolysis analysis results Carboniferous and Triassic units sediments are not productive petroleum and gas source rock.

**THE COALIFICATION PROCESS AND USE OF SATURATE BIOMARKER DATA IN THE DETERMINATION OF PALEOENVIRONMENTAL FEATURES; YENİÇUBUK- GEMEREK COALS (SİVAS-TURKEY)**

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**ABSTRACT**

The aim of this study is to determine the coalification process and paleo-depositional environment features of coalbearing units (Yeniçubuk Formation) using saturate biomarker data. Total organic carbon (TOC) and Rock Eval pyrolysis analysis, and gas chromatography (GC) and gas chromatography - mass spectrometry (GC-MS) analyses is applied to coal/carbonaceous shale and coaly clay samples of the Yeniçubuk coal field. In the Yeniçubuk-Gemerek coal/coaly samples, huminite maceral group predominates and huminite reflection, and calorific value analysis indicate that these samples are in the sub-bituminous rank. Hydrocarbon groups are determined as follows; polar + asphaltens between 68.43 % - 86.4 %, saturate hydrocarbons between 2.03 % - 18.71 % and aromatic hydrocarbons between 0.32 % - 6.63 %. A predominance of odd-carbon number n-alkanes ( $nC_{27}$ ,  $nC_{29}$  and  $nC_{31}$ ) high ratios of  $\Sigma(nC_{21}-nC_{31})/\Sigma(nC_{15}-nC_{20})$  parameter, high carbon preference index (CPI) and high terrigenous/aquatic ratio (TAR), the presence of  $C_{29}Ts$  ingredient,  $C_{29}Ts/C_{29}Ts + \text{norhopane}$  ratio represent the organic materials originated from terrestrial plants. Also, sterane distribution is  $C_{29}>C_{28}>C_{27}$  where  $C_{28}$  and  $C_{27}$  steranes show bimodal distribution. According to this distribution, relative abundance of  $C_{28}$  shows green algae and diatom and relative abundance of  $C_{27}$  indicates red algae and planktons while  $C_{29}$  indicates higher terrestrial plants. Suboxic to anoxic bottom water conditions are supported by the  $Ts/Tm$ ,  $C_{29}Ts/C_{29}$  hopane ratios and the pristane/ $n-C_{17}$  versus phytane/ $n-C_{18}$  cross plots. The thermal process is evaluated through the biomarker data during the coalification, and the moretane/hopane ratio shows immaturity and early maturity. Also, the  $20S/(20S+20R)$ ,  $\beta\beta/(\beta\beta+\alpha\alpha)$  sterane ratios indicate immature stage. High Pr/Ph ratio (1.73-12.47) and n-alkane distribution in the samples showed that Yeniçubuk formation deposited under oxic-suboxic in lacustrine- fluvial/deltaic environments.

**DETERMINATION OF EFFECTIVE PARAMETERS OF GAS INJECTION IN NATURALLY FRACTURED RESERVOIRS BY COMBINATION OF RESERVOIR SIMULATION AND DESIGN OF EXPERIMENT TECHNIQUES**

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**ABSTRACT**

Screening analysis is a useful guideline which helps us with proper field selection for different enhanced oil recovery processes. In this work, reservoir simulation is combined with experimental design to estimate main effects and possible interactions of reservoir rock and fluid properties on performance of different gas injection processes in naturally fractured reservoirs (NFRs). Studied parameters include reservoir thickness ( $h$ ), oil viscosity ( $\mu_o$ ), pore size distribution ( $\lambda$ ), horizontal permeability ( $K_h$ ), storage capacity ( $\omega$ ), reservoir dip, critical water saturation ( $S_{wc}$ ) and threshold capillary pressure ( $p_{ct}$ ). The recovery factors of different simulation designs are analyzed by use of fractional factorial design (FFD) approach. Finally, the statistical significance of results are evaluated by hypothesis testing and ANOVA, and presented by Pareto and tornado plots. Main effect analysis showed that effective parameters are ordered with respect to their importance as follows: *For Methane and nitrogen injection*:  $K_h$ , dip,  $S_{wc}$ ,  $\omega$ ,  $h$ ,  $\mu_o$  and  $\lambda$ ; threshold capillary pressure showed a minor effect on recovery factor. *For Carbon dioxide injection*:  $\mu_o$ , dip,  $S_{wc}$ ,  $\omega$ ,  $h$  and  $K_h$ ; Pore size distribution ( $\lambda$ ) and threshold pressure were not shown to be statistically significant in this process. Likeness of main effects and parameter interactions for methane and nitrogen injection prove the similarity of dominant mechanisms and characteristics of these processes compared to CO<sub>2</sub> injection which seems almost different.

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## APPLICATION OF NATURAL SURFACTANTS FOR ENHANCED OIL RECOVERY – CRITICAL REVIEW

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### ABSTRACT

The huge worldwide energy demand, and the need for more crude oil production, together with the low-efficiency of the conventional abstraction methods are part of the reasons for increasing interest in Enhanced Oil Recovery (EOR) techniques for recovering more oil from existing reservoirs. Utilization of different types of surfactants (synthetic or natural) in order to decrease the water-oil interfacial tension (IFT) is one of the most common methods for EOR. However, polymers and synthetic chemicals have a number of disadvantages such as linking to fossil fuels, high cost and environmental impacts. In this review, the application of natural surfactants produced from the leaves of Olive, Spistan, Prosopis, mulberry, zizyphus spina Christi, soapnut and chamomilla plants in EOR processes are investigated. The effects of natural surfactants extracted from the leaves of the mentioned plants on reduction of the oil-water interfacial tension (IFT) are studied and compared extensively. Pendant drop and ring methods have been employed to identify the IFT values as an influential parameter in the performance of natural surfactant flooding to increase ultimate oil recovery. This comparative study in the application of natural surfactants in EOR will pave the way for future studies and help further research in EOR schemes.

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## ASSESSMENT OF DIYARBAKIR (SE ANATOLIA OF TURKEY) AND ITS SURROUNDINGS IN TERMS OF SHALE GAS POTENTIAL

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### ABSTRACT

The world's growing population and developing technology has led to an increase in demand for energy. The steady decline in existing oil and natural gas reserves, the thought that the supply in the coming years will not meet the demand and increase in oil and energy prices led to the search for alternative energy resources. Hydrocarbon production from unconventional resources emerges as a result of this search. While it is not economic to produce from these resources in the previous years, it has been seen that hydrocarbon production from unconventional resources could become economical by using different methods than storage studies and developing technology. In this light of development, the production of shale gas which an unconventional resource has also begun to play an important role for the world energy market. Many countries, particularly the United States of America, supply a significant portion of their energy needs from shale gas. Also there is no shale gas production in Turkey, it is thought that the country has about 669 billion cubic meters of producible shale gas reserves. More than 70% of these reserves are estimated to be in Dadas Formation which in Southeastern Anatolia of Turkey. Diyarbakir is one of the most developed cities of Southeastern Anatolia with an area of 15 thousand km<sup>2</sup> and population of approximately 1.7 million. Approximately 18 thousand barrels of crude oil are produced daily in the city, which plays an important role in terms of agriculture and industry in terms of country and region. Within the scope of this study, Dadaş formation within the borders of Diyarbakir will be examined with samples taken before the outcrops and core samples taken from the oil drillings cutting the Dadaş formation. The core samples taken during the oil drilling will be analyzed in terms of mineralogical, organic geochemical and organic petrographic. These analyzes will be interpreted comparatively with the composite log data obtained from the well sand Dadaş Formation in the region will be evaluated in terms of shale gas production potential and it will be provided to shed light on shale gas drillings planned to be made in the following years.

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## ENVIRONMENTAL EFFECTS OF PETROLEUM LEAKS AROUND DIYARBAKIR CITY (SE ANATOLIA OF TURKEY) AND ITS ENVIRONMENT

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### ABSTRACT

Petroleum, a type of fossil fuels, is made up of the words "petra" meaning stone in Latin and "oleum" meaning oil (Petra oleum = Petrol) and it is Petroleum in English. Due to the growing population in the world, dependence on oil continues despite the search for clean and sustainable alternative energy sources. Just like all fossil-based energy sources, it is a fact that the use of oil causes air pollution, indirectly pollution of land and water resources, and the most important problem of today, global warming. Oil spills are one of the causes of this pollution. Natural and artificial oil spills cause oil pollution and cause damage that is difficult to recycle in the environment. Petroleum poses a serious risk to water resources in the pre-use phase. In this study; it will be investigated whether there is any pollutant effect on the fresh water resources in the pre-use stages of oil exploration, production, transportation, processing and storage. As a research area, Diyarbakir Province, which is located in the north of the Upper Mesopotamian Basin, where all phases (systems) before use such as exploration, production, transmission, storage and treatment (refining) are found altogether. Almost all of the Oil Production in Turkey is provided from the South-Eastern Anatolia Region. With daily crude Oil Production, Diyarbakir is the second largest producer of Crude Oil after Batman. There are approximately 35 Oil Fields operated by various oil producers in Diyarbakir province and approximately 200 Oil Wells are located in these areas. In the scope of this study; In Diyarbakir province, active or inactive oil fields and their locations will be determined and their impact areas will be determined. Underground and surface water resources (existing wells, streams and natural and artificial lakes) being in the impact area will be identified and their locations will be processed on the map. Samples will be taken from the water sources along with the field study. Physical and chemical analyzes of the samples will be performed. In this context, it will be investigated whether there are any petroleum components in the water resources and in what stage and where the pollution before the consumption occurs.

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## PETROGRAPHIC AND CHEMICAL PROPERTIES OF MUS COALS

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### ABSTRACT

The most important natural energy resource of our country is coal; our reserve with the newly discovered beds exceeds 14 billion tons. Although the higher quality coals are located at the western and inner part of Anatolia, there are some coal beds in the eastern Anatolia as well. Mus vicinity coals are one of them. Mus Coals are Tertiary (Pliocene) aged coals. Petrography and chemical properties (moisture, volatile matter, fixed carbon, ash content) of the coals were determined in this study. The coals which formed of many thin layers and have a total thickness varying between 0.9-3.6 meter has an average lower calorific value about 1200 Kcal/kg of original coal. Ash content changes between 17-30 %, the moisture content (with 30% average) exhibits very high values(as in original basis). The higher moisture content is thought to be derived from high ground water level and effect of surficial waters. The dominant coal maceral is huminite with 28 to 61 % amount and gelinite is the most common one. Liptinite shows a change between 2-5% and inertinite 2-11 %. The huminite reflectance ( $R_o$ ) were measured as between 0.104-0.290 % (standart deviation (0.01-0.02%)), and correspond to lignite rank. The low values of reflectances are probably due to their being buried slightly and being remote to tectonic activities. The coals comprise of 3-6% pyrite and 14-62 clay and other inorganic materials. Mus coals were classified as poor quality lignite, based on organic petrography, coal quality data and low maturity index. Detail coal petrographical analysis seems to indicate depositional environment of the coals as limnic swamps. Total reserve of the coals is about 6.2 million coals.

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**DETERMINATION OF ENVIRONMENTAL EXPOSURE TO ASBESTOS IN THE DIYARBAKIR  
SOUTHEASTERN REGION OF TURKEY**

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**ABSTRACT**

Asbestos is a silicate original mineral which is widely used in industry. Health effects of asbestosis have been known since last fifty years. Asbestos exposure cause pulmonary fibrosis, lung cancer, mesothelioma, gastrointestinal malignancies and pleural abnormalities include pleural effusions, pleural plaques, diffuse pleural thickening and rounded atelectasis. In this study health effects of asbestosis were investigated as well as the situation in Turkey. In this study, the authors examined the concentrations and mineralogical analyses of asbestos, and investigated mesothelioma risk in southeastern Anatolia, Turkey. They used a gravimetric dust sampler to collect samples from 2 villages and 2 asbestos mines (1 active). Samples were then evaluated by an X-ray diffractometer and an electron microscope. The authors found high concentrations of asbestos in an active mine (4.9 fibers[f]/cm(3)) and at a house that was plastered with asbestos (1.24 f/cm(3)) and had a very active population. They found a low concentration (0.0042 f/cm(3)) in indoor measurements taken in Armutova village, and an even lower concentration (0.000081 f/cm(3)) in the inactive mine environment. Outdoor measurements included a low concentration of 0.007 f/cm(3) in the village environment, and a high concentration of 1.17 f/cm(3) on the mine road during the passing of a sheep herd. The people in the region are continuously exposed to asbestos during normal activities. This cumulative exposure to asbestos carries sufficient risks for mesothelioma development.

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## PROPERTIES OF SIRNAK ASPHALTITES IN SOUTHEASTERN ANATOLIA

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### ABSTRACT

Asphaltites are found in the Southeastern Anatolia, in Şırnak and Silopi regions as veins. Avgamasya, Milli, Seridahli, Anılmış-Karatepe, Nivekara, Anılmış-İspindoruk, Segürük, Uludere-Ortabağ-Ortasu veins are located in Şırnak region and Harbul Üçkardeşler, Silip, Rutkekuart veins, in Silopi region. Besides these, few other unimportant occurrences are situated in Mardin-Midyat-Gerçüş, Şırnak-Herbiş, Dergül and Ceffane regions. Studies such as detail geologic mapping, excavations of the sites, drilling and chemical analyses of the occurrences related with asphaltites have been done since 1964 by MTA General Directorate. As a result of conducted drilling studies and investigations, the total reserve of the asphaltites seem to be about 81,940,000 tons with 45.473.000 tons of apparent reserve. The asphaltite veins (Avgamasya, Milli, Seridahli, Nivekara, Karatepe, İspindoruk, Segürük) located in Şırnak Region in Southeastern Anatolia are as in the form of NE-SW directed fracture fillings, which cut the layers, within the Upper Cretaceous–Paleocene aged Germav Formation. But İspindoruk and Rutkekuart veins are in the Cudi group carbonates. The veins at the South, in Silopi region, were developed within Eocene aged Gercüş Formation and concordant with the stratification. Harbul and Üçkardeşler veins are, at the same time, parallel to the trust. Proximate and ultimate analyses indicated a carbon content ranging between 50-56 % and hydrogen content between 3-6 %. Asphaltites are enriched by Cd, Cr, Cu, Mo, Vd, Ni, U and Ti. Average values of moisture, ash, sulphur, volatile matter and fixed carbon are reported as 1-5, 33-45, 4-6, 24-40 and 47-59 wt.%, respectively. HI values are varying in a wide range between 121 and 569 mgHC/gTOC and the Tmax data between 433 and 479 °C. The GC- and GC-MS-analysis of saturated and aromatic hydrocarbons showed almost a complete range of n-alkanes and no obvious signs of biodegradation. Different molecular organic geochemical proxies indicated that asphaltites were formed at different maturity stages of their respective source rock. A high-sulphur, aromatic-intermediate petroleum was stated as the origin of the asphaltites. Asphaltites have been compared with oils from Raman and Çamurlu fields and some similarities in terms of chemical composition were found. Therefore, a same origin can be postulated for both. Very recently, a source rock interval within the Middle Jurassic- aged Yolaçan formation was defined as the origin of these heavy oils and asphaltite occurrences in the region. Results of basin modelling studies showed that oil generation in the respective source rock was almost contemporaneous with the formation of thrusts, faults and fractures on the crest of anticlinal structures due to compressional tectonic phase, which started in latest Miocene and still continues. Hence, the asphaltite occurrences may have been formed by oil migrated directly from the source rock in kitchen areas into the open fractures and were then solidified subsequently.

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## **CHEMICAL PREVENTION OF ASPHALTENE FLOCCULATION IN OIL PRODUCTION SYSTEM**

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### **ABSTRACT**

The change of pressure, temperature or chemical composition of crude oil during oil production constitute the factors that may destabilize the heaviest fraction of crude oil presented in asphaltenes leading to many problems in the production system including the alteration of reservoir rock wettability, permeability reduction, plugging of tubing and production aerial facilities which generate a high production cost because of loss in the well productivity and the need of corrective measures. In this work, a crude oil sample was taken from an Algerian oil field to study the efficiency of two commercial inhibitors. The flocculation onset point of asphaltenes was measured by a solid detection system which is based on the light transmittance of flocculated particles when n-heptane is added. The effectiveness of two inhibitors was evaluated by the solid detection system at different concentration to select the best inhibitor, however, the best additive should provide a good performance at low concentration. Meanwhile, the effect of thermodynamic conditions has been also established in this work, however, the operator conditions of pressure and temperature have affected the efficiency of the added inhibitor on the flocculation of asphaltenes.

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## **INHIBITION OF WAX DEPOSITION IN CRUDE OIL OF HAOD BERKAOUI**

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### **ABSTRACT**

The deposition of paraffin in Haoud Berkaoui crude oil may occur at different parts of production system such as well bore, tubing and surface facilities which leads to a decrease of the well productivity and an increase in the cost of crude oil production in this field. For this reason, our work is interested in the prevention of paraffin deposition, however. This study contributes to examine the efficiency of two inhibitors to prevent the deposition of paraffin under different conditions of pressure and temperature by a Cold Finger in order to select the best inhibitor. The effect of the added demulsifier on wax deposition has been also studied in this work, however, the commercial demulsifier used in this field favors the deposition of wax in crude oil. Furthermore, the wax appearance temperature (WAT) of crude oil, crude oil with demulsifier and crude oil mixed with demulsifier and wax inhibitor have been measured by Pour Point equipment and the results point out that the selected wax inhibitor affects the trouble point of crude oil.

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## IMPROVEMENT OF RELATIVE PERMEABILITY AND WETTING CONDITION OF SANDSTONE BY LOW SALINITY WATERFLOODING

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### ABSTRACT

Waterflooding is generally performed to maintain reservoir pressure and as a consequence, production period is extended. However, conventional waterflooding may be not suitable for every reservoir. Low Salinity Waterflooding (LSW) which is recently the most mentioned technique is therefore, considered. Although clear explanation of oil recovery mechanism is not available, it is believed that the key mechanism is Multi-component Ion Exchange (MIE). This study aims to assess improvement of relative permeability and wetting condition of sandstone formation from oilfield in Thailand, through the MIE mechanism. The study is divided into two major parts. The first part is laboratory study including core and fluid preparations, imbibition test, coreflooding test and ion-exchange detection. After laboratory data including fluid production rate and pressure difference versus time are obtained, core simulation using reservoir simulation program called STAR® commercialized by Computer Modelling Group (CMG) is performed to study the change of wetting condition through the shifting of relative permeability. Obtaining results would help verifying suitability of the implementation of this technique in oilfield. Results from imbibition test showed that LSW yields higher oil recovery factor compared to formation water. Diluted formation water at 5,000 ppm which is approximately one-third of formation water, is the best water formulation, yielding the fastest rate of imbibition in this study. From ion-exchange detection test, results showed the variation of divalent ion concentrations compared to injected water and moreover, presence of calcium and magnesium ions in oil phase supports the occurrence of MIE during the displacement mechanism. The theoretical model matching with physical data using reservoir simulation program indicates that LSW slightly affects the original wetting condition. Water wetness is lessened as can be observed from the increment of relative permeability to water at the end point saturation. Moreover, LSW reduces residual oil saturation and at the same time, increases relative permeability to oil. From the detection of MIE together with the observation of wetting condition through core simulation, it can be concluded that LSW is a promising technique for oilfield in Thailand. As produced water must be reinjected back into reservoir based on zero discharge regulation of Thai government, this low-cost technique of diluting water salinity prior to reinjection would fulfil the requirement of government and at the same time helps increasing oil recovery of the total field.

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## ANALYSIS OF PRESSURE DECLINE DURING THE MINI-FRAC TEST IN A GAS RESERVOIR BY THE NOLTE METHOD

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### ABSTRACT

Hydraulic fracturing is a process by which a fluid or gaseous agent is used to exert pressure likely to cause the creation of cracks or widen cracks already existing in underground petroleum rocks. Submitting an oil or gas reservoir to hydraulic fracturing is intended to allow the drainage of oil or gas to be easier between the formation that encloses them and the wellbore; it is a process known as "stimulation". Almost all reservoirs in the Algerian oil fields that remain to this day require, to a certain extent, to be stimulated in order to achieve a profitable production rate. So the main objective of the fracturing is to (i) increase the production or the injectivity by creating a channel of high conductivity, (ii) to improve the communication of the fluids between the well and the tank, (iii) to pass the damages around wells, and (iv) increase the permeability of the reservoir. In this study work, a mini-frac test will be performed to determine several parameters that are needed for the hydraulic fracturing operation. The maximum pressure obtained from the injectivity test which corresponds to the fracturing pressure is 4405 Psi. In order to determine the instantaneous shut-in pressure (ISIP), a straight is plotted from the pumping stop time and the extrapolation from the stabilization of the pressure drop, the value of the ISIP obtained is 4254 psi. Closure pressure has been estimated from "Square root of time and "G-function" methods. The determination of the closure pressure is a key parameter for the success of the hydraulic fracturing operation. It has been estimated from "Square root of time and "G-function" methods, the obtained values are nearly similar which are 3863 psi and 3878 psi respectively. In order to determine the fracture dimensions by the Nolte method, it is imperative to find the propagation model of the fracture at two-dimensional. For this, we focused on the evolution of the net pressure as a function of time, the model found is of type PKN. The width and the half-length of the fracture are respectively 0.016 ft and 662 ft.

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**ESTIMATION OF SUSPENDED SEDIMENT YIELD IN THE CHERF CATCHMENT,  
ALGERIA**

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**ABSTRACT**

This work deals with the main topic of the assessment of the Cherf catchment sediment yield based on available instantaneous water discharge and suspended sediment concentration observations, and on the application of general and multivariate models. This study is also part of a broader effort aiming to predict reservoir siltation and future reliability. The 19 years of available sediment concentration data (1975/1976-1993/1994) is used to predict suspended sediment loads. The methodology involved in this study is developed by a conventional sediment rating curve and a multiple regression model. The former method is investigated with the mean discharge classes derived from the recorded suspended sediment concentrations and water discharges for the Cherf drainage basin (1710 km<sup>2</sup>), prior to the reservoir construction. The later is based on rock type erodibility, mean annual runoff and basin area variables, and which is applied for the ungauged reservoir basin of 1735 km<sup>2</sup>. For the rating curve model, the work is based on all recorded data and seasonal ratings. The mean annual sediment yield calculated with seasons is equal to 350 T km<sup>-2</sup> year<sup>-1</sup>. Using the multiple regression model, the mean annual suspended sediment yield (Tss) that entered the reservoir is estimated to 358 T km<sup>-2</sup> year<sup>-1</sup> with water supply volume of 33 Mm<sup>3</sup> (period 1994 to 2000). Based on the field observation and sediment prediction, the cause of erosion and large sedimentation in the reservoir could be the effects of anthropogenic disturbances and the favourable geomorphic conditions such as rainfall intensity and dominant weak rocks.

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## SOIL LOSS AND SEDIMENT YIELD MODELLING FOR JEQUETEPEQUE BASIN AND ASSESSMENT OF DAM SEDIMENTATION IN PERU

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### ABSTRACT

This research proposes the application of free access grid information, the application of the RUSLE model and the calculation of a coefficient of sediment production at subbasin level to estimate the dead volume in reservoirs located on the western margin of the Pacific slope, Being validated with information of the dead volume in the reservoirs of Gallito Ciego (Jequetepeque river basin) and Poechos (Chira river basin) and allowing the extrapolation of the sediment production and, therefore, the dead volume in the existing reservoirs or projected reservoirs . PISCO gridded data (Peruvian Interpolation of the CLIMATs and Hydrological Stations) of rainfall is used, with a historical series from 1981 to 2016 with a spatial resolution of 5 km on a monthly scale to determine the R factor; The SoilGrids SoilGrids Soil Texture Grid product developed by ISRIC (International Soil Reference and Information Center) with a spatial resolution of 250 m to determine the K factor; The topography from the SRTM (Shuttle Radar Topographic Mission Data) of 90 m resolution for the LS factor; The surface coverage, the GlobalLandCover product with a resolution of 30 m, for factor C and neglecting the value of factor P, due to the lack of erosion prevention activity in the basin at the regional level. The watershed of the Jequetepeque River has been chosen as a representative basin due to the characteristics similar to most of the basins of the Pacific slope, which shelters 65% of the population and suffers from a problem of water scarcity, besides having bathymetric information Of the Gallito Ciego reservoir in several years, is a source of validation with real data. The Gallito Ciego reservoir with a capacity of 544 MMC at the beginning of operations in 1988, has been reduced to 427 MMC by 2015; Resulting in a loss of useful volume of 117 MMC in 27 years. Of which, 35 MMC reduction was produced at the El Niño event. Considering the proposed methodology, the loss of useful volume due to sediment has been obtained that, since its start of operations, are 127 years of useful life, and considering events El Niño phenomenon is accentuated in 10 years extra volume for each event.

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## HYDROLOGICAL MODELING OF HUALLAGA RIVER BASIN AND STUDY OF IMPACTS OF CLIMATE CHANGE ON THE HYDROLOGICAL RESPONSE

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### ABSTRACT

The main objective of this study is to analyze the potential effects of climate change on discharges in the Amazonian basin of Huallaga River, by means of a semi-distributed hydrologic modelling software (RS MINERVE) and produce future climate change projections using the dataset generated in the AR5 report of IPCC based on CMIP5 Phase, the implications of the future projections explored in this section include the assessment of the GCMs and the scenarios selection. The Huallaga River runs from a plateau on the Atlantic slope or east of the Andes Mountain Range in central Peru, at the northwest end of the Department of Pasco. Located to the east of the Western Cordillera, in that part consists of plains of natural pastures surrounded by rugged mountains with lagoons and glaciers, then descending towards the city of Huánuco and Tingo María by rugged topography in south-east to northwest direction, average slope 12% in the highlands, and 0.20% in the jungle from the city of Tingo María. The altitude of the basin varies approximately from 200 masl to the east of the basin to altitudes higher than 5000 masl in the Andes mountain range. For the study of future climate scenarios, the research has been based on the Fifth IPCC Report with 4 new Representative Concentration trajectories (RCP). These are characterized by their total Radiative Forcing for the year 2100 that ranges between 2.6 and 8.5W / m<sup>2</sup>. The four RCP trajectories comprise a scenario in which the efforts in mitigation lead to a very low level of forcing (RCP2.6), 2 stabilization scenarios (RCP4.5 and RCP6.0) and a scenario with a very high level of greenhouse gas emissions (RCP8.5). The RS-MINERVE platform was able to capture the regime and trends of discharges. This suggests that the model may be useful in determining discharge patterns for future climate projections.

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**HYDROLOGICAL CONTEXT DURING THE COASTAL EL NINO PHENOMENON 2016-2017 AND  
IMPACTS ON PERUVIAN INFRASTRUCTURE**

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**ABSTRACT**

The 2016-2017 Coastal El Nino phenomenon was an inter-annual event that has had a development in the Eastern side of the Pacific Ocean affecting with intense rains the north coast of Peru, characterized by an anomalous upward heating in a short time of the Sea, variable closely linked to the behaviour of this phenomenon and essential to elaborate forecasts of its initiation. According to some authors and experts, this irruption of natural climate variability is the third strongest in the 20th century according to its impacts. From January to March there were major convective developments that added to the arrival of moisture from the slope of the Atlantic caused heavy rains and brought as a severe floodings and rapid movements of mass (mud flows, debris, rockfalls) affecting different cities in infrastructure and productive activities. The research aims to study the hydrological conditions in the basins of the western Andean slope, analysing observed data of maximum accumulated rainfall and discharges in several catchments, according to the information obtained from the National Service of Meteorology and Hydrology (SENAMHI) and the National Water Authority (ANA). Likewise, several numerical simulations have been performed using computational fluid dynamics (CFD) tools for the study of hydrodynamics and to reproduce the conditions that were experienced during the event with significant discharges from the main coastal rivers (Chira, Piura, Tumbes, Jequetepeque, etc). A technical visit and damage assessment has been carried out from the city of Lima to the city of Tumbes in order to generate a photographic memory and collect field data that serve to reinforce the investigations in the area of hydraulics and hydrology that eventually lead to a great contribution for the planning, development of prevention plans, optimization in the design of infrastructure works and watershed management who are vulnerable to the El Nino phenomenon and associated events.

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**TRACE ELEMENTS IN SEDIMENTS TRAPPED BY FLUVIAL POTHOLES IN A SMALL BEDROCK RIVER (NW SPAIN)**

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**ABSTRACT**

The research about the contamination of waters and sediments was focused mainly in large rivers and estuaries. There are lack specific studies from the small rivers in inland areas, particularly in the case of small bedrock rivers. This study presents the first results about the contents of trace elements in sediments trapped by fluvial potholes in a small bedrock river. The river potholes were studied as landforms linked to mechanisms of water erosion and valley incision, but the environmental assessment of their sediments related to contamination was scarcely explored. Considering the sand fraction of the sediments trapped by potholes in the Loña River, the purpose of research was to obtain site-specific data for small bedrock rivers, to assess their contamination degree, and to provide relevant information for the reference of a local background level. The Loña River is a first-order tributary of the mainstream in the NW of Spain (the Miño River). It is 19.96 km long and drains a small basin (138.48 km<sup>2</sup>) over granitic rocks. The survey area was a reach delimited upstream of a dam. The basin embraces a rural area, classified by the Eurostat criteria as sparsely populated, where forestry and farming are the main land uses. Six potholes developed in the bedrock channel were selected for the purpose of research. Sampling of sediments took place at the summer (July 2014). Once determined the concentrations of trace elements (Cr, Mn, Ni, Cu, Zn, Rb, Sr, Y, Zr, Ba, Pb) in the lab of the Scientific and Technological Centre to Research Support (CACTI, University of Vigo), the statistical analysis of the data was developed using of no parametric techniques. The Silica was the principal element of the mineralogical composition of the sand fraction. The statistical analysis reported the greater variability in concentrations for Zr and Sr. The results from the rank correlations indicated strongly positive associations as follows: Rb whit Sr and Y whit Cr. Clustering of the data provided the groups (Y, Zr, Cr); (Rb, Sr); and (Cu, Ba, Pb, Zn). The lithological source of the sands, the mineral stability during weathering processes that affect granitic rocks and the human pressures (land uses) may be related to these preliminary results; and provide significant information in order to test the environmental conditions in small bedrock rivers.

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**TITANIUM THERMOMETER AND TRACE ELEMENT COMPOSITION OF RUTILE IN METAOPHIOLITIC ROCKS FROM THE KAZDAĞ MASSIF, BIĞA PENINSULA, NW TURKEY**

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**ABSTRACT**

Ophiolitic metagabbros are exposed on the Kazdağ Massif located in the southern part of the Biğa Peninsula. Trace element composition of rutile and quartz was determined for metagabbros from the Kazdağ Massif by LA-ICP-MS. The Zr content of both matrix rutiles and rutile inclusions in garnet range from 176 to 428 ppm (average 335 ppm). Rutile grains usually have a homogeneous Zr distribution. The rutile grains from studied samples in the Kazdağ Massif are dominated by subchondritic Nb/Ta (11-23) and Zr/Hf ratios (20-33). Nb/Ta and Zr/Hf show positive correlation, which is probably produced by silicate fractionation. The Nb/Ta and Zr/Hf ratios increase with a decrease in Ta and Hf contents. The core of rutile grains is generally characterized by low Nb/Ta ratios of 17-18 whereas the rims exhibit relatively high Nb/Ta ratios of 19-23. Trace element analyses in rutile suggest that these rutile grains were grown from metamorphic fluids. Ti-in-quartz can be used as a thermobarometer when used in combination with Zr-in-rutile thermometer. P-T conditions of ophiolitic metagabbros were calculated by Ti content of quartz and Zr content of rutile, which are in equilibrium with each other. Ti contents of quartz are ranging between 28 and 42 ppm (average 36 ppm). A P-T estimate can be obtained from the intersection of the Ti-in-quartz isopleths with the Zr-in-rutile isopleths, which yield ~ 660 °C and 10 kbar. The P-T conditions of meta-ophiolitic rocks suggest that they occur as a different separate higher-pressure tectonic slice in the Kazdağ Massif. Amphibolite-facies metamorphism resulted from northward subduction of the İzmir-Ankara branch of the Neo-Tethyan Ocean under the Sakarya Zone. Metamorphism was followed by internal imbrication of the Kazdağ Massif resulting from southerly directed compression during the collision.

**PETROGRAPHY AND GEOCHEMISTRY OF JURASSIC SANDSTONES IN THE SAKARYA ZONE, NW TURKEY: IMPLICATIONS FOR PROVENANCE, TECTONIC SETTING AND SOURCE WEATHERING**

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**ABSTRACT**

Jurassic sandstones exposing in the Sakarya Zone were studied petrographically and geochemically to reveal their provenance, tectonic setting of depositional basin and chemical weathering characteristics. The Jurassic sandstones are yellowish brown in color, siliceous, partly calcareous. Texturally, the Jurassic sandstones are yellowish to brown-colored, medium to coarse-grained, mature, moderate to well sorted and grain supported. Petrographic analyses indicate that these sandstones mainly contain quartz, feldspars, fragments of volcanic, sedimentary and metamorphic rocks, and are classified mainly as litharenite, arkose and subarkose. Abundance of feldspars shows rapid deposition of sediments from nearby source rocks. Major and trace element ratios (e.g. Th/Sc, La/Th, Cr/V and Y/Ni) indicate that they were derived from intermediate to felsic source rocks. Accordingly, the probable source of the Jurassic sediments is the crystalline basement of the Sakarya Zone consisting of Devonian and Carboniferous granitoids. Based on the major elements, tectonic setting discrimination diagrams show that sandstones were deposited in a passive margin and active continental margin. The chemical index of alteration (CIA) value for the Jurassic sandstones suggest that their source region was subjected to moderate chemical weathering. According to the petrography and geochemistry results, the sandstones are suspected to have double origin. One is continental bringing quartz and metamorphic fragments, and the other one is volcanic-arc type responsible for feldspar, plagioclase and volcanic fragments. All these are also consistent with a humid to semiarid climate for the deposition of these sandstones.

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**MINERALOGICAL COMPOSITION OF PERIDOTITES AND CHROMITITES IN THE SORKHBAND  
ULTRAMAFIC COMPLEX, SOUTHEASTERN KERMAN, IRAN: IMPLICATIONS FOR THEIR ORIGIN AND  
TECTONIC SETTING**

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**ABSTRACT**

The Ordovician Sorkhband ultramafic complex located in southeastern of the Kerman Province in southern Iran. The complex has a wedge shape and is divided into lower and upper parts. The lower part comprises of dunites, Faryab Mine chromitites, massive or vein like olivine clinopyroxenites, wehrlites and subordinate olivine websterite, whereas the upper part comprises of clinopyroxene bearing harzburgites, massive and vein like olivine clinopyroxenite and minor dykes or lenses of dunites. Mineralogically, the complex composed mainly of olivine, orthopyroxene, chromian spinel and clinopyroxene. The lower dunites, with coarse granular texture, consist mainly of deformed olivines with evidences of grain boundary migration. The occurrence of elongated and oriented euhedral chromite crystals indicate their formation in mantle conditions and the presence of interstitial clinopyroxenes show also evidence of melt-rock interaction. Podiform chromitites exist only in lower dunites and have massive, banded, nodular and disseminated textures. Diopsidic harzburgites of upper part have porphyroclastic texture and consist mainly of deformed olivine-orthopyroxene porphyroclasts of first generation, which are enclosed in a matrix of secondary generation of olivine-orthopyroxene neoblasts. Characteristic textures of melt-rock interactions and also deformed textures, presented by elongated olivine and orthopyroxene with kink band, have been observed in diopsidic harzburgites. Lenses and dykes of dunites in upper part comprise mainly of olivine, with subordinate orthopyroxene, and anhedral chromite which were formed from the interaction of a boninitic melt with host harzburgites. On the basis of mineral and whole rock geochemistry, diopsidic harzburgites have a homogenous bulk rock composition ( $Mg^{\#}=90.54-93.65$ ). Also, disseminated chromites in harzburgites have a wide range of  $Cr^{\#}$  (16.35-38.02) and plot in residual chromite boundary. This shows that harzburgites are depleted residual rocks, which were resulted after 15 to 30 percent partial melting and extraction of MORB magma from a lherzolitic protolith. Chromitites composed of magmatic chromites with high  $Cr^{\#}$  (78.48-82.19). The lower dunites, using mineral chemistry of olivine and chromian spinel, are divided in to two groups: I- dunites near chromitites and II- dunites away chromitites, which have magmatic and replacement origin respectively. Group I, seems to crystallized from a boninitic melt, consists of olivines with very high Fo (up to 96.91) and high chromite content ( $Cr^{\#}$  up to 83.66). Group II, includes also dunitic lenses and dykes of the upper part, consists of olivine with low Fo (less than 91.5) and low chromite content ( $Cr^{\#}$  ~ 50-70). The mineral chemistry data, along with the calculated parental melts in equilibrium with chromian spinel of the Sorkhband chromitites and peridotites indicate that the Sorkhband complex was generated from an arc-related magma with boninitic affinity under low oxygen fugacity in a supra-subduction zone environment.

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## **GEOLOGY AND GEOCHEMISTRY OF BENI SNOUSS BARITE DEPOSIT, NW ALGERIA**

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### **ABSTRACT**

The Beni Snouss deposit occurs in the horst of Ghar Roubane of western Algeria. Two geological units are present in this area: the Paleozoic basement and the Liassic cover. The Paleozoic includes Silurian schist, Devonian limestone, Visean schist and quartzite and Variscan granites. The granite is a monzogranite with quartz, orthoclase, plagioclase, biotite and cordierite. The cover comprises Triassic red conglomerates, Liassic limestone, Bajocian dolomites, Bathonian clays and sandstones resting unconformably on the Paleozoic basement. The barite mineralization occurs as veins with massive, coarse grains and breccias texture. These veins are present in Paleozoic basement and Liassic cover. The veins are related to fractures of NS to EW directions. The vein mineralization has a simple mineralogy and consists of barite (with Sr) calcite, quartz and rare sulphides as sphalerite, galena, marcasite, pyrite and chalcopyrite. Covellite, malachite, hematite and cerusite are secondary minerals. Geochemical investigation of Beni Snouss deposit was carried on selected samples of barites with the aim of determining their mineralization potentials and the origin of mineralized fluids. The weight percentage composition of barite in the samples are 60% to 90%, good for making drilling mud for use in the oil industry, paints and other chemicals. Fluid inclusion studies indicate that vein fluids were saline (20wt % NaCl). Homogenization temperatures for primary fluid inclusion in barite, indicate trapping temperatures of 120 to 160°C. The interpretation of these data in their geologic context favors a mixing process between basinal and basement fluids.

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**QUARTZ-HOSTED FLUID INCLUSIONS FROM THE CHODARCHAY PORPHYRY-EPITHERMAL DEPOSIT, NORTHWESTERN IRAN**

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**ABSTRACT**

The Chodarchay porphyry-epithermal Cu deposit is located 50 km east of the city of Zanjan in the Taron volcano-plutonic subzone, western Alborz structural zone of NW Iran. Fluid inclusions were examined in 170 quartz grains from the deposit in doubly-polished sections, indicating that the quartz grains contained vapor-rich, liquid-rich, solid-bearing (with or without halite), vapor only, liquid only and immiscible liquid inclusions. The identified solid phases or daughter minerals were halite, sylvite, chalcocopyrite and hematite. The liquid-rich inclusions (with the temperatures of 185-480 °C and salinities of 1.2-22.4 wt. % NaCl equiv.) were quite abundant. Microthermometric analysis performed on the vapor-rich type yields a homogenization temperature range of 410->520 °C, and a salinity range of 0.2-5.3 wt. % NaCl equiv. Solid-bearing liquid-rich fluids with or without halite phase have homogenization temperature ranges of 170-440 and 280-310 °C, and salinity ranges of 29.4->34.0 and 4.2-7.9 NaCl equiv., respectively. Fluid inclusions characteristic of fluid immiscibility or boiling, including coexisting liquid-rich and vapor-rich fluid inclusions and assemblages of vapor-rich only inclusions were identified in the samples. Fluid boiling and early magmatic mixture with surface fluid may have led to lower salinity and temperature at higher levels. Salinity vs. homogenization temperature plot for the fluid inclusion data at Chodarchay shows that the fluid inclusions plot on the epithermal and porphyry fields. The development of a high-sulfidation deposit is intimately related to fluid evolution in the underlying porphyry system. Our data suggest high homogenization temperatures and high salinity fluids for the early porphyry stage. It can be said that the late epithermal stage seems to have formed mostly at low to moderate temperatures and from low salinity fluids. Epithermal inclusions are typically only liquid-rich with lower salinity. Plotted fluid inclusion data on the mean homogenization temperature vs. depth and pressure plot shows 100-1100, 1400, 200-2200 and 400-500 meters lithostatic depth respectively for L+V, V+L, L+V+Ha±S±S and L+V+S±S fluid inclusions from the Chodarchay porphyry-epithermal deposit. The porphyry mineralization emplaced at intermediate crustal depth associated with potassic alteration and hypersaline and vapor-rich fluid inclusion assemblages. Liquid-phase hydrothermal fluid that formed the porphyry Cu system at depth rose to the epithermal deposit, causing high-sulfidation epithermal mineralization. Dilution with ambient water may have caused the observed low salinities.

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## CONDITIONS OF GAUSSBERG OLIVINE LEUCITITES FORMING ACCORDING TO THE COMPOSITIONS OF MAIN MINERAL PHASES (E. ANTARCTICA)

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### ABSTRACT

Separation of Antarctica from India and the opening of the Indian ocean began about 130 million years ago under the influence of the Kergelen plume. Nowadays the influence of plume is spread along the Eastern edge of the Antarctic continent. The Gaussberg volcano is located on the coast of the Eastern part of the Princess Elizabeth Land (57° S, 89° E). The surface of the volcano is covered with well preserved pillow lavas (0.5 - 2 m in diameter) and with lava fragments covered with black vitreous crust of 3-5 cm thick. Leucitites of Gaussberg are considered to be the youngest of the currently known manifestations of lamproite magmatism on Earth ( $56 \pm 5$  thousand years by the K-Ar method) [Tingey, 1983]. The studied samples are fresh unchanged rocks with well-preserved petrographic structure and texture. They are represented by basaltic fragments about 1-2 kg each. Lava is porous, the amount of pores increases from the core to the edge of the pillow. The rock samples are mainly massive and almost aphyric volcanoes. Mineral assemblage consists of visible microphenocrysts of olivine, leucite and clinopyroxene, usually not exceeding 1 mm. Rare crystals of apatite, ilmenite, phlogopite, titanium magnetite, zircon, orthopyroxene are present also. The groundmass consists of olivine, clinopyroxene and leucite in a yellow brown glass matrix. The matrix is presented by quenched crystalline fine-grained intergrowths of leucite, diopside, red-brown mica and amphibole. Modal composition of the rock is as follows: olivine (10%), clinopyroxene (5%), leucite (20-40%) and glass (30-60%). The order of crystallization is: chrome spinel  $\rightarrow$  olivine  $\rightarrow$  clinopyroxene  $\rightarrow$  leucite [Foley, 1985; Sushchevskaya et al., 2014]. New data on the content of the main and rare elements are obtained for the mineral phenocrysts of olivine, clinopyroxene, leucite from Gaussberg olivine leucitites. Investigation was held with the use of the high precision techniques specially developed for the determination of the very low concentrations of elements in the mineral phases [Batanova, 2015]. For the first time the distribution coefficients for the rocks of this unique type were obtained. Such elements as Cu ( $D_{Cu} = 0.02$ ) and Zn ( $D_{Zn} = 0.76-0.81$ ) are of big importance from the geochemical point of view for the speculation on the source of the primary melts. The temperatures ( $T$  (°C) = 1180 – 1250) and fugacity conditions during crystallization and evolution of leucitite magmas were established. The temperature conditions were calculated by two distinct methods: from the distribution of  $Al_2O_3$  between the host olivine and spinel inclusions [Coogan, 2014] and by the host – olivine and melt inclusions  $K_D$  of number of elements [Sobolev, 2018]. Oxygen fugacity probably varied during the evolution of the melt from the less oxidized  $fO_2$  values (below the buffer MW) to more oxidized (NNO). Supposedly along with the peridotite material in melting of the primary source probably took part the rocks with pyroxenite non-continental nature. Perhaps these species could be the substance of the ancient lithosphere of Gondwana.

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**PETROCHEMICAL STUDIES OF AMPHIBOLITES ROCKS AT MASAFI-ASIMAH WINDOW, MASAFI AREA, UAE**

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**ABSTRACT**

Amphibolite is a type of metamorphic rock composed mainly of hornblende, plagioclase and perhaps clinopyroxene, with little or no quartz, and with garnet and secondary epidote. It is typically dark-colored and weakly foliated or schistose (flaky structure). Amphibolites are found in several locations in the UAE, including the Masafi-Asimah window and Wadi Hamid area, bordering Bulaydeh village. The metamorphics of both areas have previously been interpreted as forming part of the metamorphic sole of the Semail ophiolite of Oman and UAE. In the Masafi area, ortho- and para-amphibolites exist within sheared metasedimentary rocks as bands, lenses, and linear bodies up to 100 m thick. Whole-rock chemical analyses confirm that the amphibolites were originally tholeiitic basalts, however, the amphibolites are petrographically and chemically heterogeneous. Some textural and modal differences may also reflect different degrees of partial melting and mantle source heterogeneity. A comparison of trace element suggests that the protoliths were not equivalent to the Haybi alkaline and transitional tholeiites found in the underlying structural slice, or to the Semail ophiolite volcanic rocks, which lie structurally higher in the sequence. Structurally, the amphibolites lie at the top of the metamorphic sole, and above greenschist facies metasedimentary rocks that include quartzites and marbles interlayered with metavolcanic rocks. It is suggested that the amphibolites were metamorphosed in a NE dipping subduction zone environment preceding the obduction of the Semail Ophiolite, during the late Cretaceous stage of closing of the NeoTethys Ocean. The amphibolites were incorporated onto the base of the ophiolitic rocks at the stage of oceanic crust and mantle detachment. The amphibolites were tectonically transported with the Semail Ophiolite onto the Arabian continental margin.

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**GEOCHEMISTRY OF METACHERTS ASSOCIATED WITH CONTINENTAL MARGIN VOLCANIC SEAMOUNT HYDROTHERMAL ACTIVITY: SUB-SEMAIL METAMORPHIC SOLE, NE UNITED ARAB EMIRATES**

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**ABSTRACT**

The metamorphic sole attached to the Semail Ophiolite, Asima area, UAE, is the largest (75 km<sup>2</sup>) and thickest (~2000 m) sub-ophiolitic sole in the Oman Mountains of the SE Arabian Peninsula. Previous research on these metamorphic rocks has focused on the thin amphibolites at the structurally highest part of the sole, while the geochemistry of the underlying greenschist facies (T = 340-380°C; P = 400 ± 100 MPa) quartzites, muscovite- and chlorite-schists and metacarbonates, collectively forming 65% by area of the exposed sole, have been largely ignored. In this contribution we concentrate on the dominant rocks - the quartzites, and present major, minor and REE data that reveal the details of their origins as deep marine cherts. In our samples, a biogenic component dominates and is represented mainly by elements Si and P. Terrigenous materials contributed Al, Ti, Zr, Ga, Nb, Zr, Ta, Th and Sc. A significant hydrothermal component of the chert protoliths is indicated by high Fe<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> and low Al/(Al+Fe+Mn) ratios. Contributions from hydrothermal fluids include Fe, Mn, Ba, Cu, Zn, Pb, Ni, As, Tl. However, the lower than expected Fe - Mn correlation coefficient suggests redox separation of Fe from Mn with increasing distance from the hydrothermal source. There may also be hydrogenous mechanisms of deposition for these elements in some samples. Indices based on REE abundances (Lan, SREE, Ce/Ce\*, Eu/Eu\*, Lan/Ybn, Lan/Cen) for our samples all indicate a proximal continental margin or nearby pelagic environment of chert deposition. The common assumption that Fe and Mn hydrothermal components are indicative of proximal ridge environment is inconsistent with our data. The most likely paleogeographic setting is a continental margin, with alkali basaltic seamounts lying within a few 100's km of the shelf edge. The seamounts are the most likely source of the hydrothermal fluids.

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**MOBILE FORMS OF GOLD AND PATHFINDER ELEMENTS IN PODZOL SOIL AND MORaine AT NOVYE PESKI GOLD DEPOSIT AND PIILOLA PROSPRCTING AREA (KARELIA REGION)**

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**ABSTRACT**

Pathfinder elements are often used in prospecting for gold deposits at the covered areas because of the low gold concentration in overburden and high price for its analysis. Despite some success in using this technique, there are some reasons to believe those pathfinder elements do not provide the comprehensive information about the blind gold ore body existence in the study areas. Another solution of problems in gold prospecting is a usage of special methods, based on mobile form analysis in overburden, but the knowledge about gold geochemistry in supergene zone is not completed. Research of mobile forms was conducted with sequential extraction method for gold and As, Bi, Ag, Pb, Cu, Sb, Zn, Se, Mo, Te (as elements often associated with gold ore at Baltic shield) in podzol soil and moraine at Novye Peski gold deposit and Piilola prospecting area, which are located within Archean greenstone belts Segozero-Vedlozero and Kuhmo respectively. It was determined that the main mobile forms of gold are water-soluble and bound to organic matter in loose sediments at the both study area and bound to Fe and Mn (hydr-)oxides in a lower grade at Novye Peski. Other analyzed elements bound preferably to Fe and Mn (hydr-)oxides and to organic matter in a lower grade. The part of mobile form of elements from their total concentration in loose sediments is more than 45 % for all researched elements except Ni, Se, Ag, Pb. Mobile forms of gold concentrate mainly in A<sub>2</sub> soil horizon at both study area, antimony mobile forms are also concentrated in the same horizon but only at Piilola and in B<sub>1</sub> horizon at Novye Peski. Other elements concentrated mainly in C horizon at Novye Peski and B<sub>1</sub> and moraine at Piilola. Thereby, obtained results showed that gold geochemistry features are similar in loose sediments at the both study area but different to pathfinder elements, what might be contributed by different migration forms of elements.

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## IS IT POSSIBLE THAT HIGH-GRADE BAUXITE DEPOSITS FORM IN MECHANICAL SEDIMENTOGENESIS?

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### ABSTRACT

Facial analysis of continental deposits has been made for surroundings of large high-grade bauxite deposits in the world largest Fouta Djallon-Mandingo Bauxite-bearing Province. The obtained data allow judging on the possibility in principle for high-grade bauxite deposits to form in mechanical sedimentation. The studied continental deposits represent their marginal facies, namely (1) eluvium as autochthonous deposits representing the area of matter mobilization, i.e., initial formations feeding any continental deposits, and (2) alluvium as allochthonous deposits transported to the largest distances and graded most essentially in the continental environment. Eluvium, friable overburden, occurs on plateaus practically everywhere and is polygenetic. Coarse to medium debris compositionally similar to bauxites is autochthonous, formed by destruction of subjacent lateritic mantle. Fine sandy, silty, and clayey matter with SiO<sub>2</sub> up to 35-45% is mainly eolian, which is confirmed by the presence of chlorite and potash feldspar. Transported and redeposited material is initially quality-graded, depending on granulometry, and the finer is it the more essential is its difference from lateritic mantles. And is it possible that bauxite matter accumulates in any facies of continental deposits? To answer this question, we have studied channel and flood-plain facies of recent alluvial deposits in the Kogon River Valley. The valley surroundings are Silidara, Sangaredi, and Bidikum deposits where premium-grade bauxites (Al<sub>2</sub>O<sub>3</sub>≥55%) are widespread. Dominating in the alluvium are gravels and pebbles (local bauxite fragments), whereas fine gravel and sand mainly representing ferruginous laterites are essentially subordinate. Channel facies of the alluvium are most washed from fine material. They show Al<sub>2</sub>O<sub>3</sub> up to 44-42%, which is evidence for their abundant bauxite fragments redeposited from adjacent deposits, and Fe<sub>2</sub>O<sub>3</sub> of 19-23.5%, which is typical of medium-grade lateritic bauxites. However, their high SiO<sub>2</sub> (10.5-33%) and Al<sub>2</sub>O<sub>3</sub>/SiO<sub>2</sub>=2.2 do not allow designating the alluvial channel facies as bauxites. In sandy-clayey deposits of the Kogon flood plain, Al<sub>2</sub>O<sub>3</sub> decreases abruptly and Al<sub>2</sub>O<sub>3</sub>/SiO<sub>2</sub> decreases to less than 1, whereas organic increases abruptly. Therefore, the Kogon alluvium is bauxite-free everywhere, primarily because of its high silica. Similar results were obtained from studies of redeposited matter in another area, the Samu River Basin. The analysed sedimentary continental facies do not show composition of high-grade bauxites even in uniquely favourable environment.

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**BEHAVIOR OF HEAVY METALS IN THE ESTUARINE SEDIMENTS OF THE MANGUABA RIVER (STATE OF ALAGOAS, NORTHEAST BRAZIL)**

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**ABSTRACT**

The estuary area of the Manguaba River, located on the coast of Alagoas (Northeast Brazil), is dominated by sugar cane plantations and presents low indices of industrialization and relatively low population density. This work aims to verify the current state of sediment quality in the estuary, which is a good example of great diversity of colonization, refuge and nursery of economically important marine animal species. On the other hand, current estuarine inputs are considered potential progressive anthropogenic threats over the last decade. One bottom estuarine sediment core (60 cm length) was collected to explore the geochemical evolution of the sediment. This core was sectioned at 3 cm intervals. The sediment samples were analyzed (major oxides and 40 trace elements) and a principal component analysis was applied, which separated the sample into three groups. Concentrations of trace metals in Holocene sediments from the peak contamination period are compared with reference values to identify possible contaminated levels in the estuarine environment. The results showed that heavy metals are better correlated with the clay fraction. The concentration of the metals studied here is not critical, so it could be used as an unpolluted model area for future studies although the analysis of a greater number of profiles is recommended to obtain reliable conclusions.

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## SPATIAL DISTRIBUTION OF CONVECTIVE RAINFALL IN PERNAMBUCO STATE - BRAZIL

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### ABSTRACT

Extreme torrential rains usually cause damage to the physical environment and have therefore been the subject of scientific studies. The possibility of variation in the hydrological regimes caused by climate change has stimulated the development of researches that help to predict this phenomenon and the consequent environmental impacts. The objective of this work is to analyze the spatial distribution of convective rains in the Pernambuco State (Brazil) by using geostatistical techniques. For this study, the criterion of the dominant meteorological characteristics in a region, determined by the meteorological irregularity coefficients (MICs), was used. These coefficients were obtained from temporal rainfall series (thirty years). With the help of the Geostatistics tool (ordinary Kriging method for interpolation), it was possible to create a map with isolines to identify the degree of vulnerability to convective rainfall. In order to obtain the rainfall data, the two largest collections produced in Pernambuco State, the database of the Institute of Technology of Pernambuco - ITEP and HIDROWEB were consulted. The rainfall series of the second bank were produced by the National Basic Hydrometeorological Network, operated by the Brazilian Geological Survey-CPRM, in partnership with the National Water Agency. Sufficiently validated rainfall stations were selected in order to guarantee consistency of the results. The consistency analysis of the selected data series was carried out with the HIDROPLU 4.1 software. The spatial distribution was evaluated with the aid of the map elaborated for this purpose. In this map, the positions of the selected stations are georeferenced using the ArcGis program for statistical analysis for this preliminary phase, and the adjustment of the frequency distribution to the normal and log-normal distribution was tested. The best adjustment was made by visual analysis, maintaining the normal distribution for MICs. For the interpolation of these values obtained in rainfall stations, an ordinary Kriging based on the inferences of its spatial correlation structure was adopted. The anisotropy process was tested in order to investigate the existence of directional influences related to rainfall-meteorological systems. However, the process was immediately discarded as the test added an increase in the errors of the results analyzed on the spatial correlation structure during successive cross-validation investigations. The studied coefficients had their experimental semivariogram tested, from the adjustments to the theoretical, spherical, exponential and Gaussian semivariograms, with the exponential model with the best fit. As a result, the areas of convective circulation, vulnerable to intense, torrential rainfall and consequent natural disasters, obtained from the use of precise methodology with advanced software, were identified, which contribute in an efficient and technically adequate way for the preventive action of governmental institutions for the management of water resources and civil defenses, both municipal and the state.

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**THE INFLUENCE OF SOME SOIL CONSTITUENTS ON THE TOTAL COPPER AND ZINC CONCENTRATIONS IN THE SOIL SURFACE LAYER OF ACIDIC SOILS**

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**ABSTRACT**

Environmental effects of metals can only be understood when their fate and interactions with the components of the environment are known. A range of physical, chemical, and biological properties of soil influences the retention and transport of heavy metals in the soils. The aims of this study were to determine concentrations of copper and zinc in topsoils from different plots of a rural area in NW Spain, as a basis for future geochemical surveys, and to reveal their relationships with pH, organic matter content, and particle size distribution. Geologically, basic schists are the dominant rocks in the study area. A total of eighteen surface soil samples from depths of 0 to 20 cm were selected. Soils were characterized by conventional analytical methods. Total copper and zinc concentrations were determined by atomic absorption spectrophotometry after wet digestion with a hot mixture of nitro-perchloric-hydrofluoric acids. These soils are moderately acidic and well supplied with organic matter. The particle size distribution shows that the analyzed soils have moderately clay content, their texture being on average clay loam. Organic matter percentage was not correlated with the content of the analyzed metals. No significant correlation between soil pH and total copper was observed, but soil pH exhibited a significantly positive relationship with Zn. Positive correlations with silt and clay fractions but not with sand fraction percentage were observed for copper and zinc.

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## MAIN ENVIRONMENTAL RESULTS OF GEOCHEMICAL MAPPING IN SOILS OF FERNANDO DE NORONHA ARCHIPELAGO, BRAZIL

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### ABSTRACT

A geochemical survey was carried out by the Geological Survey of Brazil (CPRM) in the Fernando de Noronha Archipelago (Brazil), a group of volcanic islands consisting essentially of basalts, ultrabasics, phonoliths, trachytes, pyroclasts and Essexites rocks. It is located in the Atlantic Ocean, about 384 km away from the continent; the emerging part of its main islands has an area of 19 km<sup>2</sup>, which is considered Natural Patrimony of Humanity (UNESCO), Environmental Protection Area and National Marine Park of Brazil. A total of 71 soil samples were collected with stainless steel sampler at an average depth of 20 cm in B horizon, in a square mesh of 500 m x 500 m, obtaining a density of 3.7 samples/km<sup>2</sup>. The samples were dried at 40°C in the sieved fraction (< 80 mesh - 0.177 mm), and 53 chemical elements were analyzed by ICP-EAS/MS after digestion with aqua regia. For each chemical element, Brazilian toxicological patterns were used comparatively and, in case of omission, international standards. The highest levels of the anomalous chemical elements were: Ba (1,641 mg kg<sup>-1</sup>), Cd (26 mg kg<sup>-1</sup>), Ce (262 mg kg<sup>-1</sup>), Co (275 mg kg<sup>-1</sup>), Cr (628 mg kg<sup>-1</sup>), Ni (318 mg kg<sup>-1</sup>), U (17.5 mg kg<sup>-1</sup>) and V (519 mg kg<sup>-1</sup>). All these values are above the maximum levels of toxicity established by CONAMA, and in some cases by NOAA. It should be noted that smaller islands inhabited only by seabirds, in the extreme northeast of the archipelago, have surface guano with organogenic phosphate and have concentrated, by sorption and adsorption, several metals with geochemical affinity with the organic matter such as Cd, Ce, Cr, Y, U, Y, P, Sr and Zn. It is concluded that a detailed investigation to know the bioavailability of these elements must be carried out in order to evaluate possible risks to animal and human health.

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## COMPARISON OF INTERPOLATION METHODS FOR RAINFALL MAPPING TAKING THE PERNAMBUCO STATE (BRAZIL) AS A CASE STUDY

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### ABSTRACT

A correct analysis of the spatial distribution of rainfall is of great importance for the management of water resources of hydrological basin as well as to support climatic and meteorological studies. The objective of this work was to analyze in detail the methods of interpolation for mapping rainfall spatial distribution in the Pernambuco State in order to discover analytically the best method to spatialize data rainfall points in this region. Isolines constitute the most used graphic representation for the rainfall spatial distribution in which the curves connect points of equal height of rainfall for a given period. Data of monthly rainfall of seventy-six rainfall stations distributed throughout the Pernambuco State were used. The data were obtained from the National Water Agency (historical series of the period 1977-2006), which after carrying out a consistency analysis, were interpolated by different methods in order to verify which one is more suitable for rainfall spatialization, for both the dry season (low rainfall) and the wet season. As result, maps of the spatial distribution of rainfall in the Pernambuco State were obtained using the following interpolation methods: Inverse Distance to a Power (IDW), Kriging, Tension Spline and Topo-to Raster. Kriging is also known by the acronym BLUE (Best Unbiased Linear Estimator), being linear, as well as the IDW. The estimated values are weighted linear combinations of the available data, which is unbiased because the error mean is zero, and it is best because it minimizes the variance of the errors. This BLUE method generates isolines of curves with sharp sinuosities, and if the number of points is very low, it can generate misshapen isolines. The Tension Spline is a nonlinear method, and therefore composes a map with more gradual changes which generate isolines of low sinuosity. However, these changes that are smoother in the map can generate other inferred and not very consistent isolines since it does not contain points of data within it. The Topo-to-Raster method was the one that presented more adequate and realistic isohyets since it contains the great majority of the points interpolated within the isolines with the pre-established values, besides having smaller sinuosity, better representing the altimetric characteristics of the region. In order to generate isolines of rainfall spatialization, we conclude that the best methods of mathematical interpolation were: Top-to-Raster, Kriging, IDW and the Tension Spline. Thus, for the Pernambuco State, the best results were obtained using the Topo-to-Raster interpolation method.

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**EXPLORATORY ANALYSIS OF THE GROUNDWATER OF THE FERNANDO DE NORONHA  
ARCHIPELAGO - PERNAMBUCO – BRAZIL**

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**ABSTRACT**

The Fernando de Noronha Archipelago (Pernambuco, Brazil) consists of 21 islands and islets of volcanic origin occupying an area of 26 km<sup>2</sup>. It is located in the Atlantic Ocean at the geographic coordinates S 03° 51' 13.71" - W 32° 25' 41.53". The clayey nature and shallow soils of this archipelago make difficult the infiltration and the accumulation of water in the subsoil and, consequently, the storage of groundwater. Fractured volcanic rocks gave rise to less productive aquifers, and in areas where pyroclastic rocks occur, with greater porosity, aquifers are better producers of water. In the valleys with highly diaclosed rocks, there is a greater accumulation of groundwater upstream of intrusive dikes, which form small subterranean reservoirs. The Holocene sedimentary deposits of marine and aeolian origin are characterized by high porosity and high permeability, but do not contain considerable water volumes because of their reduced thickness and small area (7.5% of the total archipelago surface). From the Groundwater Information System (SIAGAS) developed by the Brazilian Geological Survey (CPRM), 38 tubular wells were identified, distributed along the main island, with depths varying from 21.6 to 70 m, flows from 0.3 to 6.1 m<sup>3</sup>/h and producing freshwater to salted water through a pumping regime controlled by the Pernambuco Sanitation Company (COMPESA), with a total of 110 m<sup>3</sup>/day, being used stations with desalination plants, whose tailings are discharged into the ocean. In general, the constructive profiles of the tubular wells present soil originating from the volcanic rock from 0 to 20 m; little altered volcanic rock from 20 to 25 m, and volcanic rock with different degrees of fractures from 25 to 70 m. A rigorous groundwater management system is required for the Fernando de Noronha Archipelago, because of its poor geological and hydrogeological characteristics, being able to give sustainability through the rational use of precious and scarce groundwater resources.

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## EXPLORING THE POTENTIAL ENVIRONMENTAL AVAILABILITY OF ALUMINUM IN ACIDIC SOILS BY USING SEQUENTIAL EXTRACTION

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### ABSTRACT

Soils not only perform important environmental functions but also are vital for food production. The aluminum (Al) pools in soils include Al as soluble species, electrostatically bound to organic and mineral surfaces, organically complexed, forming non-crystalline minerals, as interlayer hydroxyaluminum polymers in clay minerals, and Al incorporated within mineral structures. The stability of the forms of Al in the solid fraction governs its susceptibility to be released to the soil solution. The presence and abundance of different pools of Al in the soil may be influenced by factors related to soil formation and by land use and soil management. This study aims to assess the potential environmental availability of Al in acidic soils in Galicia (NW Spain), an Atlantic European region where the wet climate favors leaching of soil basic cations. A six-step sequential extraction technique was used to determine the partitioning of Al between the following operationally defined fractions: soluble/exchangeable/specifically adsorbed, bound to manganese oxides, associated with amorphous compounds, aluminum bound to oxidizable organic matter, associated with crystalline iron oxides, and residual fraction (within the crystal lattices of minerals). The results showed that the potentially available fraction (sum of the first three fractions) is low, which suggests very low environmental availability of this element in these soils; consequently, the possibility to affect the crops is low.

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## **GEOCHEMICAL FEATURES OF MIOCENIC SANDSTONES (SOUTHERN APENNINES, ITALY)**

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### **ABSTRACT**

Ten samples of siliciclastic sandstones belonging to the Serra Palazzo Formation (SPF) (Southern Apennines, Italy) have been studied for their petrographic and geochemical characteristics with the aim to compare their compositions with that of sandstones belonging to the Gorgoglione Flysch Formation (GFF) deposited in the same basin. SPF and GFF outcrop in Southern Apennines (Italy) and are interpreted as turbiditic successions of the foredeep and wedge-top depozones in growing Foreland Basin System (Critelli et al., 2017). SPF consists mainly of a foredeep turbidite succession consisting of siliciclastic and calciclastic arenites having late Burdigalian-Serravallian sedimentation age (Gallicchio & Maiorano, 1999). GFF represents a siliciclastic succession having  $\approx 1500$  m thickness consisting of coarse-medium grained turbidites with mudstone layers. The deposition age of detritus was Langhian-Serravallian in a wedge-top basin (Lentini et al., 2002). Sampling was performed near Forenza Village (Potenza) along two different stratigraphic logs having each a thickness of  $\approx 10$  m: Log 1 (5 samples) consists of an alternation of arenaceous-pelitic layers (thickness up to 80 cm), whereas Log 2 (n=5) consists of prevalent arenite layers (thickness up to 90 cm). According to Herron classification (1988), the sandstones from Log 1 fall over wacke and arkose fields, whereas Log 2 are arkoses, except for one sample falling in wacke field. Log 1 sandstones show a minor  $\text{SiO}_2$  content (49 wt%) with respect to those of Log 2 ( $\text{SiO}_2=57\%$  in average) and higher CaO (19% against 14%), MgO (1.5% against 1.3%) and  $\text{Fe}_2\text{O}_3$  (2.4% against 2%) contents. The abundances of  $\text{TiO}_2$  ( $\approx 0.31\%$ ),  $\text{Al}_2\text{O}_3$  ( $\approx 10\%$ ), Rb ( $\approx 98$  ppm), Sr ( $\approx 210$  ppm), Y ( $\approx 16$  ppm), Zr ( $\approx 140$  ppm) and Nb ( $\approx 7$  ppm) are similar. Overall the Serra Palazzo sandstones show a hybrid character having silicic and calcitic detritic components. The GFF sandstones show a major silicic component as evidenced by major  $\text{SiO}_2$  content (64%wt) and a minor calcitic abundance (CaO=7,2%wt). From the comparison between SPF and GFF sandstones emerges that SPF arenites show in Herron's diagram, composition similar to that of Gorgoglione sandstones. This feature is due to similar silicic detrital component whereas the main difference regarding the calcitic portion seem linked to its different origin: the GFF sandstones are decidedly poorer in CaO having only carbonatic cement without calcitic clastic detritus; the SPF sandstones show a higher CaO content for the presence of detrital calcitic component in addition to carbonatic cement. The similarity of  $\text{SiO}_2/\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3/\text{K}_2\text{O}$  ratios between the two sandstone types has been interpreted as an evidence of common origin of siliciclastic detritus. U-Pb spot dating of detrital zircons, in progress on sandstones of SPF and GFF, could be useful to better constrain the relationships between two turbiditic successions suggesting the potential source-areas of the siliciclastic supply.

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**PETROLOGIC EVOLUTION OF SUBALKALINE BASALTIC VOLCANISM IN THE EAST OF LAKE VAN,  
EAST ANATOLIA, TURKEY**

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**ABSTRACT**

Collision-related sub-alkaline basaltic volcanism to the east of Lake Van erupted from extensional fissures. Volcanic products consist of sub-alkaline basaltic lavas and plot on the Na-series lavas. Previously published K-Ar ages indicate that this subalkaline basaltic volcanism erupted in a period between 4.50 and 4.00 Ma corresponding to Zanclean (Pliocene). The subalkaline basalts consist of olivine, augite, titan-augite and plagioclase phenocrysts and micro-phenocrystals. The groundmass of these lavas contains the microcrystals of the same mineral assemblages and volcanic glass. They display porphyritic, glomeroporphyritic, intersertal and hyalopilitic textures. Results of our FC (fractional crystallisation) and AFC (assimilation with combined fractional crystallization) petrologic models indicate that fractional crystallisation can be negligible relative to crustal contamination in the evolution process of the magma chamber and the ratio of the crustal contamination to fractional crystallisation ( $r$  values) varies from 0 to 0.35. In primitive mantle and MORB-normalized incompatible trace element spider diagrams, the basaltic lavas display enrichment in LIL and REE elements compared to HFSE elements. Behaviour of mobile elements such as Ba and Th reveals that the mantle source region of the sub-alkaline basaltic lavas might have been enriched by melts that were derived from subducted sediments. Results of our melting models indicate that the sub-alkaline basaltic lavas were derived from both shallow and deep mantle sources with different melting degrees ranging between 0.8 - 5 %. The percentage of spinel seems to have increased in the lherzolitic mantle source of the basaltic lavas. This can be explained by a model in which magmas were generated by partial melting of basement of the metasomatized lithospheric mantle following lithospheric delamination.

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**MANTLE SOURCE OF BASANITIC LAVAS IN SOUTHERN TURKEY: PHLOGOPITE BEARING GARNET PERIDOTITE SOURCE**

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**ABSTRACT**

Basanitic lavas in southern Turkey erupted from extensional fractures and volcanic cones such as Delihalil and Üçtepeliler along strike-slip fault systems in the İskenderun Basin and Hatay-Hassa Graben. New Ar-Ar dating results indicate that basanitic volcanic activity occurred in 120 ka (basanitic melts). The products of the basanitic volcanism are alkaline in character. Major and trace element abundances and EC-AFC models using Sr and Nd isotopic ratios are used to propose that the basanitic samples were subjected to fractional crystallisation but were not affected by significant crustal contamination. Incompatible trace elements contents of the basanites and petrologic models imply the presence of mantle metasomatism and existence of the phlogopite rather than amphibole as residual minerals. The phlogopite may have formed by mantle metasomatism at the base of the lithospheric mantle caused by fluids or melts from the rising asthenospheric mantle due to the lithospheric dripping beneath southern Turkey. Partial melting models using fractionation-corrected data indicate that the petrogenesis of the basanites can be explained by rising along the left lateral fault zones of melts derived from the phlogopite bearing garnet peridotite mantle source. It is inferred that the phlogopite may have generated in base of the lithosphere by metasomatic fluids or melts from rising asthenospheric mantle. Basanitic melt generations with residual phlogopite indicate melting at temperatures of 1275-1350 °C at pressures of 3-3.5 GPa.



## SISORTA (KOYULHISAR - SIVAS, TURKEY) PROSPECT: AN EXAMPLE FOR HIGH SULFIDATION EPITHERMAL GOLD DEPOSIT

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### ABSTRACT

This study presents geological and geochemical features of gold mineralization located 200 km NE of the Sivas Province in Sisorta area. The general stratigraphy of the area starts with andesitic agglomerate and is overlain by andesitic lavas. All of the volcanic units intruded by Upper Cretaceous plutonic rocks. Later hydrothermal (phreatomagmatic) breccia occurred cross cuts all units and is the youngest feature. Gold mineralization is basically hosted by phreatomagmatic breccia. Alteration as propylitic, argillic, advanced argillic, vuggy quartz and vuggy silica have been determined by using XRD and PIMA analytical data from the study area, which is characteristic of high sulphidation epithermal gold deposits. Pyrite, chalcopyrite, bornite, enargite, digenite, tennantite-tetrahedrite, covellite, chalcocite, pyrrhotite, sphalerite, hematite, magnetite, and goethite have been defined by using ore microscopy-petrography. Tennantite-enargite mineral association, which has been observed on numerous polished sections, is good indication of high sulphidation stage.  $\delta^{34}\text{S}$  ‰ isotope values range from -0.4 to -10.0‰ in pyrite, from 1 to 2.3‰ in chalcopyrite, from 21.8 to 22.0‰ in K-alunite, and from 16.2 to 18.6‰ in barite from the high sulphidation epithermal system. At the early stage of mineralization S isotope value number is light and later S isotope value shows heavy numbers (especially during the formation of barite). This suggests that S was derived from a magmatic source and changed due to temperature variations in the final stages of the hydrothermal system.  $\delta^{18}\text{O}$  isotope values of gangue minerals range from 7.1 to 15.6‰ (avg. 11.5‰) in quartz, from 10.1 and 11.4‰ in K-alunite, and from 8.5 to 12.4‰ in Na-alunite. One quartz sample yielded a  $\delta\text{D}$  value of -77‰.  $\delta\text{D}$  values of K-alunite range between -55.2 and -57.6‰, whereas  $\delta\text{D}$  values of Na-alunite range between -25.3 and -61‰. Combining  $\delta^{18}\text{O}$  with  $\delta\text{D}$  from quartz and K-alunite, and Na-alunite samples, demonstrates meteoric waters were important in the formation of the alteration silicate and sulphate minerals analyzed. This feature is common in high sulphidation alteration process.  $\delta^{65}\text{Cu}$  values from copper-bearing minerals associated with gold mineralization range from -5.50 to +3.03‰. Copper isotope values closest to the intrusions (deepest part of the system) do not show significant variation (<1 per mil), whereas they are highly variable in the upper parts of the system indicating copper enrichment due to supergene processes.

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**IMPORTANCE OF ASSIMILATION COMBINED WITH FRACTIONAL CRYSTALLIZATION (AFC) AND  
MAGMA MIXING PROCESSES IN THE MAGMATIC EVOLUTION OF THE PLIOCENE-QUATERNARY  
MELİKLER VOLCANISM, KARS PLATEAU, NORTHEAST ANATOLIA, TURKEY**

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**ABSTRACT**

Melikler volcanism located on the Kars Plateau in the northeast of Eastern Anatolian is one of the most important collision-related volcanic centers in Eastern Anatolia. New K-Ar dating results indicate that this magmatic activity occurred between 4.1 and 1.7 Ma. Volcanic products consist of mildly-alkaline to subalkaline lavas, ranging in their compositions from basalt to andesite. On variation diagrams on which highly compatible and incompatible element pairs are plotted against each other, some of the data points align along the straight trends between most basic end members and evolved andesitic samples. This implies that evolved andesitic magmas in the magma chamber were possibly periodically replenished with primitive magma. To test the viability of the mixing/replenishment process, we conducted a least square mass balance calculation using the major element concentrations of most primitive basaltic sample and a number of evolved samples. Results of our mixing models revealed that basaltic-andesitic and basaltic-trachyandesitic lavas of Melikler volcanics might have been generated as a result of mixing between primitive basaltic and evolved lavas. We argue that this interpretation is statistically important because  $\Sigma r^2$  values vary between 0.4 and 0.6. Isotopic concentrations and geochemical data of the samples indicate that assimilation with combined fractional crystallization (AFC) might have been an important process in the magma chamber(s) beneath the Melikler volcanism. Results of our EC-RAFC models revealed that magma chamber(s) beneath the Melikler volcanism were affected by the combined effects of fractional crystallisation and crustal contamination processes and the evolved andesitic lavas contain up to 2-3% crustal assimilation. FC (fractional crystallisation), AFC (assimilation combined fractional crystallisation) and EC-RAFC (Energy-constrained assimilation, fractional crystallisation and magma recharge) model calculations suggest that fractional crystallisation, magma replenishment and crustal contamination processes play an important role in the evolution of the Melikler volcanism.

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**VADOSE-PHREATIC CEMENTATION IN TRIASSIC SANDSTONE, THE EASTERN MARGIN OF THE ORSOS BASIN, CHINA**

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**ABSTRACT**

A hard layer of calcite cemented sandstones overlaid weakly consolidated mudstones occur in the Middle Triassic, Ermaying Formation at the eastern margin of the Ordos Basin, China, were examined to Determine the regimes of diagenesis for Pi sandstone. The Pi sandstone refers to a type of terrigenous clastic rock assemblage composed mainly of sandstone, siltstone and mudstone with red and white color, which is characterized by exposing or being covered with sand or loess, vulnerable to weathering and erosion, distributed in the contiguous area of Shanxi province, Inner Mongolia autonomous region and Shanxi province in China, and formed during Late Paleozoic–Mesozoic. “Pi” comes from the folk name (pishuang) of arsenic in Chinese, the appellation of “Pi sandstone” means that it is harmful to soil and water conservation. Petrographic and isotopic analysis show that calcite cement in the Pi sandstones reflect characteristics of both phreatic and vadose zone cementation. In many cases vadose cements, characterized by pendant and meniscus envelopes around grains, were followed by blocky spar cements Precipitated in phreatic environment.  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values for calcite cement exhibit a mixture of features of phreatic and vadose carbonate compared with typical examples. The above results suggest that the Pi Sandstone may have experienced only shallow burial.

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**SEAGRASS-ASSOCIATED MOLLUSCAN AND FISH COMMUNITIES FROM THE EARLY PLEISTOCENE OF THE ISLAND OF RHODES (GREECE)**

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**ABSTRACT**

The existing data on benthic macrofauna accompanying fossil seagrass meadows are limited due to the low probability of fossilization of seagrass vegetation. Indirect paleo-seagrass indicators, without seagrass preservation is the most common situation in the fossil record. Well-preserved leaves and rhizomes of the Mediterranean endemic marine angiosperm *Posidonia oceanica* and the rich associated mollusc and fish fauna are contained in the early Pleistocene shallow siliciclastic sediments of the Kritika Formation of the island of Rhodes (Greece). The leaf moulds are preserved in fine-grained sands, whereas the rhizomes are found *in situ* within coarse-grained sediments. The associated molluscan fauna includes 79 species, 47 gastropods and 32 bivalves, most of them extant. The community of molluscs associated with the rhizomes comprises 49 species and with the leaves 30 species. Small gastropods grazing on microalgae (Rissoidae, Cerithiidae, Trochidae) are the most abundant elements of the fauna, however carnivorous gastropods (Nassaridae, Naticidae, Muricidae), are also diverse. Among the bivalves Lucinidae (e.g., *Anodontia*, *Divaricella*) are numerically dominate the deeper infauna and other chemosymbiont bearing bivalves, as Ungulinidae (*Diplodonta*) are also common. Although many species are not associated exclusively with this seagrass and they may occur in other environments as well, they generally thrive on *P. oceanica* leaves and rhizomes. The *Posidonia oceanica* meadows were also inhabited by two characteristic fish species *Chromis chromis* and *Serranus cabrilla*, both of which thrive in the seagrass meadows of the eastern Mediterranean until today. The studied fauna is the first reported from the early Pleistocene of Greece and shows similarities to the modern counterparts of *Posidonia oceanica* meadows, providing new data on the resilience of seagrass ecosystems to environmental change in general.

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**PETRIFIED FOREST OF LESBOS ISLAND (GREECE): A PALAEOBOTANICAL PUZZLE OF A UNIQUE GEOPARK AND THE NEW DISCOVERIES**

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**ABSTRACT**

On November 2015 Lesbos Island has faced an ultimate recognition as one of UNESCO's Global Geoparks, an honor of its international significance based on its geological treasure as revealed by the existence of the famous early Miocene Petrified Forest and the variety of its geosites. The aim of this study is to draw a holistic approach for the palaeobotany of Lesbos Island through three main subjects: a) The first one is dealing with the past, the recognition of the palaeobotanical importance of Lesbos since the ancient times and the revision of the palaeoxylotomical and foliage material, b) the second theme gives a very brief summary of the recent results from the research by the first author and c) the third one uses the revealing of the historical part of Lesbos palaeofloristic treasure and also the recent botanical legislation and studies highlighting the complexity of Lesbos palaeobotany, which underline the remaining inconsistencies and propose solutions in order to give the perspectives of the future. The Petrified Forest of Lesbos is a worldwide well known type locality which can be of a great importance for the stability of (palaeo-botanical) nomenclature only with the exclusion of the inconsistencies, the right re-examination and careful nomenclatural and taxonomic studies in accordance with the ICBN and APG III respectively. Moreover, the new studies on Lesbos palaeobotany present piece by piece the evolutionary traits of the plants as revealed by their functional anatomical characteristics. The rectification of the taphonomy processes and conditions of each and every fossiliferous locality in Lesbos, in association with new results on the palaeofloristic treasure (new holotypes for the Neogene of Eurasia, Lauraceous woods identified for the first time in Greece, a new identification key for fossil Lauraceae based on Lesbos material and especially on the exact occurrence of their idioblasts, new results from the palaeoxylotomical studies on coniferous wood fossils) revealed from the volcanic layers of the island during the Neogene can bring together all the pieces/assemblages of Lesbos palaeobotanical, palaeontological and palaeogeographical puzzle.

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## EVALUATING THE EFFECT OF MARINE DIAGENESIS ON LATE MIOCENE PRE-EVAPORITIC SEDIMENTARY SUCCESSIONS OF EASTERN MEDITERRANEAN SEA

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### ABSTRACT

The microstructure and geochemical composition of foraminiferal tests are a valuable archive for the reconstruction of paleoclimatic and paleoecological changes. In this context, the late Miocene *Globigerinoides obliquus* shells from Faneromeni section (Crete Island) were investigated through Scanning Electron Microscopy (SEM) imaging, Energy Dispersive micro-analytical System (EDS) analysis and X-Ray Diffraction (XRD) spectroscopy in order to evaluate their potential as paleoenvironmental archives in the eastern Mediterranean. Investigation of diagenetic features, in late Miocene sediments from the Faneromeni section, shows that carbonate precipitation and cementation occur in various lithologies, particularly in carbonate-rich portions, such as bioclastic or clayey limestones. We identified 3 different diagenetic stages (early, intermediate, advanced), as a function of taphonomy in the study area. The comparison of microstructural and geochemical characteristics reveals a sequence of preservation states with “glassy” to “frosty” to “chalky” shells, indicative of the diagenetic alteration of late Miocene planktic foraminiferal calcite. The early diagenetic stage occurs during the Tortonian, and consists of intermediates between “glassy” and “frosty” individuals. Around the Tortonian/Messinian boundary at the second diagenetic stage, planktonic foraminifera have a clear “frosty” appearance, showing a gradual high-Mg calcite (to dolomite) crystal overgrowth development and dissolution of biogenic calcite. During the late Messinian and progressively through the Messinian Salinity Crisis (MSC), planktonic foraminifera present a “chalky” taphonomy. The additional precipitation of authigenic high-Mg inorganic calcite and dolomite crystals in the exterior of the tests characterizes the advanced diagenetic stage. The measured amount of diagenetic Mg-rich (10-14% molar Mg on average) calcite and/or dolomite coatings is compatible with results obtained on modern eastern Mediterranean core-top sediments. The assessment of such a diagenetic alteration contributes to a more precise reconstruction of sea surface temperatures (SSTs) during the Neogene, such that only when the changing proportions of the texture are accounted for, would geochemical measurements and subsequent paleoenvironmental interpretations be more meaningful. However, further investigations should extend this approach to test the robustness of our findings across a range of taphonomies, ages and burial settings.

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## **LATITUDINAL PLANKTONIC FORAMINIFERA SHELL MASS DIFFERENCES DURING TERMINATION I**

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### **ABSTRACT**

The oceans' surface layer holds large amounts of dissolved inorganic carbon that is exchanged rapidly with the atmosphere. Carbon enters the ocean mainly through the dissolution of atmospheric carbon dioxide (CO<sub>2</sub>), and a part of it is converted into carbonate by marine organisms. Calcifying marine organisms include planktonic foraminifers that contribute to the marine carbon turnover by generating inorganic carbon production (CaCO<sub>3</sub>, shell). Anthropogenic CO<sub>2</sub> acidifies the surface ocean, changes the carbonate chemistry and decreases the saturation state of carbonate minerals in sea water, thus affecting the biological precipitation of carbonate shells. Relative changes in average foraminiferal shell mass can be interpreted as variations in test thickness and the extent of calcification that subsequently impacts the global carbonate budgets. The response of calcifying marine organisms to elevated atmospheric *p*CO<sub>2</sub> is diverse and complex with studies reporting from reduced rates of net calcification to neutral receptivity or even increased calcification intensities. This adverse behavior implies that the concentration of dissolved inorganic carbon may not be the dominant factor controlling the amount of carbonate shell masses. Here we provide further evidence that glacial/interglacial variations of planktonic foraminifera shell masses are invariant to atmospheric *p*CO<sub>2</sub>. We identify that differences in shell weights of several planktonic foraminiferal species from narrow size intervals, over the most recent deglaciation (Termination I) vary systematically as a function of latitude. Past intervals of abruptly changing *p*CO<sub>2</sub> and temperatures, such as the terminations, can offer a glimpse into the response of marine calcifying plankton to changes in surface oceans. We have compiled all the available bibliographic data of planktonic foraminifera shell weights from restricted sieve fractions of different species from the Atlantic, Pacific and Indian Oceans and we find that for the same *p*CO<sub>2</sub> conditions planktonic foraminifera from equatorial regions may alter their shell mass only as little as 8.2%, while towards higher latitudes changes in shell weights reach up to 54% during the transition from the last glacial to interglacial conditions. We attribute this low variability in the shell mass of planktonic foraminifera from the equator to the stability of the physical oceanographic conditions that characterize the equatorial zone.

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**CONODONT BIOSTRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS OF THE UPPERMOST VISEAN-LOWER SERPUKHOVIAN UNITS FROM THE CENTRAL TAURIDES (BADEMLI REGION)**

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**ABSTRACT**

The sections (BS and BSE) cropping out in the Bademli region (Turkey) have been studied in order to define distinct microfacies types and associated depositional environments and the conodont biostratigraphy of the carbonate units. Conodonts are one of the main microfossil groups used to date and correlate the Paleozoic rocks. Several beds within the measured sections in Taurides are barren of conodonts, while others contain not very abundant, but quite important taxa. Based on the appearance of biostratigraphically significant species, the following zones were established across the studied successions; *Gnathodus girtyi girtyi* Zone (Upper Visean) and *Gnathodus girtyi simplex* Zone (Lower Serpukhovian). It is known that *Gnathodus girtyi simplex* is an important conodont taxon for the identification of Serpukhovian stage. Consequently, the Visean – Serpukhovian boundary in Taurides (Turkey) has been delineated by the first appearance of *Gnathodus girtyi simplex*. Conodonts in Paleozoic deposits are generally environmentally controlled and there are different types of paleoecologic models in order to explain the distribution patterns of conodonts within depositional environments. Recent studies indicated that the distribution of conodonts was fundamentally controlled by the physical and chemical properties of the water. The studied successions in Taurides were mainly deposited in a shallow marine environment during the Carboniferous time so they comprise less diversified conodont fauna and the conodonts elements are low in abundance. In Bademli region, BSE section including the Visean - Serpukhovian boundary is predominantly composed of uniform lithologies of sandstone and sandy limestones. The defined facies types in BSE section are crinoidal bioclastic packstone, bioclastic grainstone, sandy oolitic grainstone, quartz-peloidal grainstone and quartz arenitic sandstone facies. Based on the microfacies studies, it can be stated that conodont elements essentially obtained from the crinoidal bioclastic packstone and bioclastic grainstone facies in the studied sections. These facies mainly includes high amount of crinoid fragments and other bioclasts, such as foraminifers, ostracodes, echinoids and brachiopods. Moreover, this study aims to correlate the established zonation with previously published ones from the other localities in the world and to improve biostratigraphic resolution.

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## LATE CAPITANIAN FORAMINIFERS IN SOUTHEASTERN ANATOLIA, TURKEY

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### ABSTRACT

Based on the integration of the biostratigraphic and microfacies data, Permian units outcropped around Çolpan village in the eastern part of Lake Van, were deposited in the shallow marine environment. The studied unit previously described as Triassic has been assigned a Middle Permian based on the presence of the distinctive foraminiferal and calcareous algae fauna. The studied sections are predominantly composed of recrystallized limestones. Permian foraminifers from north of Ercek Lake (Van) are typically Tethyan and show that the assemblage is Late Capitanian in age. The studied foraminiferal assemblages comprise relatively rare palaeotextulariids, tuberitinids, and earlandiids. Among fusulinids, verbeekinid and neoschwagerinid forms are absent and staffellids, schubertelloids and schwagerinoids are rare and scattered in the sections. Contrariwise, smaller foraminifera are mainly dominated by nodosarid and globivalvulinid forms in the Middle Permian carbonates of the study area. Based on the biostratigraphic studies, the defined characteristic taxa include the species of Parafusulina?, Stafella, Nankinella, Nodosinelloides, Dagmarita, Pachyphloia, Geinitzina, Glomospira, Agathammina, Globivalvulina, Climacammina and Paleotextularia. Despite the long range of the defined species and the lack of index foraminifers, recognized forms in the studied sections are very useful in the establishment of the biostratigraphical framework of the Middle Permian units. Moreover, the limestone units are rich in gymnocodiacean and dasycladacean algae. The disappearance of larger kerioitechal forms, schwagerinids, took place within the Capitanian prior to the Guadalupian-Lopingian boundary. The foraminiferal microfauna is similar to that of central and eastern Taurides (Turkey) and Iran. On the basis of foraminiferal fauna recorded within the study area, Capitanian limestones in the region are established as part of the Southern Biofacies Belt.

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**MICROFACIES ANALYSIS AND SEQUENCE STRATIGRAPHY OF THE MIDDLE PERMIAN  
YAMANYURT FORMATION, EASTERN LAKE VAN, TURKEY**

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**ABSTRACT**

The Middle Permian Yamanyurt Formation exposed in the eastern part of Lake Van, (Van, Turkey) provides an important paleontological and stratigraphical data for the understanding of the depositional environments. The detailed microfacies analysis on the basis of depositional textures, dominant carbonate grains and the proportion of skeletal and non-skeletal grains through the studied sections have allowed to distinguish six main microfacies types comprising mudstones, bioclastic mudstones-wackestones, bioclastic grainstones, intra bioclastic packstones-grainstones, bioclastic wackestones-packstones and wackestones with spicules. All microfacies types contain diverse fossil assemblages including foraminifera, algae, and fragments of echinoids, crinoids, bivalves and sponges. The recognized microfacies types were grouped into three genetically related facies associations that are integrated into three depositional environments ranging from backshoal (lagoon), shoal to foreshoal. The vertical evolution of microfacies within the studied units allows the identification of a number of cycles (parasequences) and two distinct depositional sequences. The shallowing-upward cycles in the studied sections specify the sedimentary responses to relative sea level changes ranging from foreshoal to backshoal environments. Each sequences includes a package of transgressive and highstand systems tracts based on the vertical stacking patterns of the meter-scale cycles. In the studied sections, microfacies association within the transgressive system tract indicates a deepening trend and those within the highstand system tract display a clear shallowing trend. It is confirmed that Middle-Late Permian carbonates of the region were deposited in a shallow marine environment. Correspondingly, similar shallow marine sediments comprising mainly subtidal facies were deposited during Middle-Late Permian time in the Taurides (Turkey) and Iran.

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**DISTRIBUTION OF SUSPENDED SEDIMENT IN THE GULF OF GDAŃSK OFF THE VISTULA RIVER MOUTH (BALTIC SEA, POLAND)**

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**ABSTRACT**

The Vistula River mouth is situated on the southern coast of the Gulf of Gdańsk (Poland). Considering the average flow and draining area the Vistula River is one of the largest river in the catchment area of the Baltic Sea. It is also one of the largest suppliers of terrigenous matter to the Baltic Sea. Grain size analysis of the material transported in suspension shows that it consists of the size fraction between 1  $\mu\text{m}$  and 600  $\mu\text{m}$ . The silt fraction constitutes the biggest share (55%), while medium and fine sands amount to 30%. Close to 15% of the material transported in suspension belongs to clay fraction. The Vistula water flow feeding into the Gulf of Gdańsk and carrying sedimentary material extends horizontally from 2 to 15 Nm from the river mouth, and has a vertical range of 0.5–12 m. During field research, in April 2014, many parameters were measured at stations of the Gulf of Gdańsk. A LISST-25X and CTD probe were used to determine the variations of suspension and water parameters. The flow and current directions were characterized with the use of ADCP. In the Vistula River mouth, in a surface layer, the mean concentration of suspended matter varied from 36  $\mu\text{l/l}$  do 1055  $\mu\text{l/l}$ . Mean Sauter Diameter of suspended sediments ranged in size from 44 to 172  $\mu\text{m}$ , wherein the smallest size was 22  $\mu\text{m}$  and the biggest 360  $\mu\text{m}$ . Changes observed in these waters occurred over time and reflect changes in the intensity of the Vistula waters inflow. During the research period, the flow of the Vistula grew from 650 to 1270  $\text{m}^3/\text{s}$ . At a depth of 9 m, in intermediate layer, the average particle concentration (11  $\mu\text{l/l}$ ) and mean diameter (45  $\mu\text{m}$ ) were lower than at the surface. With the increase in salinity and temperature drop, reduction of particle concentration (5–13  $\mu\text{l/l}$ ) and average diameter (23–32  $\mu\text{m}$ ) were observed. In deeper layers (below the developing thermocline) the concentration of the suspended sediments was clearly lower (2.5  $\mu\text{l/l}$ ), and the average particle diameter increased (32–42  $\mu\text{m}$ ). The different characteristic of the field of the suspension were recorded in the area of sea waters, which are not directly influenced by the Vistula River fresh waters. In marine waters concentration of suspension ranged from 1 to 2  $\mu\text{l/l}$  with relatively large particles size from 50 to 60  $\mu\text{m}$ . As the distance from the Vistula River mouth increased, the influence of riverine waters on the particle size distribution and concentration becoming less and less visible. The observed distribution of salinity, temperature and suspension concentration indicates that freshwater is spreading into a fan shape in the surface layer. The dissipation of suspension occurs along the dominant directions of the river water movement. The changes in suspension concentration and size in the water column are caused by flocculation.

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## **THE EFFECT OF DIFFUSION ON THE SEDIMENTATION RATE OF SOIL MICROPARTICLES**

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### **ABSTRACT**

The submitted paper presents the results of the experiment aimed at quantifying the effect of diffusion on the sedimentation rate of soil microparticles of different fractions. The goal of the experiment was to specify the determination of the texture composition of soils. The textural composition of the soil gives basic information about its hydrophysical properties. Standard methods for determination of granulometric soil composition are based on sedimentation methods. Measuring errors occur in the measurement of the soil microparticle rate, which are usually made of clay particles. Their source is the effect of diffusion. In the settling process with the gradual formation of the colloidal dispersion system, the deposition rate decreases. The rate of sedimentation of the dispersion particles approaches the rate of the mean diffusion feed in the opposite direction. Gradually, the state of dynamic sedimentation equilibrium occurs. The dispersion ratio was in dispersed system formed by clay soil particles from the Senne site. The dispersed medium was distilled water. Grain analyses were performed by a laser diffraction method on a Mastersizer 2000 from MALVERN Instruments. The soil microparticles' rates were measured on the basis of the time and the passage of particles with diameter  $d$  (90). The output of the experiment is the diffusion coefficient, diffusion average feed and sedimentation rate for soil particles of different sizes. The results of the work show that with size of sedimented soil particles, the effect of diffusion increased. On this basis, it is possible to verify the lower limit of the results of grain size analyzes based on the sedimentation method.

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## **A STUDY OF ANISOTROPIC CROSSHOLE SEISMIC TOMOGRAPHY BY PHYSICAL MODELING**

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### **ABSTRACT**

The crosshole seismic tomography used in seismic exploration can be applied to map a velocity section of strata between two holes. Therefore, the targets, such as geologic structure, fault, fracture zones, low velocity zone, between two holes can be accurately estimated. The strata in the crustal usually possess anisotropic characteristics of velocity. For the crosshole seismic tomography to resolve the anisotropic strata, the anisotropic characteristics of the velocity of the grids in the velocity section are usually assumed as a transversely isotropic medium with a vertical symmetry axis (VTI) or horizontal symmetry axis (HTI), thus the anisotropies of the strata can be evaluated. However, the velocity anisotropy of strata is not always VTI (or HTI), and multiazimuth fractures can be found in strata. Thus, in this study, a non-restricted azimuthally dependent velocity of the grids in the velocity section is used for the crosshole seismic tomographing. Algebraic reconstruction techniques for the crosshole seismic tomography incorporating with non-restricted azimuthally dependent velocity of the grids in the velocity section are developed. Numerical and physical models were used to test these techniques. Results of the numerical testing show that the anisotropic velocities of the media can be successfully reconstructed using the observed arrival times of seismic waves under a full coverage of ray in azimuth. The number of the observed arrival times for the tomographing is only half of the unsolved parameters. Physical modeling shows that a low velocity anisotropic medium will be difficult to detect due to that the refraction wave propagates through the high velocity isotropic medium and reaches the detector firstly. However, a high velocity anisotropic medium and anisotropic medium with a small contrast of the acoustics impedance to the surrounded medium can be successfully detected in the physical modeling. In conclusion, since more unknown parameters needed be solved than those of the isotropic crosshole tomography, a dense in the ray density and a full coverage of observations in azimuth for the anisotropic crosshole tomography are necessary to accurately estimate the anisotropy velocity of the medium.

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## **SHAKE MAPS GENERATION FOR DELHI REGION USING TWO DIFFERENT ALGORITHMS**

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### **ABSTRACT**

Delhi the national capital of India is highly sensitive to seismic risk with possible occurrence of higher magnitude earthquake from the Himalayas and in its vicinity. Some higher magnitude earthquakes occurred in this region in past 200 years, but few recorded waveforms are available from these historical earthquakes. But in recent time, the strong motion instrumentation network (SGMN) in Delhi has provided useful data. Taking advantage of recorded ground motion data, an endeavor has been made to generate near real-time Peak Ground Acceleration and Peak Ground Velocity shake maps for Delhi region. The shake maps are plotted for March 5, 2012 earthquake in the region using Earthworm software with help of newly adopted algorithms, which was widely recorded by SGMN in Delhi. In addition, shake maps are also plotted using ground motion at one of the reference site namely NDI and transfer function of other sites. The shake maps produced by two methodologies show good correlation, so that in absence of ground motion at every site, the second approach can be used as an alternate to produce shake maps in the region. The source mechanism for March 5, 2012 earthquake is computed using waveform inversion technique. We compared our estimated fault plane solution with the solution provided by others. The solution for this earthquake is in agreement with others and as well as general trend. The generated shake maps provide information about rupture process. For a country like Taiwan, plotting shake maps is a routine activity after occurrence of any moderate earthquake. The densely installed instruments across whole country in Taiwan assure the shake maps to be precise. Presently SGMN operates in threshold mode. Once it is changed to operate in real-time, it will be very helpful for accessing the damage pattern. Simultaneously, an earthquake early warning (EEW) system comprising of 100 instruments is installed in Uttarakhand Himalayas. In future, if EEW systems are installed in Delhi, data from SGMN and EEW system will be very helpful for generating precise shake maps in the region.

Corresponding Author: Himanshu Mittal

**GEOMAGNETIC FIELD BEHAVIOUR AT MUNTELE ROSU (ROMANIA) AND ANOMALY INTERPRETATION**

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**ABSTRACT**

In this study were used geomagnetic data recorded during last 5 years, from 2013 till present. The records were corrected for missing and wrong data induced by malfunction of the data acquisition system. The main purpose of the paper is to identify the magnetic field behaviour in relation with space weather, meteorological phenomenon including annual/diurnal temperature variation, local and regional seismic activity. The paper is focusing on geomagnetic anomalies detected on the recorded field at one magnetometer located near Vrancea seismogenic zone prior to  $M_w > 4.5$  crustal and intermediate depth earthquakes. During these 5 years of investigations one crustal earthquake and three subcrustal earthquakes with a moment magnitude  $M_w$  between 5.0 and 6.0, occurred in the Vrancea zone. All three intermediate depth events were accompanied by significant anomalies on Y axis (EW component) of local geomagnetic field measured at MLR observatory. The MLR magnetometer was outside the preparation zone of the crustal earthquake, located at 100km distance from the epicentre, so no anomaly was observed. In order to highlight the anomalies recorded at Muntele Rosu (MLR) seismological observatory, these data were compared with data from Surlari (SUA) observatory, located about 150 Km South-East outside the Vrancea seismogenic zone. Similarly, earthquakes with  $M_w$  between 4.5 and 5 are accompanied by same type but smaller amplitude anomalies, were the drop on Y axis was less than 10 nT instead of 20-30 nT as those occurred prior to earthquakes with  $M_w > 5.0$ . The latter ones are harder to observe during the summer time when these anomalies are hidden by large diurnal variations. The anomaly duration extends from days to sometimes months, without correlation with the earthquake magnitude. To better distinguish the local/regional anomalies from global geomagnetic behaviour, both MLR and SUA datasets were also corelated with the geomagnetic indices from NOAA/Space Prediction Center. The presence of geomagnetic storms creates a specific type of anomalies that sometimes might hide the ones related to earthquakes. The geomagnetic measurements were also compared with temperature values recorded at MLR station both for avoiding wrong interpretation of instrument response related to temperature variations, and to highlight possible correlations of magnetic field behaviour with ambient temperature. The three medium sized intermediate earthquakes that have occurred in the studied time interval provided a good opportunity to investigate the link between the presence of anomalies on geomagnetic records at Muntele Rosu observatory and seismicity in Vrancea zone.

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**IMPROVING RIGIDITY OF CLAY BY USING EXPLOSIVES AND PROOFING BY MULTICHANNEL ANALYSIS OF SURFACE WAVES (MASW)**

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**ABSTRACT**

The construction foundation problem in complex conditions with specific types of soils (peat and organic sediment, sludge, soft clay, etc.) is relevant at the present time. Excessive moisture, low bearing capacity, high compressibility, and other negative qualities of these soils make the process of foundation more expensive and complicated. To improve the properties of granular soil can be applied explosive compaction (EC) technology, which has been used for more than 80 years, but mostly for the compaction of gravels, sands and silts. This paper documents the successful application of EC for the compaction of clay soils. To cause compaction, the sequential detonations were performed using explosives placed in boreholes. To investigate the efficiency of explosive compaction on cohesive clay soil, geophysical testing was performed. Applied geophysical testing methods were a Multichannel analysis of surface waves (MASW) and seismic down-hole, whose test results are shear wave velocities ( $V_s$ ) in depth. The shear modulus ( $G_0$ ) at small deformation, which is directly related to the  $V_s$ , were used to determine the degree of soil improvement. From a comparing of results of pre-and post-blast testing, the positive effects are evident.

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**SOURCE PARAMETERS AND SCALING FOR THE CRUSTAL EARTHQUAKES IN THE CARPATHIANS AREA, ROMANIA: AN OVERVIEW**

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During the last 30 years crustal seismic activity in Romania has concentrated along the Carpathians orogen and in the adjacent areas. A significant activity is observed close to the epicentral area of the Vrancea subcrustal earthquakes that can be interpreted as a consequence of the strain field originated in the mantle, beneath the South-Eastern Carpathians Arc bend. Here several earthquake-prone zones are defined, both overlapping the epicentral area of the Vrancea subcrustal earthquakes and following the tectonic contacts between the platforms in the foreland and Carpathians orogen. Frequently, the seismic energy is released in sequences, either as foreshock – main shock – aftershocks, or seismic swarms. The largest event recorded within the considered time interval ( $M_w$  5.7) occurred on 22 November 2014 in the Carpathians foredeep area (close to Marasesti city), at the bottom of the crust ( $h = 40$  km) followed by a significant increase of seismicity over the entire area lying in front of the Vrancea region. Significant sequences were recorded also in the South Carpathians in the eastern and western sides. The source parameters are evaluated using relative deconvolution techniques (empirical Green's functions and spectral ratios) and spectral source analysis. To identify appropriate pairs of main events and associated empirical Green's function events we used cross-correlation analysis. The hypocenters distribution and the available fault-plane solutions were interpreted in connection with the active faults as geotectonically defined. The results were integrated in a unified database which provided systematic investigations of source scaling properties in correlation with seismotectonics characteristics in the study region. This paper was carried out within Nucleu 2018 Program CIRRUS PN 1815 01 01 Project supported by ANCSI.

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## **UPDATED CATALOGUE OF DOBROGEA (ROMANIA) REGION FOR 2013-2017-TIME INTERVAL**

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A complete and reliable earthquake catalogue is the basic product of the seismological networks. As the seismic network of Romania has been improved, the statistics of the detected and located earthquakes has significantly increased. At the same time, it has become a critical issue how to discriminate the quarry blasts events from the tectonic events. The study area is characterized by a moderate seismic activity with crustal earthquakes of magnitude  $M_w \leq 5.3$  and it is based on geographical distribution, between Danube River and Black Sea, and not on tectonic units. The geology of the Dobrogea fundament is very complex and the tectonic units are delimited by crustal faults. The main faults defined on the Dobrogea area are: The Sfantu Gheorghe Fault, the Peceneaga-Camena Fault, the Capidava-Ovidiu Fault and the Intramoesian Fault (Sandulescu, 1984). We identified more than 70 active and inactive quarries in the study area, using Google Earth and we used 16 seismic stations of the National Seismic Network. To this aim, we selected four template events considered as representative for the study area. In order to identify specific event-prone areas and correlate seismic activity with active tectonics or quarries location, we applied the cross-correlation analysis for the time interval 2013 – 2017 and for the waveforms recorded at Targusor seismic station (TIRR) on vertical component. We used also, the basic discrimination criteria: working hours, working days, monthly distribution, magnitude and depth of the event. The outcome of this work is an extended version of the routine catalogue for the Dobrogea area, with identification of the event source type.

Corresponding Author: Maria Rogozea

**CALIBRATION AND VALIDATION OF MEEP METHOD FOR LOCATION AND MAGNITUDE ESTIMATION OF HISTORICAL EARTHQUAKES FROM INTRA-CARPATHIAN REGION OF ROMANIA**

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**ABSTRACT**

Intra-Carpathian Region of Romania experienced strong earthquakes as it is mentioned in the national and international databases, e.g. November 26, 1829 ( $M_s=6.4$ ), October 10, 1834 ( $M_s=6.3$ ), January 26, 1916 ( $M_s=6.4$ ), July 12, 1991 ( $M_w=5.7$ ), December 2, 1991 ( $M_w=5.5$ ). The focal parameters of the historical earthquakes are determined from macroseismic data, like intensity datapoints (IDP), epicentral intensity ( $I_0$ ) and/or isoseismal areas ( $A_i$ ). The paper focuses on calibration and validation of MEEP method (Macroseismic Estimation of Earthquake Parameters, Musson & Jimenez, 2008) to provide a homogeneous and repeatable procedure for processing IDPs which may supply the location and magnitude  $M_w$  of historical earthquakes occurred in the Intra-Carpathian Region of Romania and surroundings. The MEEP method is based on grid-search, intensity attenuation-fitting and mechanics of earthquake perception. It has the advantage to be used for small and moderate events. Firstly, the epicentre is determined by the residuals minimization approach and then the magnitude is assessed through the Frankel approach, where the perceptibility area of an earthquake is proportional to the magnitude. We used two high quality datasets of earthquakes of the 20<sup>th</sup> century for which macroseismic data points (IDPs), instrumental moment magnitude ( $M_w$ ) and instrumental epicentral coordinates are available, one for calibration and the other one for validation of the method. The main parameters used through MEEP algorithm were calibrated at regional scale using high quality instrumental data: 1) crustal attenuation  $Q_3=435$  (attenuation shear-wave at  $f=3$  Hz, which is the predominant frequency of earthquake motion and represents the limit of the human perception of seismic waves), 2) Kövesligethy's anelastic attenuation ( $\alpha=0.0065$ ) and 3) isoseismal spacing ( $k=3.1$ ) coefficient. The MEEP method was successfully tested for events occurred within extra-Carpathian regions and Pannonian Basin.

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## **RELATIONSHIP BETWEEN MACROSEISMIC INTENSITY AND PEAK GROUND ACCELERATION OF THE VRANCEA (ROMANIA) EARTHQUAKES**

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### **ABSTRACT**

The goal of this paper is to develop a new empirical relationship between observed macroseismic intensity and ground motion parameters such as peak ground acceleration (PGA) of the Vrancea subcrustal earthquakes. Along time many studies have investigated and developed statistical relationships between macroseismic intensity and PGA for various seismic regions of the world (Trifunac and Brady, 1975; Murphy and O'Brien, 1977; Chernov and Sokolov, 1983; Sweny A., 2012; Ren Y. et al., 2013; Bilal M., 2013; Nemati M., 2015). The recent Romanian earthquakes especially Vrancea earthquakes, provide valuable data to examine these relationships for entire territory of the country. The Vrancea region is one of the most active seismic zones in Europe and it is well-known for the strong subcrustal earthquakes. We examine the correlation between the strong ground-motion records and the observed intensities for major earthquakes with  $M_w \geq 6$  and epicentral/maximum intensity in the range VII to IX $\frac{1}{2}$  MSK degrees occurred in Romania in the period 1977-2004. We have developed regression relationship between macroseismic intensity and PGA by comparing maximum peak ground motions to intensities recently reevaluated for five major Vrancea earthquakes. For the earthquakes used in this study, the ground motion acceleration database contains more than 200 site information, but less than the IDPs data set obtained for the same events (4200 IDPs for all events). For 1977 earthquake we had only one seismic record in Bucharest, INCERC site. As time goes by, the number of digital recordings increased, due to the developing of the strong motion network. Unfortunately, the macroseismic information are decreasing in time because the population is not willing to spend time and fill in questionnaires. The empirical relationships between ground acceleration and maximum intensity obtained and published by various authors have shown that these two parameters don't always show a one-to-one correspondence, and the errors associated with the intensity estimation from PGA are sometimes +/-2 MSK degree. In the present study, the relation between intensity and PGA will be given both as a mathematical equation, but also as corresponding ground motion intervals. Because of the intensity data spreading and errors related to mathematical approximations, it is necessary to systematically observe not only the acceleration but also all the other ground motion parameters, and especially the macroseismic intensity. The mathematical relation between these two parameters might be used for rapid assessment of ground shaking severity and potential damages in the area affected by the Vrancea earthquakes.

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**CRUSTAL ATTENUATION CHARACTERISTICS IN BISHKEK GEODYNAMIC GROUND (THE NORTH TIEN-SHAN)**

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The Bishkek Geodynamic Ground (BGG), limited by the coordinates of the rectangle, lies within the Central segment of the North-Tien Shan seismogenerating zone and represents the zone of the joint of the Tien Shan orogeny and the Kazakh plate. BGG is a zone of modern intensive deformations, which are manifested through active seismicity. Within BGG there is a seismological network KNET, consisting of ten digital broadband stations, which allows to register local and regional seismicity, as well as to solve other problems. The study of the attenuation characteristics of BGG became possible due to a large array of digital records of local earthquakes of the stations of the network KNET. During the operation of the network it recorded more than 9000 local seismic events. The study of seismic wave attenuation is carried out on the basis of Coda-wave analysis (performed over each station separately) and tomographic inversion method (performed over multiple stations for each event). On the basis of the Coda-wave analysis,  $Q_c(f)$ ,  $Q_o$  and  $n$ , as well as the change in the attenuation coefficient  $\delta$  with a depth ( $f = 1$  Hz) for the radial areas around the network stations KNET and BGG are obtained. According to the results of the tomographic inversion, horizontal sections of attenuation at a depth of 5 and 15 km are constructed. These models demonstrate a higher attenuation of seismic waves for the mountainous regions of the Northern Tien Shan and a lower attenuation for the cavities of the Kazakh plate.

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**TSUNAMI MODELING OF THE 8<sup>TH</sup> OF SEPTEMBER 2017 MEXICO M 8.1 EARTHQUAKE, USING TWO DIFFERENT SOFTWARE**

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**ABSTRACT**

On 8<sup>th</sup> of September 2017, an earthquake of magnitude Mw 8.1 was generated offshore Mexico, Chiapas area, at 04:49 UTC, with a depth of 72 km and the following coordinates: Latitude 15.02 N, Longitude 93.81 W, 98 km away from Pijijiapan (Mexico). The fault plane solution of the event was normal plane. Maximum tsunami waves of 1.1 m were measured at Salina Cruz sea level station, following the earthquake. Tsunami modeling simulations were accomplished using the earthquake's parameters (location, magnitude, depth) and moment tensor solutions given by 3 different agencies: United States Geological Survey (USGS), German Research Centre for Geosciences (GFZ) and Global Centroid Moment Tensor (GCMT). For every case study, the affected locations, sea level estimates and maximum wave heights were computed. There are two software used for modeling, the Tsunami Analysis Tool (TAT), provided and developed by the Joint Research Center, Ispra, Italy and TRIDEC Cloud, provided by the German Research Center for Geosciences (GFZ), Potsdam Germany. After analyzing the modeling scenarios, a comparison between the results of the two software was accomplished, for the same earthquake parameters. When comparing the values between the modeled data, the results show that the parameters of GFZ and GCMT computed with TAT overestimate those computed with TRIDEC, with maximum 3.9 m wave height at Arista location for the GCMT parameters ran with TAT. For the USGS data set, the results are similar, maximum waves of 2.4 m at Pasito de la Senora with TAT, and 2.9 m at Puerto Madero with TRIDEC. The Salina Cruz station, where 1.1 m height waves were measured, gives results only for the simulations ran with TAT, with 1.0 m for the GFZ earthquake parameters, 0.6 m for the USGS and 1.4 m for the GCMT parameters. Both software overestimate the maximum measured waves.

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## **MODELING TSUNAMIS FOR THE BLACK SEA SHABLA AREA, USING TRIDEC CLOUD SOFTWARE**

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### **ABSTRACT**

The scientific literature documents 21 past tsunamis in the Black Sea area. Three of them were triggered in Shabla area, the most dangerous for the Romanian and Bulgarian shore-lines. The most recent event, from 31<sup>st</sup> of March 1901, a 7.2 M earthquake lead to waves of 2.5-3 m; in year 543-544 AC, an earthquake of 7.5 M triggered waves of 2-4 m height; the oldest event was in Bisone area, from 1<sup>st</sup> Century BC; Numerous tsunami scenarios were accomplished for the Shabla area, with TRIDEC Cloud software for modeling, and past earthquake parameters (location, focal mechanism) as input. The modeling was based on the following parameters: locations of 2 recent earthquakes (5<sup>th</sup> of August 2009, M 5; 3<sup>rd</sup> of December 2012, M 4.2); increased magnitudes varying from 7 up to 8, with steps of 0.2; depths of 5, 10, 30 km, and different fault plane solutions. The worst case scenario displays waves of maximum 3.05 m in Varna (Bulgaria), for a possible earthquake of M 8, depth 10 km, and 0.6 m in Constanta (on the Romanian shore); waves of 2.65 m (Varna) were obtained for the same magnitude but a depth of 5 km, with 0.32 m in Constanta; another scenario shows for M 7.8 and depth 10 km, possible waves of 1.95 m in Varna, and 0.25 m in Constanta; moderate tsunami waves of 0.87 m are given in Varna by a scenario using M 7.5 and a depth of 30 km, displaying 0.13 m at Constanta; waves of 0.72 m result in Varna for the same magnitude but a depth of 10 km, with 0.16 m in Constanta; the modeling estimate low waves of 0.41 m in Varna and 0.07 m in Constanta for M 7.2 and 10 km depth; very low waves are given by a scenarios with M 7 and depth 5 km, of 0.25 m waves in Varna and 0.05 m in Constanta; similar results are displayed by a scenario with the same magnitude but 10 km depth, displaying 0.15 m waves in Varna and 0.06 m in Constanta. To conclude, tsunami modeling for this area results in similar waves values to the past estimates, and reflects the necessity of further studies for a better evaluation of the tsunamis effects.

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**GEOMAGNETIC FIELD BEHAVIOUR AT MUNTELE ROSU (ROMANIA) AND ANOMALY INTERPRETATION**

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**ABSTRACT**

In this study were used geomagnetic data recorded during last 5 years, from 2013 till present. The records were corrected for missing and wrong data induced by malfunction of the data acquisition system. The main purpose of the paper is to identify the magnetic field behaviour in relation with space weather, meteorological phenomenon including annual/diurnal temperature variation, local and regional seismic activity. The paper is focusing on geomagnetic anomalies detected on the recorded field at one magnetometer located near Vrancea seismogenic zone prior to  $M_w > 4.5$  crustal and intermediate depth earthquakes. During these 5 years of investigations one crustal earthquake and three subcrustal earthquakes with a moment magnitude  $M_w$  between 5.0 and 6.0, occurred in the Vrancea zone. All three intermediate depth events were accompanied by significant anomalies on Y axis (EW component) of local geomagnetic field measured at MLR observatory. The MLR magnetometer was outside the preparation zone of the crustal earthquake, located at 100km distance from the epicentre, so no anomaly was observed. In order to highlight the anomalies recorded at Muntele Rosu (MLR) seismological observatory, these data were compared with data from Surlari (SUA) observatory, located about 150 Km South-East outside the Vrancea seismogenic zone. Similarly, earthquakes with  $M_w$  between 4.5 and 5 are accompanied by same type but smaller amplitude anomalies, were the drop on Y axis was less than 10 nT instead of 20-30 nT as those occurred prior to earthquakes with  $M_w > 5.0$ . The latter ones are harder to observe during the summer time when these anomalies are hidden by large diurnal variations. The anomaly duration extends from days to sometimes months, without correlation with the earthquake magnitude. To better distinguish the local/regional anomalies from global geomagnetic behaviour, both MLR and SUA datasets were also corelated with the geomagnetic indices from NOAA/Space Prediction Center. The presence of geomagnetic storms creates a specific type of anomalies that sometimes might hide the ones related to earthquakes. The geomagnetic measurements were also compared with temperature values recorded at MLR station both for avoiding wrong interpretation of instrument response related to temperature variations, and to highlight possible correlations of magnetic field behaviour with ambient temperature. The three medium sized intermediate earthquakes that have occurred in the studied time interval provided a good opportunity to investigate the link between the presence of anomalies on geomagnetic records at Muntele Rosu observatory and seismicity in Vrancea zone.

*This paper was carried out within Nucleu Program, supported by ANCSI, project no. PN 18150101/2018 and PN18150203/2018*

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## **GIS-BASED ASSESSMENT OF SOIL CLASSIFICATION CONSIDERING SEISMIC SITE EFFECTS IN MALATYA, TURKEY**

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### **ABSTRACT**

Because of the increasing site investigation costs in Turkey, geotechnical surveys contribute to decreasing the expenses of construction projects. This study presents a geographical information system (GIS) which manages the geotechnical data obtained from detailed geotechnical surveys as well as from in situ observations in Malatya, Turkey. The GIS has been used as a critical tool in civil engineering in recent years. In this study, comprehensively examined data from 192 preliminary boreholes located in Malatya have been integrated using a relational database system. The geotechnical surveys and in situ observations of Malatya have been examined in terms of shear wave velocity ( $V_s$ ) and dominant soil vibration period ( $T_0$ ). The Spatial Analyst extension in ArcGIS has been employed to develop seismic soil classification maps for the study area according to the 30 meter depth shear wave velocity and dominant soil vibration period values. Two different earthquake resistant structural design methods were adopted by using the obtained soil parameters. These methods are National Earthquake Hazard Reduction Program (NEHRP) and Regulation about Buildings in Earthquake Zone (Turkish Earthquake Regulations, TER). From the analysis of geotechnical borehole survey results, thematic maps of NEHRP and TER are compiled in order to represent the distribution of geotechnical engineering properties of Malatya. (e.g.  $V_s$ ,  $T_0$ , soil amplification). The primary goal of this study is to estimate the seismological data variability of seismic ground motion for the city Malatya. Furthermore, the secondary goals are to compare and discuss the NEHRP and TER according to the seismic soil classification thematic maps. After generating the NEHRP map, soil class C ( $360 < V_s \leq 760$  m/s), and D ( $180 < V_s \leq 360$  m/s) were found to be present mostly in the study area, while soil class B is found rarely in the study area. A major part of the Malatya is located on soil class C. According to Turkish local site classification method, it has been observed that the northwestern part of the study area was found to be Z3 (0.55-0.65 sec) and Z4 (0.70-0.90 sec) soil class.

Corresponding Author: Nurullah Akbulut



## **DEVELOPMENT OF A GIS SYSTEM PROTOTYPE FOR SPATIOTEMPORAL ANALYSIS OF SEISMIC EVENTS**

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### **ABSTRACT**

The paper presents the selected functionality of the GIS system prototype developed to support the tracking of seismic activity related to the mining activity of the copper ore underground mine. The system allows to perform spatiotemporal analyzes related to seismic activity, spatial mapping of seismic shocks as well as reporting of a set of statistics describing the nature of these events and their dependence on mining activity. The database design takes into account a number of factors affecting the appearance, course and intensity of seismic shocks. For this purpose, the identification of information needs in the field of monitoring of seismic events was carried out and the data sources were determined, the structure of the data stream was proposed, and methods for their integration and auto-validation were developed. The analytical module of the system focuses a number of analytical methods in the field of statistics and spatial analysis. The article presents an example of the functionality of the analytical module on the example of a selected mining plant.

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**TOURIST ATTRACTIVENESS ANALYSIS OF OLD CONSTRUCTION-MINING OBJECTS  
IN LOWER SILESIA**

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**ABSTRACT**

The article describes the results of research focused on the analysis of tourism availability and attractiveness of selected objects of former construction and mining works located in Lower Silesia. 18 objects were selected for the research. Based on the literature review, 12 criteria have been defined; they have an impact on increasing the tourist attractiveness of the object. These are natural values, cultural attractions, green areas, road infrastructure, railway infrastructure, air infrastructure, bus transport, lodging base, gastronomic base, the price of visiting the facility, the opening period of the facility and the promotion of the object. For these criteria, a point scale was developed to determine the degree of importance of a given criterion. For the first 9 criteria, a multi-criteria analysis of the attractiveness of objects using two methods was carried out: the weighted sum method, taking into account the weightings of the AHP criteria and Map Algebra without taking into account the criteria weights. The resultant cell values of the resulting raster were classified as imaging areas: low (class IV), average (class 3), good (class 2) and very good (class 1) tourist attractiveness. Comparing the results obtained in two methods, the classification of 15 objects in the same classes was obtained. Taking into account the inclusion of weights for individual criteria, the results obtained from the weighted sum method were selected for further analyzes. In the final analysis of tourist attractiveness of objects of former construction and mining works, the classification of objects according to the other three criteria was also taken into account, adding up the points for each object. Finally, the obtained results of the analyzes and the attractiveness of the objects of former construction and mining works were combined. The results of analyzes might be helpful for tourists to choose tourist facilities for sightseeing.

Corresponding Author: Justyna Górnjak-Zimroz

## **DC RESISTIVITY METHOD FOR UNDERGROUND WATER EVALUATION IN SOUTHERN BRAZIL**

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### **ABSTRACT**

Climatic changes and the fast growing of water requirements put pressure on the natural resources available. Farming is responsible for 92% of the global water footprint and until 2050, the world food needs will increase around 70%. The state of Rio Grande do Sul (RS), whose economy is based on agriculture and livestock, has faced prolonged droughts. The industrial sector linked to the primary sector is very dependent on water resources for food processing. In order to produce 1 kg of grain approximately 1,500 liters of water are required while 1 kg of beef requires 15,000 liters. Changes in the rainfall pattern lead to broken crops, resulting in impoverishment of population and state. In 2012, RS government estimated that the drought would have already caused a loss of US\$ 580 million. One possible solution to overcome the lack of meteoric water is the exploration of ground water. In this work it is proposed the use of electrical resistivity sounding (ER) method to determine the depth and the quality of underground water reservoirs. Special attention is given to the recharge zones. Geophysical surveys were performed in the Santa Cruz do Sul municipality. After acquisition, data were processed and inverted using the software Res2Dinv®. The DC resistivity method was carried out in 3 lines with 60, 80 and 80 m long, with electrodes spacing of 5 m, applying the dipole-dipole array. Layers of clay soil and sandstone were identified. It is believed that the sandstone layer has the potential to store water. This characteristic allows the reservoir recharging, but shows its vulnerability for external contaminants. Geophysical information were compared with data from wells in order to perform a calibration. It is expected to include in the study regions where there are no wells drilled so far, and acquire data from other points of the recharge zone of the Guarani Aquifer, that cross Rio Grande do Sul state from east to west.

Corresponding Author: Daniela Sotelo

**SEISMIC EVIDENCE OF HIGH TEMPERATURE CRUSTAL MATERIAL IN THE CAMPANIA REGION  
(SOUTHERN ITALY)**

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**ABSTRACT**

The genesis of the Campanian Plain (Southern Italy) and the surrounding volcanic edifices (Roccamonfina in the north, Campi Flegrei and Mt. Vesuvius in the south) is related to the complex tectonic events accompanying the opening of the Tyrrhenian Sea (about 15 Ma to present). According to several authors, the Apulo-Adriatic slab west-dipping retreat was followed by the opening of backarc basins, floored with oceanic crust, in the western Mediterranean area (e.g. the Tyrrhenian basin) because of the upwelling of asthenospheric material. A snapshot of this geodynamic evolution is provided by some tomographic studies performed in the western Mediterranean area which detected the presence of low velocity mantle layers (LVL) at 60-130 km of depth, characterized by an average  $V_S$  velocity of 4.0-4.2 km/s. Such low velocity layers rise to shallower depth (< 30 km) below the Campanian and southern Tyrrhenian volcanic areas, evidencing a mantle flow against the immersing Apulo-Adriatic slab feeding the orogenic volcanism active in southern Tyrrhene and in the Campanian province. A comprehensive lithospheric (up to 73 km depth) shear wave velocity ( $V_S$ ) model of the Campanian volcanic area is proposed based on the results obtained in Campanian Plain, in the Neapolitan area and for the volcanic systems of Roccamonfina, Campi Flegrei district and in the north-eastern part of Mt. Vesuvius.  $V_S$  models are obtained by the non-linear inversion of group velocity dispersion data of fundamental-mode Rayleigh surface wave, extracted by frequency-time analysis from earthquake recordings and, mostly, from seismic noise cross-correlations between two receivers. In the inversion, local data (up to 7 s) are joined with available regional phase (25-80 s) and group (10-150 s) velocity data. The most distinctive feature is a widespread presence of a low-velocity crustal layer rising from depths of 14-15 km, in the Campanian Plain, to 11-12 km below the Campi Flegrei, and to 5-6 km toward the Roccamonfina and Mt. Vesuvius volcanoes, overlying a soft Mantle ( $V_S$  of 4.1-4.2 km/s) retrieved at depths of 20-26 km. The percentage of  $V_S$  reduction increases from 4-5 %, in the middle of the Campanian Plain, to 9-10 % below the Campi Flegrei District, and to 10-15 % below Roccamonfina and the north-eastern sector of Mt. Vesuvius. The presence of such low velocity layers can be explained with the presence of partial melting and/or to the brittle-ductile transition zone. These findings agree with the geodynamic context of the southern Tyrrhenian Sea: stretching of the continental lithosphere, with passive upwelling of asthenosphere, and consequent magmatism and high surface heat flow.

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## **APPLICATION OF REFRACTION SEISMIC IN THE VULNERABILITY OF UNDERGROUND AQUIFERS**

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### **ABSTRACT**

The multichannel seismic survey consists of a geophysical technique of indirect quantification, whose principles are based on the acoustic properties of the seismic waves produced locally. The study deals with seismic refraction, whose main advantages are avoidance of any environmental impact during the exploration, low cost and a fast way to present the results. The objective of the technique is to reveal acoustic characteristics of the geological environment, such as the propagation velocity of the P wave allowing estimation of the type of rock that constitutes the subsoil. The determination of the depths of the layers depends on the velocities estimated in the data analysis (Michel, 2015). Seismic waves are mechanical vibrations that are propagated in geological layers (Anomohanran, 2013). These waves can be natural or artificial. Seismic wave propagation obeys the Snell-Descartes law, which states that when a seismic wave encounters an interface that separates two layers with different acoustic impedances, two different waves are created: one reflected wave and one refracted wave. By definition, the acoustic impedance is the product of medium density by the propagation velocity of the wave. A seismic survey is based on the analysis of seismograms, that is, a graphical representation of the distance of the receivers by the time of displacement of the signal until it returns to the surface. With this graph it is possible to draw lines, which represent the transit times of the seismic wave in the geological environment, which are commonly called "travel time" (Kearey, 2002). In this research work the ABC reciprocal method was applied, whose processing depends on 5 shooting points (Hagedoorn, 1958). This information provided by the seismic survey helps determining the degree of vulnerability of local groundwater reserves. The region of interest of the study is the central depression of the State of Rio Grande do Sul, Brazil. This is a recharge region of the Guarani Aquifer System. This system consists of a set of geological formations rich in sand and poor in clay, which results in a kind of compartmentalized sponge with potential to accumulate underground water, covered by impermeable rock. Profiles analyzed, in the region of the municipality of Santa Cruz do Sul, suggest the presence of basalt, argillite and sandstone at approximately 10 meters' depth. With these conditions it is possible to infer local variability in the issue of vulnerability of groundwater from geological characteristics. Thus some regions are, of course, more protected than others, which require more attention in the matter of propagation of some contaminant.

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**SPEAKING ABOUT HEAT FLOW, ICE FUSION AND TEMPERATURE ALTERATIONS**

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**ABSTRACT**

Heat flow density measurements are difficult to obtain in Antarctica and Greenland due to climate and ice thickness in those regions. The works published about that subject shows that spatial distribution of the heat flux values is highly heterogeneous. Maximum and minimum values of heat flux vary with different authors and method used, but all of them say that East Antarctic is characterized by low heat flux values (45-85 mW m<sup>-2</sup>) with the lowest values found especially in the central part. The values obtained in West Antarctic (65-180 mW m<sup>-2</sup>) and in the Antarctic Peninsula (maximum of 170 mW m<sup>-2</sup>). In the work whose data is used high values were obtained in the West Antarctic Rift system (maximum value of 130 mW m<sup>-2</sup>). Some local geothermal anomalies have been reported such as Lake Wilhams (285 mW m<sup>-2</sup>) or Siple Dome (69 mW m<sup>-2</sup>). Elevated heat flux values are obtained in volcanic regions and in regions with relatively recent tectonic activity, in West Antarctic. The east Antarctic is characterized by low values, however the Coastal part of Queen Mary Land, the Lambert Rift and Victoria Land, show higher values, suggesting Cenozoic processes in the region, including volcanism or extension. Ice fusion occurs near the base of the ice sheet. In order to study this phenomenon 13 places were chosen from two profiles in WA and EA (Martos, Y. et al, 2017) with data related to heat flux, sub glacial topography and ice thickness. An average thermal conductivity of 2.35 W K<sup>-1</sup> m<sup>-1</sup> and density of 917.5 Kg m<sup>-3</sup> were used for the ice. Relations between the amount of molten ice per year due to the heat flux, the altitude and the thickness of the ice were obtained. The effect of temperature alteration at the surface in the temperature of the ice was calculate considering different modes of temperature variation, using an average value of 1.3 X 10<sup>-6</sup> m<sup>2</sup> s<sup>-1</sup> for the thermal diffusivity of the ice. The results obtained show differences in the two regions studied but the heat flow values used were found from “Curie Depth Temperature” using an average value for thermal conductivity. Different thermal conductivity values could explain some of the discrepancies found. In addition, horizontal conduction of heat must be considered due to horizontal heterogeneities. All the models show that temperature variations occurred in a small interval of years cannot be responsible for the fusion in the bottom of the ice sheet but the influence of a temperature raise at the end of the last glaciations can be detected at present.

## USE OF NON-DESTRUCTIVE METHODS IN STRUCTURAL ANALYSIS OF PETROUS MATERIALS - ULTRASONIC TESTING AND GROUND PENETRATING RADAR (GPR)

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### ABSTRACT

In the extractive and transformation processing industry of ornamental rocks, the presence of discontinuities, grain size, porosity and textural anisotropies in the explored blocks is an economic risk factor. This study aims the identification and possible quantification of these elements. The existence of a low-cost, non-intrusive and fast inspection method for the evaluation of blocks would facilitate their use avoiding their wastage. For this purpose, two non-destructive methods ("P" Wave Ultrasonic Testing and the Ground Penetration Radar (GPR)) were tested on a limestone rock block and compared the models obtained. The portable ultrasound equipment used was a Proceq Pundit Lab (Portable Ultrasonic Non-Destructive Digital Indicating Tester) which is based on the pulse rate method with 54 KHz to provide information about the uniformity, cavities, cracks and defects of the material concerned by the measurement of the ultrasonic wave time and the measurement of the pulse rate. The equipment used for the GPR data acquisition was a PULSEEKKO GPR (SENSORS & SOFTWARE), with a system of two bistatic antennas (transmitter and receiver) with a frequency of 1 GHz, using the reflection method with a common offset and with an antenna separation of 15cm. The acquisition configurations of the equipment used in the two methods are shown in table 1. To make a comparison of the results valid and representative, both tests were performed with 10 centimetres spacing between measurements, according to a pre-defined and common grid. In the case of the ultrasonic test, velocity coloured maps were created based on the results of the measurements, and through this colour differences it was possible to detect and locate some of the individual and visible fractures, but also not visible fractures on the surface of the tested face. By increasing the distance between transducers, the measurement depth inside the block also increases, creating maps of the same face at different depths. This method allows us to create several GPR profiles (radargrams) were obtained because of the processing, and were used to create 2, 2,5 and 3D models to identify the existing structures, their vertical and horizontal limits and spatial relationships between them. The comparison of the results obtained by the two methods, supported by visual observation, allowed us to verify the correspondences and to determine which source is responsible for the measured values, as well as their spatial dispersion that is closely related to the existing structures. It is possible to conclude that the proposed methodologies are valid, that the subject of the study has been achieved, and the existing structures have been identified with considerable resolution and accuracy. The use of the GPR revealed to be the best method for the aimed proposed.

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**SEISMIC, PARASEISMIC AND MECHANICAL RESISTANCE EXPERIMENTAL TEST OF RZB-04-04  
COMMUNICATION DEVICE USED IN NUCLEAR POWER PLANT**

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**ABSTRACT**

Some of special equipment is installing into the nuclear power plants. In Slovak Republic EMO (Mochovce Power Plant) operators need to install the special communication device into the processing buildings. This type of electronics is sensitive to many environmental conditions. One of this most important sensitivity is the vibration resistance sensitivity. Except of the machinery induced vibration the seismic and paraseismic effects act on any part of the power plant. This article describes how it is possible to test the RZB – 04 – 04 communication device in laboratory conditions. This test was performed on shaking table with controlled dynamic space excitation. This induced vibration special device can generate the movement in three directions on plate basement. The induced vibration can simulate random vibration using artificial accelerograms. Accelerograms used to simulation of seismic and parseismic movement are transformed into special data format and it runs the shaking table. For the communication devices the VUJE a.s. (Research Institute of Nuclear Energetics) regulation defines the mechanical resistance test due to harmonic vibrations. For this purpose, the seismoartif software package on academic licence were used. The individual regulation only for EMO defines acceleration amplitude spectral response load curves. The world database of earthquake accelerograms with maximal magnitudes was also used. The paper shows the results of these interested and unique dynamic tests. The paper also contains the assessment of functionality of this communication device during dynamic loading. The RZB – 04 – 04 passed all dynamic tests and it is suitable to use in nuclear power plant.

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## **ECOLOGICAL APPROACH AS AN URBAN DESIGN SOLUTION FOR SENSITIVE TERRITORIES**

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### **ABSTRACT**

The urban spaces of river banks are sensitive areas, not only in environmental terms but also considering the spatial planning rules. Often the spatial planning rules are focused on building and urban development questions rather than of ecological approaches. In this sense, this article aims to present an urban design project for a sensitive territory of river banks having as pivotal concern ecological solutions. This proposal is due to the requirement of linking the landscape features of river banks with the characteristics of the urban fabric. The case study area is the Train Station surroundings of São Pedro do Sul, a city in the central region of Portugal very well-known because of its thermal baths. It was proposed to the university team, on behalf of the Urban Planning Unit of the Master Degree in Architecture at the University of Beira Interior, by the Municipal authority. The students were organized in groups in order to propose the urban design projects, ensuring the continuity of the urban fabric with the Vouga river. The best projects won prizes (1<sup>st</sup>, 2<sup>nd</sup> and honour awards) offered by the city hall. This fact was an extra motivation for students along to the design process in an academic environment comprising an international background (including Portugal, Greece, Brazil, Slovakia, Lithuania and Poland). Regarding the presented solution, the conclusions show that the main strategy was to preserve and to enhance the ecological identity of the place, possible given the agreement in between university and municipal authority, working together.

Corresponding Author: Ana Virtudes

**QUALITY EVALUATION OF THE EARTH'S CRUST HEIGHT MOVEMENT KINEMATIC MODEL IN THE NORTHERN PART OF THE REPUBLIC OF CROATIA**

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**ABSTRACT**

The focus of this paper is the quality evaluation of the relative height movement kinematic model of the Earth's crust that covers the territory of the Republic of Croatia. This model offers necessary data for the calculation of relative vertical displacements and moving speed of Earth's crust discrete points. Consequentially it can be used for reductions in direct levelling measurements from their surveying epoch to another chosen epoch by the elimination of relative height movement effects. As the quality of the model is not yet unambiguously analysed and determined this paper offers kinematic model quality analysis on the northern part of the Croatian territory. In this area an indirect quality assessment method is used based on levelling measurements accuracy investigation. The measurements accuracy is determined in levelling networks of the 2<sup>nd</sup> order that almost completely cover the northern part of Croatia. Original levelling measurements from precise levelling network (2<sup>nd</sup> order state networks) are corrected for the systematic effect of relative height movements and reduced from their original survey epochs to the mean epoch of so-called Second High Accuracy Levelling Network (1<sup>st</sup> order state network). Precise levelling network is investigated simultaneously at the level of original and reduced measurements, comparing "a priori" and "a posteriori" measurements accuracy criteria. The result suggests more or less successful elimination of the systematic effect of crustal relative height movements from the levelling measurements. Furthermore, the results confirm hypothesis that the kinematic model can be reliably used for the determination of regional relative height changes and regional trends in crustal movements within the centimeter level of accuracy.

Corresponding Author: Marko Radanović

## **SIMULATION OF AN ALTERNATIVE REALISATION OF THE CROATIAN HEIGHT REFERENCE SYSTEM**

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### **ABSTRACT**

The current Croatian height reference system (HVR71) has been established using the so-called Second High Accuracy Levelling Network (IINVT) of the former Yugoslavia. This network survey was realised from 1970 to 1973. Today almost 50 years later, it is quite clear that a renewal of the Croatian height reference system is necessary. The survey and design of a new fundamental levelling network for the Republic of Croatia is an expected step. In Croatian particular case there is a significantly limiting key factor for the levelling network design. That limiting factor derives from the fact that the size and the specific shape of the Croatian territory in comparison with the standards of realization of levelling networks have a negative correlation. Considering the aforementioned facts, a careful and comprehensive analysis was conducted. As a basis for the analysis of this issue, a simulation of the new Croatian height reference system realisation was performed. The simulation is based on the grounds of IINVT network observations which had originally been used to create the current official height reference system of the Republic of Croatia, but with a modification of its geometrical configuration. In accordance with the need for continuous monitoring of height displacements of the same benchmarks that had been observed previously (the recent crustal movements issue), the principle of preserving as big as possible segment of the IINVT network configuration on the Croatian territory had been retained. One of the fundamental elements of the height reference system quality certainly is the quality of the absolute benchmark height positioning. In this paper it is shown how radical change of network configuration due to the adjustments to the specific shape of the Croatian territory affects the accuracy of the absolute benchmark height positioning.

Corresponding Author: Ivan Razumović

**OBSERVATIONS BY SPACE GEODESY METHODS ON OBJECTS OF USING ATOMIC ENERGY**

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**ABSTRACT**

The report provides an overview of the observations of the recent movements of the Earth's crust using global navigation satellite systems (GNSS) at nuclear energy facilities. In 1995-2002 observations were made at the geodynamic test ranges of the Novovoronezh, Kalinin and Rostov NPPs. According to GNSS observations, a conclusion was made about the stability of the site of the Kalinin NPP and it was recommended to take into account the deformations of the Earth's surface in a north-south direction for better design decisions. The creation of a geodynamic test ranges for monitoring the Rostov NPP area on the basis of GPS technology facilitated the state environmental expertise during the launch of the first reactor of the nuclear power plant in 2001. In the area of the construction of the first in Russia deep repository for high-level radioactive waste (Krasnoyarsk region), a geodynamic test range was created to monitor the recent movements of the Earth's crust and a methodology for processing and interpreting geodynamic observations was developed, taking into account the large-scale space-time effect. For the first time, the velocities of horizontal deformations of the Earth's crust have been instrumentally measured for a region located at the junction of the largest tectonic structures-the Siberian Platform and the West Siberian Plate, and the cyclic nature of the geodynamic regime has been established. Completed in 2010-2016, the observations showed that in 2010-2013 the maximum changes in the distances between observation points did not exceed 10 mm per year. In 2013-2014 the activation of tectonic regime was manifested by the change of signs of deformation of compression and stretching of the upper part of the Earth's crust on right bank and left bank of the Yenisei river. The annual rates of maximum change in the lengths of the baseline lines during the activation period reached  $\pm 18$  mm. Mean square errors in terms of plane and height for 2012-2016 were 3.0-3.5 mm and 6.0-7.4 mm, respectively. Taking into account the scale factor, new methodological approaches were developed for interpreting the data, which made it possible to assess the degree of impact of the recent movements of the Earth's crust on the preservation of the natural isolating properties of rock massifs to justify the geoecological safety of high-level radioactive waste disposal in the area. Based on the results of observations, the boundary conditions were established for modeling the stress-strain state of the rock massif.

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## **HIERARCHIZATION OF LAND CONSOLIDATION WORKS IN THE RURAL AREAS OF CENTRAL POLAND**

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### **ABSTRACT**

According to studies carried out by the authors, the development of agricultural production space in the analyzed area resulted in a highly defective spatial structure of agricultural land. The resulting defective spatial structure must be urgently rearranged in line with the achievements of the 21st century. However, land consolidation and exchange cannot be performed in such an extensive area, primarily for economic reasons. In connection with this fact, a hierarchy of needs for land consolidation and exchange works and their urgency must be established using objective methods of assessment. Therefore, this paper aims to determine the needs for land consolidation and exchange in the villages of the gmina of Drzewica, in the powiat of Opoczno, Łódź voivodeship. In administrative terms, the analyzed gmina consists of 17 villages and Drzewica – a town with powiat rights that was not included in the study. The total area covered by the study is 10600.1851 ha. The analyses were based on 24 features describing each of the villages, split into 4 thematic groups. First of the groups (general features) includes the total area of the village, total number of plots, number of inhabitants, average area of plots owned by private owners in respective precincts. The second group, referring to private land, comprises features connected with land owned by private farmers, including: number of registration units in the group of farms, number of plots and average area of plots in those units. The third group is productivity ratios for cropland and grassland. Group four comprises plots without access to roads where the number and area of real properties without access to roads was determined. In the last group the ratios of fragmentation, their average value and percentage of the area of plots covered by orchards and forestland were determined along with the average value of and the synthetic elongation ratio for plots within the precinct. The used features describe the spatial structure of the analyzed villages in detail. The rankings of urgency of land consolidation and exchange works for respective villages were developed using the zero unitarization method and Hellwig's method. Both, for Hellwig's calculations and the zero unitarization method the values of synthetic measures fall within the range [0;1]. These rankings were created by means of synthetic measures of the urgency of consolidation. The measures can be used to classify objects according to the size of multi-theme and multi-feature phenomenon, that is, the analyzed spatial structure of land in the presented gmina.

Corresponding Author: Przemysław Leń

**ANALYSIS OF THE IMPACT OF FEATURES ON THE RANKING OF URGENCY OF LAND  
CONSOLIDATION WORKS**

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**ABSTRACT**

In EU member states the restructuring of rural areas based on consolidation is a common measure, thus Poland's membership of the EU provided an opportunity for developing rural areas through the financial support of such measures. The development of agriculture in Poland and its production capacity is much differentiated in terms of space. One of the reasons for such a situation is the process of long-term transformations of agricultural management in areas with different social and economic situation continuing for many years. The objective of land consolidation works is creating more favourable management conditions in agriculture and forestry by improving the territorial structure of farms, forests and forestland, reasonable configuration of land, aligning the limits of real properties with the irrigation and drainage system, roads and terrain. For the purposes of creating the ranking of urgency of the land consolidation and exchange works in the gmina of Poświętne, 26 most significant features characterizing respective villages were selected. Those features were calculated based on data obtained from the register of land and buildings maintained by the Powiat Administration in Opoczno. The ranking was created using the zero unitarization method. This method allows standardizing diagnostic variables by testing the range of the characteristic. In order to obtain a synthetic measure, mean values are calculated for sets describing the respective characteristic features according to the following formula: Standardized measures fall within the range  $\langle 0;1 \rangle$ . The results can be interpreted as an average of optimum values achieved by each of the objects. Thus, the higher the synthetic measure, the higher position of the object in the ranking being created. The studies were carried out in the rural gmina of Poświętne, situated in Opoczno powiat in Central Poland, which consisted of 17 villages covering a total area of 14081.0 ha. This paper is a continuation of surveys during which the authors studied the impact of single features on the position of respective villages in the ranking. This paper aims to analyze the impact of features on the ranking of urgency of land consolidation works by leaving out 2 or 3 features which described the analyzed villages and checking their impact on the results of the ranking of urgency of land consolidation and exchange works in respective villages within the analyzed gmina.

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## **THE APPLICATION OF TOPSIS METHOD TO HIERARCHIZATION OF LAND CONSOLIDATION WORKS**

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### **ABSTRACT**

The policy of the European Union up until 2020 to be pursued in rural areas is oriented at diversifying their functions. In EU member states, including Poland, the spatial structure of rural areas is the land consolidation process. The basic definition and purpose of consolidation is given in the Act of 26 March 1982 on Consolidation and Exchange of Land where consolidation was defined as a rural management procedure aiming at transformation of the spatial arrangement of rural land in order to create more favourable management conditions by improving the territorial structure of farms, reasonable configuration of land, and aligning the limits of real properties with the system of water irrigation structures, roads and terrain. Undertaking consolidation works which contribute to improving the conditions of agricultural production in all the villages of the analysed gmina simultaneously is impossible, mostly for economic reasons but also with regard to technical and social problems. Works aiming to improve unfavourable conditions should be carried out successively in villages where they are most urgent. For the needs of analyzing the urgency of consolidation works multidimensional statistical methods can be applied. This publication attempts to apply TOPSIS – a linear ordering method. The idea behind TOPSIS is determining the distance between the analyzed objects from the ideal and anti-ideal solution. The final result of the analysis is a synthetic measure which creates the ranking of the analyzed objects. The best object is the one closest to the ideal solution and at the same time farthest from the anti-ideal solution. A number of analyses regarding the spatial structure of the analysed gmina were necessary for the ranking purposes. The study area covers 14 villages of the gmina of Rusinów with registered area of 8279.1709 ha, which accounts for 10.3% of the overall area of the powiat of Przysucha.

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## **VISUAL ANALYTICS OF FOREST AND OTHER ROADS DENSITY**

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### **ABSTRACT**

One of the unwanted consequences of increased motorization and road development is the increase in traffic accidents. That is why more attention needs to be paid to ways of reducing or preventing a large number of victims. This can be achieved through the improvement of basic elements: man, vehicle and road, and regulations, controls and sanctions. One of the projects that assess the road safety is the EuroRAP (European road assessment program) project. This paper presents indicators of development for the road network and presents their value in Europe and Croatia. It will also be linked to the density of traffic and road safety in Croatia. It will define the place of reduced traffic safety and explain the possible causes of accidents in these areas and propose remedial measures. Croatia has the most developed road traffic. Traffic is a result of society's needs and is inevitably linked to many other factors that serve society and we can define their dependence. This paper will show an example of the correlation between highway conditions in hazardous areas and traffic accidents over a period of five years. The section on which the A6 motorway is to be seen. Information obtained by data analysis will be compared numerically and graphically. Spatial analytics and cartographic visualization is the main means of describing the interdependence of the data. Cartographic representations to the user in a convenient way represent the information obtained and allow them to be easier to understand. The paper presents the results of the research of spatial distribution of traffic accidents in Croatia. The results are divided by counties. An example of the accident number data analysis is an example for identifying a hazardous site on the A6 motorway mainly passing through different landscapes. All comparisons and analyses are presented graphically in the form of charts, chart diagrams and other cartographic related views. From the results it can be concluded that there are significant differences in the data obtained between the counties and it is often the case that values are similar for counties similar to the level of development and the same number of population. From the results it is concluded that the number of traffic accidents is more dependent on the population than the length of the road network or the landscape through which it passes over the surface of the county. To invest in the rehabilitation of hazardous sites it is necessary to consider several factors from repeated traffic accidents. Also, we compare the spatial development indicators for the road network of Croatia according to the selected countries in Europe and county counties in Croatia. It also shows the number of traffic accidents per counties and links with indicators of spatial development.

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**ANALYSIS OF THE ACCURACY AND USEFULNESS OF MEMS CHIPSETS EMBEDDED  
IN POPULAR MOBILE PHONES IN INERTIAL NAVIGATION**

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**ABSTRACT**

By using inertial sensors embedded in modern telephones, such as a three-axis accelerometer and a gyroscope, it is possible to determine the position of the user in all conditions, regardless of the place, time or surrounding terrain obstacles. For this purpose, it is necessary to determine the starting coordinates, speed and orientation of the device. The system determining the position of the user on the basis of indications of inertial sensors is called the Inertial Navigation System (INS) and is a part of dead reckoning navigation. The accuracy of the position determined in this way depends mainly on the class, stability and quality of the sensors used. The accelerometers, gyroscopes and magnetometers used in cell phones are made in the MEMS (Micro Electro-Mechanical System) technology, which has been developing dynamically since the end of the 20th century. Sensors, despite their miniature dimensions and weight, are cheap in production and more and more accurate. The article attempts to determine the accuracy and usefulness of popular mobile phones in navigation using the IMU (Inertial Measurement Unit) by determining the coordinates of the user's route. A special script in the Matlab environment was written for comparison analyses of IMU route with the indications from the GNSS receiver. It should be noted that positions calculated on the basis of data from IMU devices were not integrated with the GNSS system in any way. In the practical part, two modern cell phones operating under the Android system, i.e. Sony Xperia M2 Aqua and Samsung Galaxy Note 3 were used to create an inertial navigation system. The measurement was carried out simultaneously with two telephones in three different scenarios. Based on data collected using sensors (accelerometers and gyroscope), subsequent user positions in the geocentric coordinates were determined using the Matlab script. The conducted research has shown to what extent a modern mobile phone can be used to create an inertial navigation system. The achieved results are presented, analysed and discussed.

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**SUPPORTING HYDROGRAPHIC VESSEL VERTICAL MOTION DETERMINATION USING RTS  
GEODETTIC SYSTEM**

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**ABSTRACT**

The paper presents the results of vertical trajectory determination called "heave" of the hydrographic vessel using Robotized Total Station (RTS). A reference water level for bathymetric measurements, the most frequently adopted in surveys on small areas, is not a flat horizontal surface. The water level changes significantly over time and distance. For this reason, hydroacoustic survey is performed on an unstable floating platform. During hydrographic sounding raw data had to be brought to the common water level. To reach the final reduced depth measurements, it is necessary to obtain the precise vertical position of the platform. Usually roll, pitch and heave vessel motion effects are defined by the Inertial Measurements Unit (IMU) sensors. Unfortunately, the slow rise of water level is difficult to measure by the hydrographic inertial system. For this reason, the author decided to use a geodetic RTS measurement system. A modern robotized instrument has been adopted for precise hydroacoustic measurements carried out in situation when the water level was changing slightly over time. The study abstract text is same with describes an experiment conducted on Gdansk Bay in Poland, where the changing vessel height was determined with the use of RTS, Real Time Network (RTN) and Motion Reference Unit (MRU) systems. The final results show that RTS provides sub-centimetre determination of vertical vessel motion. Robotized Total Station proved to be very useful and essential in engineering inland and coastal bathymetric measurements.

## OPTIMIZATION OF THE LAYOUT OF MOTORWAY OVERPASSES ON THE EXAMPLE OF THE A4 MOTORWAY SECTION JAŻWINY – GÓRA MOTYCZNA

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### ABSTRACT

The developed, innovative method of estimating the impact of motorway on agricultural land allows determination of all the losses associated with the directions of this impact. The basis for the determination of losses is the analysis of variability in land use and the quality classes and location of access roads to the land along the axis of the planned motorway. The approved measure of the multidirectional impact of the motorway on agricultural land is a change in the value of land, which is determined with taking into account the differences of their suitability for agricultural production. The developed method of determining the impact of motorway on agricultural land was presented on the example of A4 motorway section between Jażwiny and Góra Motyczna. The existing section of motorway was assessed and then for the same section, the calculations were made again, but with an alternative location of the motorway overpasses (flyovers). In the case of the existing section, the construction of one kilometer of the section of motorway under consideration will result in a reduction in the value of agricultural land of 2119 cereal units. Acquisition of land for the construction of the motorway and its negative impact cover about 78% of the total reduction in value of agricultural land. The remaining 22% of the land value reduction is related to the increase in transport and the deterioration of the plots layout. On the other hand, in the case of the section with alternative arrangement of overpasses, the value of agricultural land is reduced of 2088 cereal units. Acquisition of land under construction and under motorway's toxic impact will be equal 79%, while the combined effect of transport growth and deterioration of the layout makes 21%.

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**THE ASSESSMENT OF THE IMPACT OF THE MOTORWAY ON THE AGRICULTURAL LAND ON THE EXAMPLE OF A4 MOTORWAY SECTION FROM WOLICA PIASKOWA TO CZARNA SĘDZISZOWSKA WITH APPLICATION OF THE AUTHOR'S SIMPLIFIED METHOD**

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**ABSTRACT**

The method of estimation of the motorway impact on the agricultural land presented in this study enables the determination of all losses related to the directions of this impact. The developed method of estimation of the motorway impact on the agricultural land is presented on the example of the section of the A4 motorway running through the villages Wolica Piaskowa and Czarna Sędziszowska of the length about 6.364 km. These are areas located in the Podkarpackie Voivodeship. The construction of one kilometer of the motorway section under consideration will result in a reduction in the value of agricultural land amounting to 867 cereal units. Taking over the land for the motorway construction and its negative impact covers about 76% of the total loss of value of agricultural land. The remaining 24% of the loss in value of land is related to the increase in transport and the deterioration of the plots layout. The author's method for assessing the motorway impact on agricultural land presented in this study takes into account all the most important directions of the motorway's impact on agricultural land, and shows this impact measurably and in comparable units. A very important feature of the applied method is its very low labor intensity compared to other methods of estimating the impact of the motorway on agricultural land. This is the effect of introduced simplifications in the assessment of motorway impact limiting the scope of obtaining output data for the analysis of the course of the motorway axis and automation of the calculations carried out with the help of a developed computer program operating in the Visual Basic environment.

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## **GENERATING OF BUILDING FACADES ORTHOPHOTOPLANS WITH UAV AND TERRESTRIAL PHOTOS**

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### **ABSTRACT**

Scanning technology is currently one of the fastest growing technologies on the market. Many years have passed since the introduction of the first laser scanner and this technology has found its application in various industries. The interest in this subject is still growing. Technological development means that 3D scanners are systematically improved, which directly affects the extension of areas in which they can be used: from surveying and industrial surveys, through medicine, forestry, forensics and many others. Laser scanning allows easy and quick acquisition of three-dimensional data about objects with a complex structure and construction. It happens that this technology allows you to measure in a place where traditional methods would not be possible to use. Laser scanning has revolutionized measurement methods in many areas - one of them is the inventory measurement of historic objects. Research on the use of ground-based scanning for the registration of cultural heritage objects has been conducted for several years around the world. This is evidenced by the growing number of publications on the use of this technology for documentary purposes. The use of this method enables the measurement of complex objects, structures and architectural details with the results obtained in virtually real time, while retaining the millimeter accuracy. The point cloud, the result of this measurement, is an excellent base for creating 2D and 3D documentation. Unmanned Aerial Vehicle (UAV) has become very popular in recent years. Until now, they have been associated with military activities, and now they are increasingly used for both entertainment and commercial purposes in the service sector. Their advantages were noticed not only by photographers, but also by surveyors or designers. In the future, laser scanning with the use of UAV will surely be popularized, which will further expand the field for UAV applications. However, UAV technology now offers results that are inaccessible to manned vessels, taking into account at least the size of the field pixel, low cost and short time of the raid. UAVs are therefore great, as an intermediate tool between terrestrial measurements and traditional large-scale aerial imaging. The study aims to show the possibility of using terrestrial laser scanning and unmanned aircraft as a tool for obtaining high resolution photogrammetric material in order to develop colorful, metric orthoplans and 3D models of an architectural object. The object of the study was the church dedicated to Saint. Bartholomew the Apostle in Mogila and the chapel of St. Malgorzata at Salwator in Krakow.

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## **NECESSITY OF 3D CADASTRE AND POSSIBLE CASES**

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### **ABSTRACT**

The paper describes the current state of cadastre and land registration in Bulgaria. The objects of cadastre are clarified. The necessity of information about rights, restriction and responsibilities increases in complex spatial situations. After a brief review of cadastral and land registration legislation, the possibility of future development of a 3D presentation of the cadastral objects, taking into account the current state of the cadastral system in Bulgaria. The prerequisites, the possibilities and the means for realization and application of 3D cadastre in Bulgaria are clarified and the challenges to its realization. Problems concerning the design of an efficient system for land administration, possible technologies and standards for realization of 3D cadastre are described. The possible data sets, in accordance with ISO 19152, which should be present in the realization of 3D cadastre in Bulgaria are analysed. In addition to the data from the digital model of the cadastre, specialized data is also needed. Some of the specialized objects require a three-dimensional representation, which is a prerequisite for 3D cadastre development. Many of the various specialized objects impose restrictions on land immovable, even though it is not required the presence of the object itself. Schematically describes the steps that go through to unify data and achieve interoperability.

## **ANALYSIS OF APPLYING THE EGNOS SYSTEM IN APV-1 AND LPV-200 OPERATIONS**

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### **ABSTRACT**

The EGNOS satellite system was created, inter alia, to support air operations. In May 2016, the first LPV-200 landing approach in Europe was implemented at the Paris airport. The article presents the results of research on the quality of the EGNOS system, carried out in various places in Poland. Data obtained in real time and in post-processing mode were used for analyzes. 24-hour observational data recorded in 2015 using the Polish TPI NETpro network were used. Research includes a period of low and high ionospheric activity. All data used in the work has been developed for APV-1 and LPV-200 applications. The algorithms described in the documentation characterizing the possibilities of using satellite systems in aviation were used in the work. The calculations were performed in the professional PEGASUS software, which is intended for testing the GPS / SBAS positioning quality in Europe. It was also necessary to use proprietary software - PP\_SBAS\_Analyzer. Summing up the results of research carried out at selected TPI NETpro network points located in Poland, it can be concluded that the quality of GPS / EGNOS positioning depends on the location of the observation. The basis for conducting a more thorough analysis should be weak results obtained for the territory of Poland in the extreme south, where, according to the results of experiments, it is not possible to implement procedures compatible with APV. Noteworthy are the significantly different results of the positioning quality test at some points located only about 100 km apart. Therefore, prior to the application of the EGNOS system in aviation, it seems necessary to conduct local monitoring of the system's operation. The results of the conducted research prove that the quality of positioning using the EGNOS system has significantly improved in recent years and can meet the requirements of satellite air navigation in accordance with APV-1 and even LPV-200.

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**THE EFFECT OF TEMPERATURE CHANGES ON VERTICAL DEFLECTIONS OF METAL RAIL BRIDGE CONSTRUCTIONS DETERMINED BY THE GROUND BASED RADAR INTERFEROMETRY METHOD**

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**ABSTRACT**

The paper describes possibilities of the relative new technique – ground based radar interferometry for precise determining of the effect of temperature changes on vertical deflections of metal bridge structures. The ground based radar interferometry method is used in practice, among other things, for the quick contactless determination of vertical deflections of metallic railway bridge structures. The precision in deflection determination is up to 0.01 mm in real time. At the same time, it is also possible to capture and analyse the oscillation frequencies of the monitored object with a maximum frequency of up to 50 Hz. Deflections are determined at multiple points of the object at the same time, for example on individual cross beams. This allows to obtain both general and detailed information about the behaviour of the structure under its dynamic load and to monitor the impact of vehicle passages or their groups. Moreover, the ground based radar interferometry method is not sensitive to temperature changes. It can therefore to be used successfully to determine the effect of temperature changes on deflections and deformations of metallic objects, such as bridge structures. The influence of temperature changes is of two kinds. First, a direct effect on the very structure causes deformations due to thermal expansion of the metallic material. Furthermore, it is the effect on the character of the dynamic deformations caused by load changes - the transit of vehicles. This character varies with temperature, as demonstrated by experimental measurement in practice. Practical examples from practice documented by experimental measurements are given in the article. For example, at a 75m long metal bridge over a six-hour period with a temperature change of 25°C, a vertical deflection - lifting the bridge deck was about 9.5mm due to the thermal expansion of the material. There has been also a change in the nature of the dynamic deflections caused by train passes. At low night temperatures (about 14°C), deflections were much smoother than at high afternoon temperatures (about 39°C).



**STATISTICAL METHODS FOR THE DETECTION OF NON-MARKET TRANSACTIONS BASED ON DATA FROM THE PRICE AND VALUE REGISTER**

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**ABSTRACT**

The mathematical model for determining the value of real estate, formulated for example for the current needs of individual property valuation, or for tax purposes, should be as transparent as possible, allow the valuation of many properties at the same time, and above all should be a reliable model. Estimating the value of real estate in a comparative approach can be carried out by several methods that have one thing in common, require a thoroughly prepared property base that was traded on the analyzed real estate market. This requires, among others, obtaining data on real estate transaction prices, the date of transaction and selection of relevant attributes, whose values should reflect real estate prices. In the work, a database of real estate for development has been developed on the basis of a register of prices and property values. Because the information contained in the register is very modest and not sufficient to carry out a property valuation, in order to describe the characteristics of the real estate, a record map, information contained in the Geoportal.pl and field interview were also used. The preliminary assessment of the collected material allowed to state that there are real properties in the base, the prices of which have no market characteristics. For correct formulation of any valuation model, it is necessary to detect and eliminate or reduce the impact of such properties on the valuation results. For this purpose, a multidimensional analysis was used and verified on three methods of detecting outliers. The identification of outlier observations based on the model's rests with respect to the standard deviation of the estimation, Mahalanobis metric, which takes into account the information on individual component variances and correlations and Cook distances, connecting the Mahalanobis distances and standardized stanzas, thus constituting a total measure of the impact of individual observations regression line.

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## **INTEGRATION OF 3D MODEL FROM UAV SURVEY IN BIM ENVIRONMENT**

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### **ABSTRACT**

Building Information Modelling (BIM) technology is already part of the construction industry and is considered as a very useful tool. From a survey with an Unmanned Aerial Vehicles (UAVs), using photogrammetry is possible to determine characteristics such as sizes and shape object, volumes, areas, distances, elevations and furthermore the reconstruction of high-quality model. A whole integration between the two methods will become a game changer for the construction sector. In this paper, we present a rapid methodology for 3D reconstruction of bridges using commercial drone and structure-from-motion algorithms to obtain 3D model and as-built drawings, to integrate into BIM environment to improve the inspection procedure decreasing costs. In the first part, we introduce the use of UAV in civil engineering and their application for surveying. Then we focus on the process for 3d reconstruction starting from photos: preparation of image acquisition plan and workflow for building point cloud and obtain as-built drawings. Finally, we present a case study of an integration of a 3D model in BIM environment.

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**SOFT COMPUTING TECHNIQUES AND GPS NETWORKS TO MONITOR AND CONTROL ACTIVE FAULT**

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**ABSTRACT**

The monitoring of geodynamic phenomena is constantly evolving thanks to the use of increasingly refined techniques. The increasing availability of data acquired over time, through the GPS system allows creating specific models able to simulate the situation in question. The prediction of earthquakes is still scientifically impossible: the earthquake is the result of a complex system of factors and events that occur below the earth's crust. Soft computing techniques are known in scientific literature as capable methods for function approximation. Within this framework, they are applied to forecasting time series in non-linear problems, where an estimation of the sample starting from actual measurements is very difficult. In the first part of the paper, we provide the result from a long series of GPS data acquired over time on experimental GPS network straddling the active fault in Castrovillari (Italy). Then, we exploited soft computing techniques in order to find a correlation between the crustal movement and earthquake phenomena, to provide a useful information to refinement of models of geophysical monitoring and prevention of natural disasters in areas of high seismic risk.

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**ACCURACY OF GEOPOTENTIAL MODELS USED IN SMARTPHONE POSITIONING IN THE  
TERRITORY OF POLAND**

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**ABSTRACT**

Effective realisation of both land and sea transport has always required the determination of safe and fast routes. In the era of technological progress and modern technologies, the classic methods of navigation and paper maps have been practically replaced by satellite positioning and marine electronic maps. The degree of occurring changes is evident in the common use of mobile phones and tablets in car navigation and recreation. Among the determined geolocation data in these fields, only the ellipsoidal longitude and latitude of the receiver are most commonly used. Knowledge of these coordinates is sufficient to present the position on the maps available online or offline. The third of the coordinates, ellipsoidal height, finds particular application in some areas of recreation, such as mountain climbing or cycling to present the differences in elevation along the track. However, the ellipsoidal heights related to the reference ellipsoid, excluding some regions of the Earth, are not identical to the normal heights used widely in many European countries. The conversion of ellipsoidal heights into normal heights takes place through the use of geopotential models that are currently commonly implemented in the GNSS modules of smartphones. Geopotential models, which are discrete sets of quasigeoid spacing values from the reference ellipsoid, allow interpolation of the local undulation value added later on to the determined ellipsoidal height of the receiver. The publication will present the results of the conducted comparative analysis of geopotential models of selected telephones with the EGM2008 model developed by The National Geospatial-Intelligence Agency (NGA). The analysis will concern the results of measurements carried out in selected regions of Poland. The cohesion of both geopotential models will be shown, which directly translates into the correctness of the heights computed by the phone receiver. The conducted research proves the occurrence of significant distortions in the calculated values of undulations. The examined issue, in the perspective of the rapid development of personal navigation and the increasing accuracy of the receivers of mobile phones, is an important factor affecting the credibility of the positioning results.

## SHOCK-WAVE CONSOLIDATION OF BORON AND CARBON CONTAINING ULTRAFINE POWDERS AND INVESTIGATION THEIR STRUCTURE/PROPERTIES

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### ABSTRACT

The unique properties of the ultrafine grained composites, makes them attractive for aerospace, power engineering, machine and chemical and other practical applications. Carbon and Boron based composites are important and on high demand because of their specific properties and wide areas of application. It must be noted that SiC, TiC, TiB<sub>2</sub> and B<sub>4</sub>C are characterized with high hardness, wear resistance, corrosion resistance, they have high melting temperatures. Therefore, they find wide application for preparing the details to working at high temperatures and aggressive media. According to the phase diagrams in the selected systems, the composites/intermetallics may be obtained with wide spectrum of phase composition, in crystalline and amorphous structures. Depending on the composition and structure, the synthesized composites exhibit different specific properties. The potential of the system for development of new structural/composite materials in different thermodynamic conditions is very attractive. Nano structured composite materials of Ti-Al-Si-B-C system, prepared in the form of micromechanical blends, solid solutions and intermetallic compounds are of great practical interest because of improved mechanical properties in comparison with coarse grain material (>1 μm). The methodology and technology for the fabrication of bulk materials from ultrafine powders of Ti-Al-B-C and Si-B-C systems are described in the paper. The crystalline coarse Ti, Al, Si, C powders and amorphous B were used as precursors, and blends with different compositions of Si-C-B, Ti-Al-B-C and Ti-Al-C were prepared. The powders were mixed according the selected ratios of components to produce the blend. For Mechanical alloying (MA) the high energetic "Fritsch" Planetary premium line ball mill was used. Ratio ball to powder by mass was 10:1. The time of the processing was varied from 2 to 5 hours with rotation speed of 500 rpm. For the consolidation and bulk sample formation Explosive Compaction (EC) technology was used. The experiments were performed at room temperature. The shock wave pressure was varied in the range of 5-20 GPa. The ultrafine powders and bulk compacts of different compositions were prepared for investigations. The microstructure was studied by SEM and the effective regimes for obtaining nanopowders and nanocomposites in Ti-Al-Si-B-C composition has been established.

Corresponding Author: Mikheil Chikhradze

**DETECTION TECHNIQUE FOR *COCHLODINIUM POLYKRIKOIDES* RED TIDE USING GOCI LEVEL 2 DATA AND MACHINE LEARNING**

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**ABSTRACT**

*Cochlodinium polykrikoides* (*C. polykrikoides*) are representative harmful algae causing red tide in South Korea. The most frequently *C. polykrikoides* red tide occurrence in the central Sea of Korea is the mixed with turbid water area (high concentration of CDOM (Chromophoric Dissolved Organic Matter) and SS (Suspended Solids)) and clear water area. *C. polykrikoides* bloom in clear water can be detected using Chlorophyll-*a* anomaly or Optical property of sea water based method. However, in the case of turbid water, there are many limitations when applying the method used in the previous research. In this study, we tried to extract *C. polykrikoides* red tide pixels from Level 2 data of GOCI (Geostationary Ocean Color Imager) using machine learning technique. Logistic regression model, decision tree model, and artificial neural network model were used for red tide pixel detection. 306 pixels were sampled from GOCI image in red tide occurred area, clear water area, turbid water area, respectively. 70% of data sets were used as training data sets, and the remaining 30% were used as verification data sets. The accuracy of detection was higher in the order of logistic regression model (97.82%), artificial neural network model (94.54%) and decision tree model (86.18%). As a result of applying the machine learning technique, it was confirmed that the accuracy improvement was much higher than the previous studies (less than 60%). The ability to classify the red tide pixels as red tide was similar in all 3 models. However, in the artificial neural network model and the decision tree model, there were a case of confusion between the clear water pixels and the red tide pixels. In particular, the decision tree model showed a lot of cases what red pixels were classified as clean water compared to the other two models. As a result of applying the model to the satellite image, three models showed similar detection ability when the red tide occurred. However, in the case of no red tide occurred, it was confirmed that a large number of red tide pixels were detected in the decision tree model. Comprehensively, it was confirmed that the detection accuracy was higher than that of the previous studies when the machine learning technique was applied to detect red tides in satellite images. However, the decision tree model has a high rate of false positives even during non-red tide period, which is unsuitable for using the early warning of red tide.

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## COMPARATIVE STUDY OF SATELLITE IMAGES AND UAV IMAGES FOR SPATIAL RESOLUTION RESAMPLING

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### ABSTRACT

Monitoring using traditional satellite-based remote sensing can acquire periodic data on river areas. However, local monitoring such as droughts, floods, and river environments are difficult to identify due to the low spatial resolution, and there is a limit to the periodic use that is required due to the specific return visit period. On the other hand, UAV (Unmanned Aerial Vehicle) image has superior time resolution and spatial resolution compared to satellite images, and is economically inexpensive and easy to operate. Also, periodic operation is possible if necessary. This study aims to utilize satellite images and UAV images for river basin monitoring. Prior to this, the satellite images and the unmanned aerial images are compared. The sensor mounted on the UAV is MultiSpec4C, which has green (550 nm), red (660 nm), red edge (735 nm) and NIR (790 nm) bands. October 30, 2017. It was photographed at the upper stream of Hapcheon-Changnyeong weir, and was produced as a single orthoimage with a spatial resolution of 33.98 cm. Satellite images were taken from Sentinel-2 MSI images of ESA taken on the same date. MSI images have 10, 20 and 60 m spatial resolution per band. Band 3 (560 nm), Band 4 (665 nm), Band 6 (740 nm) and Band 7 (783 nm) of Sentinel-2 MSI were used for comparison with unmanned aerial images. The UAV image was resampled to match the satellite resolution of 10m using Mean, Median, Max, Min, Majority. The results show that the resampling using the mean has the highest correlation in all bands (The R-values were Green = 0.92, Red = 0.95, Red Edge = 0.89 and NIR = 0.91). In the comparison of images using the well - known NDVI (Normalised Difference Vegetation Index) and NDWI (Normalized Difference Water Index) ratio functions, the resampling using the mean showed a high correlation (The R-values were NDVI = 0.97 and NDWI = 0.97). This result shows that the resampling method using the mean is effective in comparing the satellite image and the UAV image for monitoring the river basin.

Corresponding Author: Hong-Joo Yoon

## **ALGORITHM FOR AUTOMATIC PATH ROUTING IN MOUNTAIN AREAS**

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### **ABSTRACT**

The main purpose of the research is to achieve fully automated technique for calculation of new trails in the mountain areas. The main idea is to provide user with a possibility to move around the area regardless of the existing routes, which can make user independent of using trails. Such concept is nowadays getting a lot of attention due to the growing need for revitalisation and enabling new areas to be used for tourism and educational purposes. Moreover, proposed solution can become a useful tool for emergency services, foresters or park employees. The main project assumption was to create a tool able to find a new path between two locations given a set of input parameters provided by the user. The new path had to be distinct from any existing paths in the area. The algorithm was designed to be a solution for path routing in poorly recognised areas or within big acreage as it can take a long time to explore the area in enough details to manually create a plan of the new path. The result of the project is the new ArcMap toolbox, built with a help of spatial analysis tools of the ArcGIS platform. The project uses GIS methods, taking advantage of remote sensing, spatial analyses and Python scripting. This makes it possible to create an automatic tool that is able to process various data in relatively short time (comparing to manual work on planning new path). As the end result algorithm generates a map with least cost path, which after conversion to GPX file is ready to use with supporting devices, e.g. a smartphone. The project has been verified in surroundings of Gorczański National Park in southern Poland. Performed tests allowed to find optimal settings and proved that an algorithm works correctly.

Corresponding Author: Katarzyna Adamek



## **APPLICATION OF AREAL CHANGE DETECTION METHODS FOR POINT CLOUD DATA**

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### **ABSTRACT**

Surveying techniques such as Terrestrial Laser Scanner have recently been used to measure surface changes via 3D point cloud (PC) comparison. Since there are no signalized points when using laser scanners and no identical points between two epochs, judging an object change detection can only be based on areal methods. A surface based analysis is able to detect changes that are unknown and spread along the whole surface. Existing methods for point cloud comparison and the source of uncertainties are reviewed in the first part of the paper. Current comparison methods are based on a closest point distance or require at least one of the point cloud to be meshed. Better results can be achieved with using Least Square Adjustment of polynomial surfaces (planes and quadric height functions) applied on point cloud data. Special attention is paid to computing normal vectors on a cloud with local modelling (best fit plane, 2D triangulation or quadric height function). Direct comparison of point clouds in 3D could be made in two steps: (1) surface normal estimation and orientation in 3D at a scale consistent with the local surface roughness; (2) measurement of the mean surface change along the normal direction. Examples for change detection based on measurements obtained from terrestrial laser scanning for several objects in Bulgaria with different geometrical shape (free form, double-arc and linear) are given. Several methods for comparing two point clouds are used and the obtained results are analyzed.

Corresponding Author: Gergana Antova

**CONTRIBUTION OF REMOTE SENSING FOR GEOLOGICAL STUDY OF THE SOUTH – EAST OF  
CONSTANTINE BASIN, NORTH OF THE ALGERIA**

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**ABSTRACT**

The main objectives of this work are to map and characterize network of likely fractures to develop major deposits carbonated in the region. It is a contribution to a better knowledge of the geometry of existing surface fractures networks and their extension in subsurface. For this it appeals to the tool of remote sensing and seismic. Using remote sensing data, our study enabled us to draw up a card lineamentire, along with tectonic analysis, where we could list 409 lineaments divided into 9 classes according to their directions, among which: the main directions of the NW/SE fracturing are: H (N1300-N1500), G (N1100-N1300) and F (N900-N1100). These three classes are in agreement with the major flaws of the region, which are: the fault of Biskra-Outaya, Ouinet-Morsott-Tébessa and the dextres form. Of after the deferential work carried out on the South East Constantine area, and the results obtained by the seismic reflection, as well as the well data, summarizes our reservoirs are characterized by a mainly low to medium porosity and low permeability, these tanks are carbonated, and are affected by the majority of vulnerabilities detected on the surface, but these do not contribute to the improvement of the Petrophysical characteristics This can be reported to the clogging of the cracks.

**STRUCTURAL EVOLUTION OF THE MIDDLE ZONE BETWEEN THE VAULT OF MEHAREZ AND DEPRESSION OF ABADLA DURING THE PALEOZOIC: BECHAR REGION, SAHARIAN PLATE FORM**

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**ABSTRACT**

Bechar basin is located North-West of the Saharan platform. This is a vast Algerian mining area little explored. He is known by its tectonic complexity, which is one of the causes of the poor understanding of the oil system and the poor obtained results. Different stratigraphic unconformity and different tectonic phases are responsible for the destruction of potential hydrocarbon deposits. The main purpose of this work is to understand or identify the structural evolution of the region of junction between the dome of Méharez and depression of Abadla during the Paleozoic. Carboniferous represents the land exposed in the region and presents the layers very important which are of the order of 6000 m in the deep basins. Structural analysis, we see that the area is complicated by faults in different directions. The study of seismic highlights a direction reverse faults F1, which coincides with the beginning of the upper area of Loucha-Méharez in the West who played the role of geodynamic barrier, and a direction F2 of normal faults, which dominate and correspond to the deepening of the basin. The structural evolution shows the succession of three important phases that have contributed to the structuring of the region: A phase antéviseenne extensive, responsible for the start of burial of a basin subsides. A phase the beginning Visean, responsible for generalized subsidence of the basin to the Namurian and lower Visean and a phase compressive post - Namurienne responsible for the formation of the folds of overlap of NE-SW direction. The State of maturity of organic matter is closely related to the evolution paléostructurale of the region. Active subsidence phases correspond to the cooking of organic matter and the phases of uplift delay maturation. The main traps defined in the study area are structural, stratigraphic, and reef, not affected by this structuring Carboniferous.

Corresponding Author: Moussa Sadaoui

## **VISUALIZATION OF SPATIO-TEMPORAL BUILDING CHANGES USING 3D WEB GIS**

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### **ABSTRACT**

The use of mobile devices and applications has increased dramatically over the last decade. In 2014, there was more mobile than standard desktop PC users. The significant technological progress provides intuitive and innovative ways to design web/mobile solutions. Modern standards such as HTML5 and WebGL enable three-dimensional scenes to be visualized on phones and tablets. Modern laser scanning methods and photogrammetric techniques allow for quick data acquisition and semi-automatic construction of 3D scenes of entire areas. These allow achieving better management, research, protection, and promotion of places and cities. To date, there is no universal methodology that would allow using historical data to reconstruct the situation from previous periods and visualize changes of building facade using the web. This article presents currently available technologies allowing to create a universal solution for both desktop and mobile platform. They allow integrating up-to-date three-dimensional models with products created based on historical data. An interactive web application presenting the spatio-temporal changes of buildings in two study areas was presented (campus of the University of Warmia and Mazury and the Old Town of Olsztyn). The potential sources that allow the building of three-dimensional structures based on historical data were described. The proposed architecture is universal and easy to implement. The content displayed on the map is determined by the timeline slider, which allows presenting changes in the building facades over time. Each building has its own attributes, some of which also have one or more 3D models. In the end, the potential stages of the system's development were presented, including the possibility of participating volunteers in the process of obtaining historical data and using the augmented reality to present 3D models of the buildings directly in the field.

Corresponding Author: Tomasz Templin

**INNOVATIVENESS OF MAKING SPATIAL DATA AVAILABLE AS AN ELEMENT OF BUILDING AN INFORMATION SOCIETY**

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**ABSTRACT**

The economic development of the state is to a large extent dependent on the consciousness and knowledge of the society. It is in the government's interest to expand this awareness and knowledge through the administration. Modern computer technologies, the Internet and the development of information transfer and making available technologies create new opportunities for popularisation of the knowledge through e-administration. In the European Union countries, general rules for the development of the spatial information infrastructure have been defined in the European Parliament Directive - Inspire. The article presents the adjustment of the Polish spatial information infrastructure to the European Union regulations, principles of building an information society, websites providing geo-spatial data, implementation projects in this area and criteria for assessing the level of maturity of this type of services. The article also presents the possibilities of use of these data for commercial purposes and scientific research and the benefits to society obtained through the making these data available.

Corresponding Author: Jacek Gniadek

**CHANGES IN THE SPATIAL STRUCTURE OF AGRICULTURAL LAND AND THEIR INFLUENCE ON THE RESULTS OF AGRICULTURAL PRODUCTION**

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**ABSTRACT**

The results of the research included in the study concern the analysis of the spatial structure of agricultural land, belonging to non-resident owners for the object in the south-western Poland. The basic surface element adopted for the research was the continuous part of the registry parcel, covered by a one form of use. The specialized computer programs were used for the research and made it possible to obtain and process the necessary information contained in the land and building registry documentation maintained in a digital system. The adopted technology has allowed obtaining dozens of spatial configuration features of the surveyed parcels, which in the next stage were the subject to detailed research. The analysis covered eight basic features of the parcels layout, the first four of which determine the spatial parameters of the parcel, two further features concern the estimated cultivation costs dependent on its layout and the last two describe the location of the parcel in the village and in the farm. The obtained result gave the basis for finding positive and negative sides of the examined fragments in the existing land system, pointing to the disadvantages and limitations, resulting from changes made over the years.

Corresponding Author: Jacek Gniadek

## MONITORING OF BALCOVA LANDSLIDE TRIGGERD FROM IZMIR FAULT

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### ABSTRACT

Landslides may be considered as natural disasters; considering the geological and the geographical features of Turkey and the misuse of land, landslides cause serious financial damage and a possible loss of life. Most of the research, concerning landslides, is carried out with physical inspection creating the possibility for accidents thus, only covers areas with high landslide hazard risks. Therefore, in accordance with the ever-innovating technology, researchers prefer methods that can detect and scan the avalanche hazard areas remotely. Light Detection and Ranging (LiDAR) also known as laser scanning system, is one of the ground-based remote sensing equipment which provide detailed and highly accurate 3D data. LiDAR systems can store spatial information as a group of x, y and z coordinates and these data can be used in other computer-aided design software for creating models and making engineering calculations. There are two types of LiDAR systems are exist today based on acquiring platforms, these are; airborne (ALS) and terrestrial (TLS). Main purpose of this study was to observe the earthquakes caused by the Izmir Fault Line, chosen for the study, while making use of the data obtained with the LiDAR method, determining the scale and the speed of the (mass) activity in the avalanche hazard area and how the buildings and public areas are affected by it. The Balçova and Narlıdere neighborhoods were chosen for the ground-based system LiDAR method to be used to observe and research landslides frequently found in these areas. Two field study was carried out in 6 months and LeicaScan Station II terrestrial laser scanner was used in the study area. The LiDAR data were resolved to 0.07 m × 0.07 m (horizontal × vertical resolution) at 150 m from the scanned surface. Point to point comparison method was used to monitor the landslide and the results were mapped.

Corresponding Author : Oğuz Yasin Özsoy

## THE COMPARISON OF THE WEB GIS APPLICATIONS RELEVANT FOR 4D MODELS SHARING

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### ABSTRACT

The paper presents the results of the project: Cultural Heritage Through Time (CHT 2, <http://cht2-project.eu/>) realized in the framework of the "Joint Programming Initiative in Cultural Heritage" JPI-CH (<http://www.jpi-culturalheritage.eu>) by international consortium: Politecnico di Milano (IT), Newcastle University (UK), Salamanca University (ES) and Stanislaw Staszic Scientific Association SSSA (non-profit organization), (PL). Aim of the project was integration of 3D models of buildings, cities and landscapes for monitoring and preservation of cultural heritage. Research were conducted on three levels of detail according standard CityGML: LoD0 – regional, landscape scale, LoD1/LoD2 – urban scale, LoD3 – architectural scale, level of detail - building outside. Basing of this assumption four test sites were selected: i. the city centre of Milan (IT) – urban scale, ii. the Medieval walls and historic centre of Avila (ES) - urban/architecture scale, iii. Hadrian's Wall and its landscape (UK) – landscape scale, iv. the Fortress Cracow (PL) - architecture scale. The different approaches have been used to create time-varying 3D scenarios: 1) In regional, landscape scale (LoD0) digital aerial photogrammetry and airborne laser scanning (ALS), as well the use of re-photographing techniques coupled with GIS systems, allowed analysis of the same scenarios at different times, with the possibility of comparing image-based or ALS-based DTMs with historical maps. Using this 4D approach it is possible to highlight the transformation of a landscape through time and to hypothesize future changes due to anthropogenic and natural factors. This type of knowledge is a key factor for all those entities (e.g. cultural, political, or administrative) responsible for managing a territory. 2) In architectural scale (LoD3) Terrestrial Laser Scanning (TLS) and close-range photogrammetry were used which allowed for detail 3D model generation and can be starting point in object reconstruction and analysis of objects transformations through the time. 3) Urban scale (LoD1/LoD2) is between regional scale and architectural one and all mentioned above technology were applied in used in this case to varying degree and the method was called as hybrid one. Final 4D models were published in the Internet. In the paper state-of-the art of the technology of 4D models sharing in the Internet is presented. 4D models were understood as 3D models solid one and point clouds changing through the time. Results of the practical initial tests of different software (commercial: Hexagon and CityEngine from ESRI and open-source: 3DHOP and Potree) are also shown. Web site: <https://cht2.eu/> was created where 4D model are placed for all partners.

Corresponding Author: Ewa Glowienka



## **EPM FOR SOIL LOSS ESTIMATION IN DIFFERENT GEOMORPHOLOGIC CONDITIONS AND DATA CONVERSION BY USING GIS**

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### **ABSTRACT**

Techniques like remote sensing and GIS are nowadays applied to evaluate erosion risk. The real use of GIS comes from the ability to integrate spatial information as well as statistical and analytical processes to derive spatial patterns not readily apparent to the observer. Various methods/models have been developed to assess erosion intensity, soil loss, production of erosive material, sediment transport etc. The Erosion Potential Method (EPM) is the most used method for erosion risk assessment and development of erosion maps for Western and Central Balkan countries. The main aim of this project is to construct a GIS overlay model with the use of some basic GIS analytical functions according to the EPM. The study area covers two regions with different geomorphologic conditions. Significant erosion processes as well as sedimentation processes are visible on the field, especially intense erosion, as gullies, landslides, rock falls and talus cones which are not taken into consideration with other more commonly used methods in Europe. EPM will be employed in the GIS environment for soil loss estimation in  $m^3/km^2/yr$  as initially imposed by this method, and later data will be converted in  $t/ha/yr$  as imposed by the more commonly used methods in Europe, which will consequently give an idea about the applicability of the EPM model in different geomorphologic conditions to obtain compatible and comparable results with the results obtained from other methods.

Corresponding Author: Mohamed Elhag

## **THE EFFECT OF HERBICIDES PARAQUAT AND GLYPHOSATE ON THE EARLY DEVELOPMENT OF TWO TEST PLANTS**

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### **ABSTRACT**

The publication deals with the effect of herbicides paraquat (PQ) and glyphosate (G) on germination and early development of standard test plants – garden cress (*Lepidium sativum* L.) and radish (*Raphanus sativus* var. *radiculata* L.). PQ has proven environmental toxicity and its usage is forbidden in Europe, while G is widely used in agricultural practice. Pollution of soil and surface water with pesticides can cause a reduction in biodiversity and species abundance, alteration in the structure of populations with consequent degradation of terrestrial communities. Besides their ability to bioaccumulate and biomagnify along the trophic chains and thus remain in the biotope over a long time in increasing concentrations, they can inhibit seed germination and early development of young plants in ecosystems. The ecotoxicology tests were conducted with 200 µM, 350 µM, 500 µM, 650 µM, 800 µM, 950 µM and 1100 µM herbicides concentrations, and a control – distilled water. The number of germinated seeds (Ek) and viable sprouts (K), length of stems and roots, and absolute dry weight of stems, roots and leaves were used as parameters for identifying the pesticides impact. The ecotoxicology tests showed a generally pronounced higher toxicity of PQ compared to G. In addition, the genetic analysis using ISSR markers showed that plants respond to herbicide stress through changes at DNA level that are in general dose-dependent and, at least partially, stress-specific.

Corresponding Author: Silvena Boteva

**THE PRINCIPLES FOR THE APPLICATION OF VIBRATION INTENSITY SCALE FOR THE PREDICTION AND ASSESSMENT OF THE IMPACT OF ACTIONS THE EXPLOITATION OF THE MINE ON BUILDINGS AND PEOPLE**

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**ABSTRACT**

In this paper the validation results of the validation of the selected scales to assess of the impact of seismic tremors on the subsoil in area with mining exploitation on properties with engineering structures is presented. Here are shows the results of the work carried out within the framework of the verification scale analysis of selected cases, the damage to the buildings. After the made analysis most cases showed no effect design solutions, for modern structural systems and traditional constructions of buildings, on the type and form of damage occurring as a result of the action. Analysis of damage on selected cases allowed on the modernisation of the existing borders of the degrees of intensity in the selected scales, which was presented in this publication. Characteristics of shock effects mining buildings is constantly modified and updated every describe final results paper. In the form of updates the description of the consequences of the impact of vibrations from quakes mining on buildings for the needs of the individual scale development was on the basis of the most recent experience gained in this field, made using observation actual effects of mining shock in buildings from between years 2014-2017. A comparison of the existing and the revised scales passes the boundaries between the various degrees of intensity of the impact of mining on buildings or structures and the people in them. The revised scales cater to compliance with data empirical findings. The in this paper results of the statistical data and analysis, modelling of selected representative cases give better results as to predictions from the reality are shows.

**APPLICATION OF ANALYTICAL AND NUMERICAL METHODS FOR SIZING THE PILLARS OF THE  
BOUKHADRA IRON MINE - ALGERIA**

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**ABSTRACT**

The main purpose of this work is to size of the mine the iron mine of Boukhadra. Several problems related to the strains and the rock instabilities of are encountered frequently, especially in the favorable zones with the laps and faults. And this happened during the progress of the exploitation activities. These problems may cause short, medium and / or long-term subsidence and collapse at the surface of the mine. Consequently, these affect seriously the safety of workers, the cessation of production and even in any case the closure of the mine. The magnitude of these effects depends on the structure of the massif, the mechanical and physical properties of the rock mass, the state of the exploited areas and other natural factors. In this paper, we have proceeded to the determination of the main parameters of the room and pillar mining method such as the dimensions of the pillars and the distance between them by the analytical and numerical methods relating to the evaluation of pillar stability and exploited spaces. The main goal of this study is to achieve an optimal rate of ore extraction and an allowable safety factor. The application of UBC method gave us a safety factor equal 1, 4 to and an extraction rate of 80 /. As for numerical modelling with the application of Plaxis 2D software, the results obtained are as follows: low total displacement of the order of  $10^{-6}$  m. The results of this study show the similarity of the values obtained by both the analytical and numerical methods.

Corresponding Author: Mohamed Laid Boukelloul

## **MINING CAPITAL COST ESTIMATION USING NEURO-FUZZY COMPUTING TECHNIQUE**

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### **ABSTRACT**

High initial investment in open pit mines requires an acceptable estimation of capital expenditure (CAPEX). Mining CAPEX estimation always is a challenging issue, because, both of overestimating and underestimating of capital cost can lead to project failure. Overestimating may undervalue the profitability of the project, even it can lead to become an uneconomic project, as well as underestimating may postpone the construction and accordingly the production phases. Up to now, capital cost estimation models could not estimate mining CAPEX in a reliable range of error. For this reason, in this study, to develop a reliable cost model, the economic data of 52 porphyry copper mines is collected. Due to the inherent complexity of mining CAPEX estimation, the most effective parameters are selected, by using principal component analysis process. Finally, based on the gathered data from Infomine, using a neuro-fuzzy computing technique, an ANFIS cost model is developed. According to the results, the fitting error obtained from the ANFIS model lies in a reliable range of error ( $\pm 10\%$ ). Since, the wide range of data dispersion is used in the model construction process, the presented model can be used for estimation of mining CAPEX in all domain of mining scale.

Corresponding Author: Morteza Osanloo

**MODELING AND ANALYSIS OF UNDERGROUND PILLAR STABILITY: CASE OF MINE CHAABET ELHAMRA, ALGERIA**

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**ABSTRACT**

Room and pillar mining is extensively used by small to medium scale Zinc and lead mining in Algeria. This method provides a good alternative for stratiform/stratabound "monto" type deposits and advantageous due to its simplicity and requirement of little information to be used. It is probably the most representative method among the total load approach methods although it also remains a safe design method. A critical aspect for this method-in both technical and economical terms-is the pillars design in order to obtain a good stability and an acceptable mineral recovery. Using a finite element software (PLAXIS 3D), analyses were carried out with an elasto-plastic model and comparisons were made with methods based on the total load approach. The present paper describes the results were presented as the optimization for improving the ore recovery rate while maintaining a safe working environment.

Corresponding Author: Radouane Nekache

**ASSESSMENT OF SEISMIC HAZARD IN RELATION TO ROCK-BURST PREVENTION MODIFICATIONS  
IN KGHM POLISH COPPER JSC POLKOWICE-SIEROSZOWICE MINE, POLAND**

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**ABSTRACT**

The Polkowice-Sieroszowice mine is one of three underground copper ore mines in Poland. These three mines belong to KGHM Polish Copper JSC, excavating one of the largest copper ore deposits in the world. The deposit is situated in the south-western part of Poland in the Lower Silesia province. Due to the specific and difficult geological-and-mining conditions in the three mines, seismic events occur which often result in an excavation serious damage defined as the rock-burst or elastic recovery. Such the dynamic phenomena have been occurring since 1972 and have posed the most dangerous natural threats in underground workings. Therefore, the mining technology has to take the account of seismic hazard prevention. Numerous preventive measures adjusted to the conditions prevailing in the given operating field have to be applied so that the hazards can be mitigated, fought or limited. The appropriate choice of prevention activities must be preceded by measurements and observations, which constitute different methods for identifying, predicting and assessing the condition of the rock mass as well as for evaluating the protection effectiveness. In the Polkowice-Sieroszowice mine the rock-burst prevention involves: assessment of rock mass state and active, technological, and organizational-technical methods for combating the hazard. The active prevention consists in blasting works which provoke the rock mass to distress itself and thus to reduce its capability to accumulate elastic energy. The technological prevention embraces yielding the edges of the walls and pillars in the place of development, the extraction of the deposit with a wide opening of the front and the adjustment of the size of the technological pillar to the local geological and mining conditions. The organizational-technical measures introduce after-blasting waiting time and high hazard zones where the number of employees should be reduced. The influence of changes and improvements in the prevention activities on the seismic hazard was analysed and determined. The effectiveness of prevention methods was assessed in connection with their modifications, which concerned certain elements of active methods, the pillar size changes and alterations in the frequency of rock mass observations. Most of these modifications resulted from the operational progress and had a little impact on the seismic activity. Nevertheless, the effectiveness of such alterations was calculated. The research was carried out for one mining division in the Polkowice-Sieroszowice mine over the period of 2013-2015 years. The increase in the effectiveness of seismic/rock-burst prevention in most cases resulted in reduction of seismic activity.

Corresponding Author: Anna Barbara Gogolewska

**MODELING OF AERODYNAMIC PROCESS FOR COAL WASTE DUMP LOCATED IN  
GEODYNAMICALLY DANGEROUS ZONE**

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**ABSTRACT**

Previously made evaluations show confinedness of fire coal waste dumps to geodynamically dangerous zones which in this work are considered as borders of active blocks of the earth crust. According to the hypothesis under development, when disposing the dumps in geodynamically dangerous zones (GDZ) which have a high penetrating, aerodynamic relation of the dumps with the environment occurs, making the dumps firing possible. Firing of the dumps inflicts environmental, social and material damage. This research is aimed to study possible mechanism of gas mass transfer through GDZ into the body of dump on the base of computer modeling of aerodynamic processes. A relevant geometry model is developed, borderline conditions are proven and modeling of aerodynamic process is shown in the work. Taking into account actual data on location and characteristics of firing dumps of a region of Eastern Donbas (Rostov region, Russia) calculation are performed by means of ANSYS software. A dump located in GDZ is modeled. The GDZ is set in the model as a highly penetrating linear zone in the rock, which has a deep emplacement. The GDZ crosses mine fields and has an expression in relief of the Earth surface. Temperature of the rock within the dump may reach 420 degrees Centigrade. Petrophysical characteristics are taken into account in the model (porousness and permeability) of its main structural elements, dimensions of the dump, width of GDZ, difference of relief heights, depth of mine workings location under the dump. The results of the modeling show influence of the dump temperature, petrophysical characteristics of the model structural elements, depth of the mine openings location on aerodynamic processes within the dump mass. Operability of the model at the preset border conditions allows to deeply argue the hypothesis of the air intake into the dump body with consideration of the local geodynamics. According to the results obtained, geodynamic conditions of mining area where coal waste dumps are disposed, may be and are an important factor, which has an effect on creation conditions for spontaneous combustion of dumps and its further impact on environment.

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## APPLICATION AND DEVELOPMENT OF THE METHOD OF GEODYNAMIC ZONING ACCORDING TO GEODYNAMIC HAZARD FORECASTING AT COAL MINES IN CHINA

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### ABSTRACT

In China, the method of geodynamic zoning had three periods of its development: “formation”, “development”, and “innovation”. At the first stage, a significant preparatory work was performed, and the investigations were carried out to identify the geodynamic hazard zones at the Beipiao coal deposit field. At the second stage, models were created linking the block structures of the crustal tectonic plates and coal minefields, the work was continued on the geodynamic zoning of deposit fields deemed being of dangerous rock bumps occurrence. At the third stage, a program was developed for calculating the stress state of the rock massif, taking into account the data on geodynamic zoning. A model of multifactorial recognition of dangerous sections of minefields by sudden outbursts and rock bursts has been developed, and the corresponding research has carried out at the coal deposit fields. Investigations of the connection between the energy of a rock burst and the size of the massif area involved in this process have been carried out, followed by the creation of the corresponding model. The effectiveness of the method of recognizing areas of an increased geodynamic hazard was provided during the work using examples of particular mines. For the Yue Jin minefield, outburst's dangerous, threatened, and non-dangerous areas have been identified. For the Jingxi minefield, rockburst's dangerous, threatened, and non-dangerous areas have been identified. It is recommended to apply preventive measures based on the results of the forecast being conducted to improve the geodynamic safety in mining.

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**TO THE RE-USING OF DATA ON ROCKBURSTS FOR UP TO DATE RESEARCH OF THE  
GEODYNAMIC SAFETY PROBLEM**

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**ABSTRACT**

Nowadays, anthropogenic seismicity during mining operations is actual in many countries around the world. Strong rockbursts and anthropogenic earthquakes cause not only large material damage but also social and environmental impact. At that, the major geodynamic events and sudden seismic activity remain statistically rare events that makes it difficult to study these phenomena and to find out regularities. Uniqueness of their occurrence conditions and, often, inaccessibility of information contribute to such state of affairs. At that, rockbursts were known since the 19th century and information on conditions of their occurrence is available in published papers and special catalogues. It seems that use in summarizing and analysis of the data on strong rockbursts occurred in the past at the deposits worldwide could contribute to a better understanding of a nature and mechanisms of anthropogenic earthquakes which take place today. In this connection, a problem on the rockbursts data re-using for search of the anthropogenic seismicity regularities has been arisen. In paper, structure and content of the published in the Soviet Union and Russia special catalogs and international bibliography indexes on rockbursts are analyzed. The data available in the catalogs and publications can be used for studying and confirming of some studying regularities related to the reactivation of tectonic faults, presence of tectonically strained zones, occurrence of geodynamic hazard far from the place of mining works. It is concluded that repeated analysis of the data on the rockbursts occurrence at the deposits worldwide on the basis of up-to-date geomechanical concepts will allow extending the statistical basis for search and identification of the anthropogenic seismicity regularities.

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**NUMERICAL RESEARCH OF OXIDATION ZONE VARIATION IN GOAF OF LONGWALLS U-TYPE SYSTEM FROM BORDERS AND U-TYPE SYSTEM TO THE BORDERS VENTILATED**

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**ABSTRACT**

Endogenous fires are significant hazard in the Polish and global underground mining industry. These fires are result of spontaneous combustion of coal due to the inability to discharge heat from the oxidation process. One of the main places of occurrence of endogenous fires are goaves in longwalls. By endogenous fire we mean self-ignition of coal, caused by a process of self-heating of coal (leading to increase in temperature), and under endogenous fire hazard possibility of coal self-ignition as a result of its self-heating process in mining heading or its surroundings. Hazard of endogenous fires in these goaves are formed due to the airflow with determined velocity and specified chemical constitution. The velocity of air stream mainly depends on the type of rocks forming the stroke and applied longwall ventilation system. In the paper results of numerical research of airflow through goaves ventilated in U-type system from borders and U-type system to the borders are presented. The aim of the analysis was to determine in these goaves a oxidation zone. For determined mining-geological conditions, the critical value of velocity of airflow and oxygen concentration in goaves, conditioning initiation of coal oxidation process were determined. Modelling studies carried out basing on the developed methodology included in its scope the study of spatial models of exploitation longwalls being ventilated on the U-type system from the borders and U-type system to the borders and its goaves. Results of tests and analyses, as well as conclusions presented in this article should be a valuable source of knowledge, and could be used in the practice of choosing exploitation longwall ventilation system and ventilation parameters of the air.

## NUMERICAL SIMULATION APPLIED IN IDENTIFICATION OF ROOF BED SEPARATION FOR MINING THICK COAL SEAM UNDER NAPPE STRUCTURE

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### ABSTRACT

In China coalmines, economic losses and human casualties inflicted by roof bed separation water have been acutely severe in recent years. This article takes the engineering case, mining thick coal seam under nappe, in Xinji No. 1 Coalmine in Huainan mining field. Given the low tensile strength of lower roof bed under large mining heights, numerical simulation is applied to No. 1307 fully mechanized top-coal caving (FMTC) working face by coupling elastoplastic finite element model (FEM) in rock mechanics with “no-tension analysis” (NTA) to map out, in the roof bed, pattern of stress distribution and the maximum heights of caving zone (37m) and of water-conductive fractured zone (98.5m), quantitatively delineating the location of bed separation. Specifically, bed separation F is the closest to the water-conductive fractured zone (by merely 1.93m) and of a maximum width of 6.4m, flagging a major threat to mining safety. These results are further corroborated by exploratory drills. Research outcomes can be of reference to other coal-mining countries when identifying bed separation and treating related water hazards during mining under complex geological conditions.

Corresponding author: Herong Gui

## THE EFFECT OF SAMPLE DIMENSION ON THREE AND FOUR POINTS BENDING TESTS OF FINE CRYSTALLINE MARBLE AND ITS RELATIONSHIP WITH DIRECT TENSILE STRENGTH

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### ABSTRACT

The indirect tensile strength test methods such as three and four points bending tests and Brazilian tests have been commonly used to determine tensile strength and other mechanical properties of rocks since it is a quick, easy, and inexpensive testing method. These testing methods are most commonly performed according to ISRM, ASTM, and EN standards. The effect of sample dimension for a consistent three and four points bending value has not been well defined in previous works. Sample dimensions of three and four points bending tests were suggested differently from each other by EN and ASTM. The aim of this study, in order to analyze the effect of sample dimension on bending strength property of fine crystalline marble and is to determine the direct tensile strength of rock by using new dumbbell shape. Indirect tensile strength of marble will be determined by using three and four-point bending test methods according to related standards. It will also be investigated that whether the relation is existing between direct and indirect tensile test results. In addition to experimental study, stress distribution and stress intensity on the sample will be analyzed by using ANSYS. As a result, it will be determined that indirect methods which have different sample dimension (three or four point) is appropriate for determining of tensile strength of marble according to numerical and experimental results. It will be proposed a new coefficient for estimating true tensile strength of marble from the indirect test results. In addition, most suitable sample dimension will be determined for indirect tensile strength (three or four-point bending tests) of marbles.

Corresponding Author: Servet Demirdag

## DETERMINATION OF THE DIRECT TENSILE STRENGTH OF GRANITE ROCK BY USING A NEW DUMBBELL SHAPE AND ITS RELATIONSHIP WITH BRAZILIAN TENSILE STRENGTH

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### ABSTRACT

The tensile strength is commonly used for determining the load bearing capacity of rocks, their deformation, damage and drilling, blasting, fracturing, crushing, etc. It is also used to analyze the stability and serviceability of rock structures. Therefore, determining of uniaxial compressive strength and tensile strength of rocks are very important especially in terms of stability and safety. Uniaxial compressive strength of rocks are widely used for determining these parameters in the design of engineering excavation due to simple, fast, and reliable. However, many researchers also have indicated that the tensile strength of rocks can be used effectively as a design parameter. Different test methods for determining the tensile strength of the rock material have been used. These are direct and indirect methods. Direct methods are more expensive and time consuming in general. The indirect methods have been used up till now because it is simple, cheap and easy to application. Although these methods widely preferred and accepted, there are some problems on determine of true tensile strength of rocks. In the literature, there are huge amount of studies on predicting tensile strength of rocks from indirect methods. When considering empirical data obtained from these methods, it has been seen different results. In this study, the determination of the direct and indirect tensile strength of granite rock will be carried out in compliance with related standard test methods. In order to analyze rock tensile strength between direct (with using a new dumbbell shape) and indirect (Brazilian tensile strength) test methods will be conducted and obtained results will be compared between them. A new dumbbell shape samples will be used in direct tensile tests and cylindrical specimens which have different t/D ratios such as 0.5, 0.75, and 1.0 will be used in Brazilian tests. Moreover, stress distribution and the stress intensity within the sample will be analyzed with Finite Elements Method and numerical modeling techniques by using ANSYS R.14 software. As a result of this study, a new approach will be proposed for the experimental determination of true tensile strength of granite rock from Brazilian test method.

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**THE APPLICATION OF SEISMIC MONITORING AND NUMERICAL MODELING FOR THE ASSESSMENT OF THE POSSIBILITY OF SEISMIC EVENT OCCURRENCE IN THE VICINITY OF ORE REMNANT**

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**ABSTRACT**

Seismic and rockburst hazard is one of the basic problems associated with deposit exploitation in many underground mines. Rockbursts are responsible for many mining accidents, and their effects: damaged excavations, destroyed equipment and machinery, generate financial losses and disrupt the operational continuity of the mining facility. Dynamic phenomena occurrence is one of the major natural hazards in polish underground copper mines in Legnica-Glogow Copper Belt (LGOM). The degree of seismic hazard in the LGOM, depends among others on the great depth of the copper deposit exploitation, high-strength rock layers in roof strata, the ability of rock mass to accumulate elastic energy as well as an increasing amount of mining works to be carried out in difficult geological and mining conditions, for instance in the vicinity of remnants. The purpose of this paper is to show the influence of ore remnant on the possibility of seismic event occurrence by seismic activity analysis and numerical modelling. The possibility of using numerical modelling to back calculation of the occurrence of a seismic event, as a result of sudden shear rupture, is also presented. Analysis were conducted for the case study of Polkowice-Sieroszowice polish underground copper mine for the room-and-pillar mining system with room deflection. For the selected mining field, quantitative analysis of seismic activity in connection with the mining situation in this field were performed. The location of the tremors epicentres in the context of the existing geological and mining situation was also analysed, paying special attention to the impact of remnants and dynamic phenomena located in their vicinity. Then, the back analysis of deposit exploitation by room and pillar mining system with roof deflection in the selected mining field was performed. Numerical simulations were conducted in a plane deformation state by means of Phase2 v. 8.0 software, which is based on the finite element method. The results of seismic and numerical analysis show that undisturbed rock remnants may have a negative impact on the seismic and rockburst hazard in the mining field. Analysis show that on the edge of rigid remnant sudden fracturing of roof strata may occur, as a result of exceedance of shear strength (shear rapture). This may cause a high-energy mining tremor, and under the appropriate conditions, may result in the rockburst phenomenon.

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**STABILITY ASSESSMENT OF HEADINGS SITUATED IN A FIELD OF HIGH HORIZONTAL STRESS IN  
POLISH COPPER MINES BY MEANS OF NUMERICAL METHODS**

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**ABSTRACT**

The tests on three-dimensional stress pattern in Polish copper mines made in 2012 confirmed the occurrence of high horizontal stress in the Legnica-Glogow Copper Belt. No procedures (criteria) have been defined for proper selection of mining support for mining headings situated in a field of high horizontal stress. This is why, for a long time now, as mining works progress in deeper regions of the rock mass in the Legnica-Glogow Copper Belt, there is a need to identify the problem and define criteria (procedures) in order to ensure long-term and safe functioning of mining headings, particularly those being driven under unfavorable geological and mining conditions. These procedures should include, inter alia, values and directions of high horizontal stress. This article concerns the problem of access headings stability and preparatory headings stability driven in a field of high horizontal stress in Polish copper mines. This problem is very important due to the special safety requirements for mining headings that have been in use in mines for over a decade. The finite element method (FEM) was applied to assess the stability of mining headings under the conditions present in one of the copper mines in the Legnica-Glogow Copper Belt (the Polkowice-Sieroszowice copper mine). Rock parameters for numerical modeling were determined on the basis of the Hoek-Brown classification. RocLab 1.0 computer software was used for this purpose. Stress field parameters were determined on the basis of underground tests performed in the Polkowice-Sieroszowice copper mine in 2012. Numerical modeling was performed by means of RS2 software in a triaxial stress state and plane strain state. 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 headings situated in a field of high horizontal stresses by rock bolts is presented.



## CUT-OFF GRADE OPTIMIZATION FOR BAUXITE ORE SELECTION FROM MULTIPLE PITS

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### ABSTRACT

Determination of cut-off grade is a complex task in dealing with multi element ores that are mined from different pits. The Bauxite ore contains a variety of elements namely alumina and silica. In order to determine whether a given block is ore, the common procedure is that if any block whose metal content exceeds a cut-off value is ore, and whose content in each contaminant is below an appropriate cut-off value. This problem fits into a binary linear programming model. The objective of the model is ore tonnage maximization at a given target grade. One assumption of the model is the free selection of blocks inside the final pit limits. The method uses a self-adaptive differential evolution algorithm to solve the model and selects those ore blocks that meet the blend requirements, such that any block satisfying the requirements is accepted as ore and others are rejected as waste. When the method is applied to multiple pits with different grades, it is found that ore tonnage at target grade is maximised if different cut-off is used in different pits. It is shown that this model provides maximum ore tonnage when compared with the traditional cut-off grades

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## THE QUANTITATIVE IMPACTS OF ROYALTIES ON A SUSTAINABLE MINE PLAN

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### ABSTRACT

The role of mining industry in sustainable development is important; since raw material is essential to improve life quality in a region. The variability of mineral and energy prices has motivated the governments around the world to incorporate in royalty taxes into their mineral taxation regimes with respect to national policy-making. These taxes are means for governments to hinder or encourage the amount of investment flows in mining projects for reaching to the sustainable development goals. Moreover, in terms of responsible mining, mining companies should evaluate the impact of these taxes on the economy of their projects. This paper examines the valuation of a gold project in the presence of royalty taxes and the role of the project over the sustainability of the region. In that regard, real options Monte Carlo simulation is used to characterise the different exposures of the mining company and of the government to the risky cash flow that they receive from the project. The key conclusion of this work for governments and mining companies is that the impacts of royalties on a mining project are identified, and the results are used to improve the mine plans.

Corresponding Author: Mehdi Rahmanpour

**IDENTIFICATION OF OPERATING MODES OF LOAD-HAUL-DUMP VEHICLE IN UNDERGROUND COPPER ORE MINES**

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**ABSTRACT**

The main purpose of this paper is to identify the operating modes of the load-haul-dump vehicle, which is used to copper ore haulage from the mining face to the discharge terminal. The load-haul-dump vehicle works with the bucket loader and is used when haulage distance is within the range of about 250 - 1500 m. The work of this vehicle might be consider as cyclic. One complete cycle of load-haul-dump vehicle includes the following processes: a. filling up of the cargo box by loader, b. driving with full box to unit discharge terminal, c. unloading of the cargo box, d. driving with empty cargo box to the mining. There is an on-board monitoring and diagnostic system installed in c.a. 100 machines in considered company. It allows for a continuous monitoring of selected parameters of the machine, c.a. about 30 operational parameters of the machine. Each variable is sampled every 1 second. Thanks to developed segmentation algorithm, usage of selected signals allows to extract information about the number of courses completed and the duration of individual processes etc. The developed algorithm uses three variables: engine speed, driving speed, fuel consumption. Validation was performed for several working shifts. The result is a set of operating indicators indicating the number of all cycles, the duration of individual processes as well as the total duration of completed cycles and the effective time of work. The algorithm can be used to evaluate the efficiency of the operator's work, more effective planning of the haulage process. It can also be used as a basis for calculating more advanced analytical algorithms (e.g, determining the fuel consumption characteristics, efficiency of co-operating machines on haulage).

Corresponding Author: Mariusz Kościelny

**INFLUENCE OF NATURAL AGING PROCESSES IN STEEL CORD CONVEYOR BELT ON ADHESION BETWEEN CORE AND COVERS**

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**ABSTRACT**

The paper presents the results of adhesion strength tests of the rubber covers to the core of a conveyor belt type St 3150. The investigations focused on four conveyor belts from the same manufacturer, produced in 1987, 1998, 2007 and 2016. The tests demonstrated that the values of adhesive strength decrease with time. The decrease of this parameter was caused by the natural aging of belts operated in a mine and therefore exposed to various atmospheric factors such as variable ambient temperature, snow, rain and solar radiation. The results of adhesion strength tests of the cover to the steel cord served to evaluate the usefulness of such belt in further operation on belt conveyors. The evaluation was made with regard to the admissible values for belts operated in a mine.

**ESTIMATION OF PURCHASE AND REPLACEMENT COSTS OF CONVEYOR BELTS AND THEIR SPLICES IN AN UNDERGROUND MINE BASED ON THEIR DURABILITY**

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**ABSTRACT**

A cost model for the purchase and replacement of conveyor belts using the average durability of belts and splices of various types (including adhesive and vulcanized one) was developed for a hypothetical underground mine using continuous belt transport. For the given belt purchase prices and costs of belt segments splicing in the loop, variant cost models of belt maintenance were made. The influence of various factors on the total costs of belting, including such factors as: belt prices, splicing costs, durability of belts and their joints, type of splicing, time and costs of planned and emergency belt replacements, were investigated. The analyzes were carried out without taking into account random differences in durability, therefore the confidence interval for total costs for the given confidence level was not presented. Data from users were used for calculations. They were not preceded by any statistical analyzes of actual belts and splices operating times. The results are therefore of qualitative rather than quantitative nature, nevertheless they should accurately reflect the level of costs and the impact of the analyzed factors on its changes.

Corresponding Author: Mirosław Bajda

**GRAIN SIZE DISTRIBUTION OF COPPER ORE AS MEANS FOR QUALITATIVE EVALUATION  
OF ITS LITHOLOGICAL COMPOSITION**

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**ABSTRACT**

Information about the grain size distribution of a material plays an important role in optimizing production systems in various branches of industry. Analysis of particle size distribution in the run-of-mine material is frequently employed to verify the quality of drilling and blasting operations. Adequate software and improved grain size identification technologies not only help to monitor and evaluate the results of blasting operations, but also inform the selection of blasting methods which best correspond to particular geological and mining conditions both in surface mining and in underground mining. The accuracy of indirect, image-analysis methods used in the identification of grain size distribution motivated some pilot works aimed at using the grain size to evaluate the quality of a lithologically complex copper ore deposit. Describing the run-of-mine material fed to the Ore Enrichment Plant (OEP) with the use of its grain size distribution may improve the techniques currently employed to optimize the energy efficiency of ore treatment processes. A model of ore flow in the underground transportation system, developed in the FlexSim environment, as part of the DISIRE research project, may prove a valuable optimization tool. This paper presents the results of preliminary research aimed at verifying whether grain size distribution of the run-of-mine material correlates with its lithological composition. The examinations covered grain size distribution in copper ore transported on belt conveyors in two mines in which the extracted ore has different lithology. The research was performed with the use of photogrammetric techniques and the Split Desktop 4.0 computer application. The advantage of the proposed technique is that it can be used at any location in the mine. The analysis was performed on the photographic material collected in situ at the "Lubin" mine. This material was supplemented with qualitative data stored in the Run-Of-Mine Ore Monitoring system (further: MOPRONA), as defined on the basis of channel samples collected on the day of tests.

Corresponding Author: Robert Król

## **GUIDELINES FOR ORE TRACKING SYSTEM IN THE COMPLEX UNDERGROUND TRANSPORTATION GOT FROM THE DISIRE PROJECT**

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### **ABSTRACT**

Tracking of a mined ore is now considered as one of the key issues for the needs of improvement of the whole value chain of metal production. Ore beneficiation processes (grinding, milling, floatating) aimed to increase the metal recovery and decrease the energy use as well as reconciliation of mining production depend on the identification of a mined ore. However, even if the ore is recognised at mining faces (with the help of analysis of channel samples and orebody modelling), after being mined it is blended on its way from various mining fields to the processing plants. In a complex transportation system consisting of belt conveyors with switching points, ore bunkers and shafts, batches of mined ore become anonymous. Following the growing needs of getting the knowledge from the transported or processed raw material, the DISIRE research project (within the Horizon 2020 framework program) was carried out in 2015-2018. It was focused on investigation of the Process Analyser Technology (PAT) tags for annotating the transported or processed bulk material for the needs of its further processes control and optimisation (economic, decrease of energy use). The DISIRE work package "Non-ferrous mineral processing" was devoted to implementation PAT tags for the identification of conveyed copper ore in the underground mines to get the data necessary to improve the ore processes settings control. The complex investigations consisted of the analysis of available data from existing information systems, tests of the use of labelled tags in the harsh operational conditions of the underground mine, digital experiments of simulating the ore flow throughout the transportation system, the specific modelling of the ore particles movement inside the shaft ore bunkers with the use of Discrete Element Method. These main research activities were supported by supplementary investigations like application of picture recognition techniques for differentiation of various ore batches and statistical analysis of ore loading process (by trucks from mining fields). The processing of the real data as well as the numerous in-situ experiments have proved the possibility of the application of PAT tags for the needs of ore tracking and allowed to set the guidelines of the ore tracking system. The ore tracking system should be based on the dedicated simulation model of the mine transportation system, supported on-line by the data from existing information systems that monitor mining production and machinery control. As the mining transportation system is subjected to frequent changes, PAT tag experiments should be repeated to validate the simulation model. Ore bunkers play a key role in ore mixing which should be identified with the help of DEM modelling. All investigations were done on the basis of the chosen KGHM S.A. underground mine set of real operational data. The copper ore mined in these mines is considered as one of the most complex in the world (and the most difficult to be processed), so the implementation of the ore tracking system would be of great value for the more effective ore processing.

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## **THE INTERNAL CLIENT AND EFFICIENCY IN THE MINING PROCESS**

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### **ABSTRACT**

A sequence of intentional actions carried out within a fixed period of time by means of a specific set of machinery and equipment and with specific resources (materials, energy, human labor and financial and information resources) creates an industrial process. Sometimes the definition also includes the fact that industrial processes should be repeatable. An industrial process is often mistakenly classified as being synonymous with a production process. Many authors, including mining specialists, perceive the basic process in the mine without much consideration, as being a specific type of production process. The fundamental process in the mine (regardless of the method of mineral extraction) is not a production process owing to the lack of manufacturing processes within it, and the product research and development processes typical of manufacturing companies do not occur here, as the deposit - the natural accumulation of a particular mineral exists prior to the decision-making process regarding the start of the extraction. In the article, the authors analyze the efficiency of the extraction process from the perspective of processes within a mining company and working time efficiency and effectivity of longwall shearers. Presented are the current working diagrams of a longwall shearer and changes in its speed as shown in the E-mine reports, as well as changes in the shearers effectivity (working time with cutting) of the same longwall shearer in the time available (month) in one of one hard coal mines following the implementation of pro-efficiency adjustments. The authors indicate that the adoption of a process approach in hard coal mining has great potential for the improvement of the work efficiency of this equipment.

Corresponding Author: Małgorzata Wyganowska



**PETROGRAPHIC STUDY AND IRON ORE TREATMENT DEPOSIT OF GARA DJEBILET TINDOUF**

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**ABSTRACT**

The iron ore deposit "Gara Djebilet" is one of the largest iron ore deposits in Africa, with three (3) billion tons of reserves. The latter has not been the subject of treatment studies. sufficient minerals, showing the delicacy of finding a suitable treatment method to reduce the levels of harmful elements namely phosphorus. As this is mainly intended for the steel industry, the presence of phosphorus in the iron ore; generates microcracks in the crystal lattice of iron after the metallurgical melting, which makes the steel brittle and reach the plasticity of the elasticity stage. The purpose of this study is to reduce the levels of impurities in iron ore, especially phosphorus to provide ore that meets the quality standards that the requirements of steel producers. The ore was processed by the high intensity wet magnetic separation (HIMS) method which yielded insignificant phosphorus reduction values of 0.46 MP<sub>2</sub>O<sub>5</sub> (%), followed by a leaching operation to extract the portion of the metallic iron while again reducing the harmful element content such as phosphorus as previously indicated to make the ore tradable in accordance with international standards.

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## RECOVERY OF CHROMITE FROM PLANT TAILINGS BY FALCON CONCENTRATOR

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### ABSTRACT

Nowadays, the importance of low grade deposits and tailings has increased due to the increasing demand for chromium, decreasing reserves and declining grades by the production of high grade chromium deposits and developing technology. It is expected that in the future low grade chromium ores will be the only source used in the production of ferrochrome. The objective of the present study was to investigate to recovery chromite from Sivas -Kangal-Çamözü chromite plant tailings assaying 4.95% Cr<sub>2</sub>O<sub>3</sub> by using a Falcon Concentrator. The effect of operating variables such as grain size, centrifugal forces and water pressure have been studied. Concentration experiments have been performed at rotation speeds of 20 G, 30 G, 40 G by keeping water pressure constant on different grain sizes of -600µ, -500µ, -300µ, -150µ and -75 microns. Chromite grade and yield values at different variables were investigated. The identification and chemical compositions of the chromite was determined by XRD and XRF. By using L40 type Falcon Concentrator a concentrate assaying of 13% Cr<sub>2</sub>O<sub>3</sub> with 63.03% recovery was obtained from Sivas-Kangal-Çamözü plant tailings at 30 G rotor rotation speed with -150 micron feed grain size at 40 kPa water pressure. It was found that the degree of liberation is an important parameter for Falcon Concentrator. At -600µ, -500 µ and -300 micron grain sizes by increasing rotor rotation speeds the grades of chromite decrease and yields are increase. On the other hand, experiments conducted -150 micron grain size showed grade and yield are both increases. Higher grades were obtained by using low rotor rotation speeds.

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## THE PROPERTIES OF THE ROCKS USED AS AGGREGATE IN DIYARBAKIR AND VICINITY

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### ABSTRACT

Different rocks from almost all geologic ages, ranging from the Silurian Devonian to the Quaternary, are exposed in Diyarbakir and its vicinity. This rock variety, which having different ore formations, can be regarded as an industrial raw material used in cement and marble industry. In this study, the formations which are used as an industrial raw material and form the source of aggregate production are investigated. As it is known, aggregates are considered in two groups as naturally occurring aggregates and aggregates formed by crushing and grinding. Natural aggregates are composed of sediments ranging from silt-sized to large blocks carried on the edges of rivers and streams. Since these sediments are accumulated from different areas, they are usually in the form of a compacted mixture of abrasion-resistant silica. This aggregate type, which is distinguished as the current alluvium and the old terraces, is exposed in the streams of Dicle River Valley and in such different branches of the Dicle River as Batman Creek and other streams. Up to recent years, the aggregates were obtained by sizing from the alluviums in the stream beds and occasionally passing through a small amount of crushing; however, as a result of some measures taken by the state for the protection of stream beds, the aggregates are now being obtained by using crushers. Due to not dissolve and pulverize in the crushers, relatively compacted limestones and basalts are used during the crushing process. Their usability as an aggregate has been determined by the tests performed on the rocks collected from the geological units. As a result, the most suitable geological units for aggregate production by crushing-screening in Diyarbakir region are determined as Karacadag basalts and Lower Miocene Euphrates Formation limestones. The samples taken from other geological units were subjected to different tests in the laboratory and their suitability for aggregate production was examined.

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## THE EVALUATION OF OIL FIELDS IN AND AROUND DIYARBAKIR IN TERMS OF PRODUCTION

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### ABSTRACT

This study aims to give information about the oil production of 42 Oil Fields and the wells of each field in Diyarbakir and the surrounding area where is geologically located at the boundary of Anatolian plate and Middle Eastern oil region in the Southeastern Anatolia of Turkey. The structure of oil reservoirs at this region, the interaction of oil and water at the reservoir, capping mechanism of reservoir oil and water are the given topics about the reservoir. Average drilling depth of oil wells at the surrounding area, chemical structure and physical properties of production formations, calculation of production rate, pump types and selecting the suitable type of pump for several production rates, advantages and disadvantages of the pump types are also the other given information about the region. Moreover, regional evaluation of the oil and water ratios, API gravity of produced oil, salinity and pH values of produced water are mentioned by using the analysis of samples taken from the wells in different regions of Diyarbakir province. The other purpose of the study is to inform about stocking of produced oil and water by using surface systems, separation systems of oil from the water, injecting of separated water to water injection wells, analysing the down hole and surface equipment failures for production wells and environmental effects of oil production. Giving information about the economical aspect of the oil production for Turkey and Diyarbakir region is also one of the other goal. Solutions are offered for the encountered problems during the production, separation, transportation, and the refinery processes of there serves in Diyarbakir city of Turkey, that imports most of its petroleum and natural gas use despite being very close to relatively large reserves.

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## ORGANIC GEOCHEMICAL PROPERTIES OF OIL SEEPS IN THE SOUTHEASTERN ANATOLIAN REGION (TURKEY)

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### ABSTRACT

In this study, The Organic Geochemical features of The Oil Seeps and Asphaltites have been determined by analyzing 80 samples of Oil Seeps and Asphaltites that were taken from 80 different petroleum/bituminous oil seeps throughout SE of Turkey. In this context, the main total organic carbon (TOC), Rock-Eval pyrolysis analysis, thin layer chromatography, column chromatography, gas chromatography and gas chromatography mass spectrometry and GC-IRMS analysis were performed. The Oil Seeps in the studied locations were classified as fluid oil, impregnated in the rock, solidified oil traces and oil-and gas waters. Southeast Anatolia Region samples present 1.5-73%, TOC value, Tmax, 416-474, Hydrogen Index, 0-778 mgHC/gTOC, Oxygen Index as 6-442 mgCO<sub>2</sub>/gTOC. The solid samples of the seeps in HI-Tmax diagram and Hydrogen Index diagram, Oxygen Index diagram are generally distributed in the field of TYPE II-III and TYPE III kerogen. The samples having high total organic carbon are mentioned as migrated hydrocarbons. In the evaluation of thin-layer chromatography; polar compounds were formed dominantly and the saturated hydrocarbons were extremely low. The amount of hydrocarbon has been determined to be in the range of for Southeast Anatolia and 0.002g. The total extract amounts have been determined to be 26-438202 ppm in Southeast Anatolia Region. The samples evaluated in Gas chromatography analysis showed that n-alkanes distribution is in the range of n-C<sub>23</sub>-n-C<sub>32</sub>, light inserts suffered from bio-degradation and Pr/Ph ratios are not usually apparent or smaller than 1 as in Kilis samples. Gas Chromatography-Mass Spectrometry analysis indicated that the compositions of the samples are within the range of C<sub>30</sub>-C<sub>35</sub>, and hopans are determined to be dominant. C<sub>27</sub> and C<sub>28</sub> peaks are dominant compounds. GC-IRMS chromatogram of Southeast Anatolia Region samples presented <sup>13</sup>C range as (-) 30.94-(-) 18.96 and have an average of -15.00. In the light of the values held, the Petroleum/Bituminous mechanisms of the samples mentioned in geological environments, and their source rock correlations, formation conditions and migrating mechanisms were tried to be determined.

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## GRINDABILITY OF REFRACTORY BRICK WASTES

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### ABSTRACT

Refractory materials are ceramic materials which are designed to resist high temperature, corrosive liquids and gases, mechanical and thermal stresses. Refractor materials are replaced at the end of its utilization and changed with their new one, the old ones are stocked and removed away. The old refractory materials with their utilization completed can be used as means of raw materials with recycle technologies. Depending on its further utilization in industry, they are crushed and size reduction is carried out, and they are replaced with raw material, and also they are gained as an economical value. In order to carry out size reduction, ball mills are generally being used in this field. In size reduction processes, particles are harder to be ground finer sizes as particle size distribution gets finer and finer, and depending on this amount of consumed energy is increasing. For this purpose, optimum condition between size reduction and energy consumption had been widely investigated. Recently some new types of ball mills are designed. Ball mills (stirred mills) is structured as a media consisting of a grinding vessel, ball and stirrer. There is water jacket around the body of the mill so that it doesn't get so warm. Mostly the grinding vessel is filled about 70-85 % with grinding media such as zircon balls, quartz, aggregates, steel, ceramic and etc. Grinding operation can be performed either dry or wet conditions. Grinding in these kinds of mills, abrasion and shearing forces are being more effective. The experiments were carried out in a lab scale stirred ball mill which has an engine with 2.2 kW power, and rotational speed of stirrer can be arranged. In order to carry out the experiments, Siemens Midi Master 1500 frequency inverter was used to arrange various rotational speeds and time. Body of the vessel is 2945 cm<sup>3</sup> and it has a net volume of 2825 cm<sup>3</sup> subtracting the pins and stirrer body and 40 % of this volume is filled with balls. 6 mm, 4 mm, 2.36 mm balls and a mixture of each in one third ratio was used. Sample is weighed to fill 90 % of the volume between balls. The original sample was collected from a Refractory Brick Company waste yard. Experiments were carried out with 300 kg of sample. And this sample was crushed with a cone crusher to the size ranges of -2360+1700 µm, -1180+850 µm, -425+300 µm and it was prepared for milling experiments. As increase in rotational speed, finer the size distribution of the product was obtained. And as expected, a final product size distribution in a specific time period of grinding with high speed of stirrers can only be achieved with longer time periods if the lower the rate of stirrer speed. Observing of the change in the grinding media size, 6 mm balls are the best ones in terms of less time of grinding. Decrease in grinding media size, fragmentation rates are decreasing.

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**FUZZY LOGIC APPLICATION FOR UNBURNED CARBON PREDICTION ON A SPECIFIC 55MW THERMAL POWER PLANT BASED ON EXPERIMENTAL CHARACTERISTICS OF COAL**

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**ABSTRACT**

In this study, properties of coal which was being utilized to local thermal power plant was studied. Coal samples which had been exported from coal suppliers were shipped almost every month of the period of one year of this study. The plant under investigation was a newly built and it was being operated with a second hand boiler. After some months of operation and stabilization of combustion of pulverized coal inside that specific boiler, the problem of high amount of unburned carbon was faced. Having high amount of unburned carbon in ash is not only economic loss for a plant but it also means the less potential of ash usage in many fields such as cement additive. The main two specific reasons of high amount of unburned carbon problem are simply either due to coal characteristics or operation conditions. Designed boilers operate with specific coals and effective combustion with a well-designed boiler suitable for that coals results with less percentages of unburned carbon in ash. It should either coal specification be proper to boiler and boiler operation conditions or the other way around. In the scope of this study, some coal characteristics analyses (size distribution, proximate and ultimate analyses, petrographical analyses, spontaneous combustion propensity analyses, thermal activity) were carried out and each coal samples were characterized. Not only feed coal samples of the plant were analyzed characteristically but also the amount of unburned carbon in fly ash corresponding to utilization of that specific coal sample was determined. Finally, any possible relation between that coal analyses results and unburned carbon amount was executed. In order to obtain a correlation between coal characteristics and amount of unburned carbon, fuzzy logic and membership functions were employed. While employing fuzzy logic, some limitations to each analyses results were determined, which would end up a helpful decision tool for plant operators in order to compromise with a coal supplier.

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## **FUZZY LOGIC APPLICATION TO PREDICT SLAGGING-FOULING POTENTIAL ON A SPECIFIC 55MW THERMAL POWER PLANT BASED ON EXPERIMENTAL CHARACTERISTICS**

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### **ABSTRACT**

In this study, properties of coal which was being utilized to local thermal power plant was studied. Coal samples which had been exported from coal suppliers were shipped almost every month of the period of one year of this study. The plant under investigation was a newly built and it was being operated with a second hand boiler. After some months of operation and stabilization of combustion of pulverized coal inside that specific boiler, the problem of slagging and fouling inside the boiler was faced two-three times. The main issue was mostly the slagging inside the boiler and it ended up one week or more of no operation of the power plant. Having more than high enough temperatures inside the boiler and utilizing not proper coals mostly the main reasons of slagging. Stabilization of temperature inside the boiler was at least realized however the problem of slagging was still outstanding time to time (depending on variation of coal suppliers). Some coal ashes have less melting points than the others and ash composition changes respectively. As it is already known from the empirical equation of slagging and fouling potential, not only the coal ash melting temperatures but also ash composition is important factor in terms of this problem. In the scope of this study, some coal characteristics analyses (size distribution, proximate and ultimate analyses, petrographical analyses, spontaneous combustion propensity analyses, thermal activity) were carried out and each coal samples were characterized. Not only feed coal samples of the plant were analyzed characteristically but also the ash samples were analyzed in terms of composition and melting temperatures. Finally, possible relation between coal&ash analyses results and slagging-fouling potential was executed. In order to obtain a correlation between coal&ash characteristics and slagging and fouling potential, fuzzy logic and membership functions were employed. While employing fuzzy logic, some limitations to each analyses results were determined, which would end up a helpful decision tool for plant operators. They would be able to avoid high slagging-fouling potential coals before the utilization throughout the plant.

Corresponding Author: Serdar Yilmaz



**THE USE AND CHARACTERIZATION OF HEKIMHAN-MALATYA-TURKEY HEMATITE ORE AS CERAMIC GLAZE PIGMENT**

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**ABSTRACT**

In the present study, the characterization and the possibility of the use of Hekimhan Hematite ore having a grade of varied between 36-35% Fe was investigated. The ore was ground in a planetary mill and screened at 38 microns sieve and calcined at 750 °C, 900 °C, 1050 °C, 1200 °C for 5 hours, 3 hours and a hour. The prepared material was mixed with commercial opaque ceramic glaze at 100:5, 7,5, 10, 15, 20, 40 ratios and applied to fired ceramic bodies. L\*a\*b color values and brightness values of the ceramic sample fired at 1050 °C were examined. Color parameters are compared at different temperatures values. The structure of pigments was determined by XRD, XRF and SEM analysis. It has been found that ground hematite ore can be used in both commercial and artistic ceramics as colorants.

Corresponding Author: Nilgun Kizilkaya

## CORRELATION BETWEEN IMAGE ANALYSIS AND GROSS CALORIFIC VALUE FOR COAL SAMPLES

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### ABSTRACT

RGB (Red Green Blue) analysis is the determination of images with numerical values. With rgb analysis of images pixel by pixel determination of r,g, b values is obtained. Rgb value of a black is 0 (R=G=B=0) while rgb of white is 255 (R=G=B=255). At stable light conditions images can be characterized with rgb analyses. Lignite coals are known as brown coal and hard coals are usually named as black coals. Coal samples which have rgb values between some values could be classified. Calorific values of coals will be correlated with the rgb and hsv values of coal sample images. Which image parameter has better effect on calorific value correlation by taking images of calorific value known various type of coals. For instance, assuming the average r value has the best effect on calorific value, the change in calorific value of low average of r values to high average of r values of coal types could be observed. In this study, prepared samples were filled in standard sample pots and their images were taken. Since images taken coal samples have huge numbers of particles at this size range, images of each particle would be reflect on whole image as average r,g,b or h,s,v. Type of coal would be better represented with the effect of all these particles on the average r,g,b or h,s,v values of coal type. With the help of this study, calorific values of various types of coals would be plotted with respect to r,g,b,h,s,v values and knowing images parameters calorific value of an unknown coal would be calculated easily. In this study restricted number of coal samples are analyzed, 5 samples of each coal type (hard coal, butiminious, subbutiminious, and lignite) and totally 20 samples are analyzed.

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## SMOLDERING TEMPERATURE OF A STEAM COAL

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### ABSTRACT

In this study, smoldering temperature of a steam coal was investigated. Smoldering ignition is defined as low temperature and slow reaction of porous organic materials like coal without flame. However, this is sometimes one of the most important issues in terms of spontaneous combustion of huge piles. Regarding thermal power plants, they export tons of coal and they store it either open atmospheric conditions or in stocks. Hot weather conditions especially in summer may result in ignition of some coal particles and smoke out of the pile surface may be observed. When ignition starts on the surface however, it may trigger the reaction within the body of the pile. This reaction inside the pile may continue weeks or months without notification. Smoldering combustion of coals is another source for CO<sub>x</sub> emissions and smoldering of coal based emissions can be up to %15 of human reasoned CO<sub>x</sub> emissions. Smoldering combustion problem is mostly faced in some countries like America, Russia, Canada and Indonesia. Coal is classified in terms of its rank however for electrical power production purposes there might be some other specification needs to be considered in terms of classification of coals. For examples some coal types with all desired quality specification may have some problems of low smoldering potential. In order to carry out smoldering temperature experiment, coal samples should be prepared and ground to 200 mesh (at least %80 of total amount of sample). Smoldering temperature experiment should be cut off when intense smoke is coming out or when the spontaneous combustion is about to start. The experiment results also include some basic information about combustion kinetics and profile of that specific coal analyzed. In this study, the hot surface ignition temperature of a steam coal is determined as 270 C.

Corresponding Author: Ihsan Toroglu

## EXPLOSIVE SYNTHESIS OF HIGH ENTROPY ALLOYS IN Ti-Ni-Fe-W-Cu SYSTEM

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### ABSTRACT

High Entropy Alloys are characterized with specific properties, including high hardness, wear-resistance, high strength, structural stability, corrosion and oxidation-resistance. The complex of desired properties defines the the increasing interest for the application in different fields of engineering. In spite of the interest towards High Entropy Alloys/materials, most of the traditional methods do not allow to fabricate the desired varieties of composites, due to the technological limitation. On the other hand, investigations towards high entropy materials are increasing, as there are some properties that have to be studied and validated in multi-component systems. The goal of the current investigations is to carry out experiments and define synthesis regimes for Ti-Ni-Fe-W-Cu system powders by mechanical alloying and establish the technological parameters for the formation of High Entropy Alloys. The other goal of the work is to make experimental investigations for the synthesis of bulk materials by explosive consolidation technic. The paper describes the preliminary theoretical investigations and initial experimental results of mechanical alloying and explosive compaction of Ti-Ni-Fe-W-Cu multi-component system. As a result of preliminary investigations are established the technological parameters for mechanical alloying. The blend with different percentage content of powders were prepared. The high energetic Planetary ball mill was used for blend processing, mechanical alloying, amorphization ultrafine/nanopowder production. The time of processing varied in range of: 1-12 h. Selected Ball milled blends were compacted by explosive consolidation technology. For shock wave generation, the industrial explosives and new explosives obtained from decommissioned weapons were used in the experiments. The technological parameters of the explosive consolidation has bees studed and are discussed in the paper.

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## SHOCK-WAVE CONSOLIDATION OF BORON AND CARBON CONTAINING ULTRAFINE POWDERS AND INVESTIGATION THEIR STRUCTURE/PROPERTIES

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### ABSTRACT

The unique properties of the ultrafine grained composites, makes them attractive for aerospace, power engineering, machine and chemical and other practical applications. Carbon and Boron based composites are important and on high demand because of their specific properties and wide areas of application. It must be noted that SiC, TiC, TiB<sub>2</sub> and B<sub>4</sub>C are characterized with high hardness, wear resistance, corrosion resistance, they have high melting temperatures. Therefore, they find wide application for preparing the details to working at high temperatures and aggressive media. According to the phase diagrams in the selected systems, the composites/intermetallics may be obtained with wide spectrum of phase composition, in crystalline and amorphous structures. Depending on the composition and structure, the synthesized composites exhibit different specific properties. The potential of the system for development of new structural/composite materials in different thermodynamic conditions is very attractive. Nano structured composite materials of Ti-Al-Si-B-C system, prepared in the form of micromechanical blends, solid solutions and intermetallic compounds are of great practical interest because of improved mechanical properties in comparison with coarse grain material (>1 μm). The methodology and technology for the fabrication of bulk materials from ultrafine powders of Ti-Al-B-C and Si-B-C systems are described in the paper. The crystalline coarse Ti, Al, Si, C powders and amorphous B were used as precursors, and blends with different compositions of Si-C-B, Ti-Al-B-C and Ti-Al-C were prepared. The powders were mixed according the selected ratios of components to produce the blend. For Mechanical alloying (MA) the high energetic "Fritsch" Planetary premium line ball mill was used. Ratio ball to powder by mass was 10:1. The time of the processing was varied from 2 to 5 hours with rotation speed of 500 rpm. For the consolidation and bulk sample formation Explosive Compaction (EC) technology was used. The experiments were performed at room temperature. The shock wave pressure was varied in the range of 5-20 GPa. The ultrafine powders and bulk compacts of different compositions were prepared for investigations. The microstructure was studied by SEM and the effective regimes for obtaining nanopowders and nanocomposites in Ti-Al-Si-B-C composition has been established.

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## **THE IMPACT OF WATER MIST THICKNESS ON SHOCK WAVE ATTENUATION**

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### **ABSTRACT**

Explosion protection systems for underground structures are designed to create a suppressing barrier between the site of explosion and the facility to be protected. Studies have shown that water mist, provided that its properties are correctly selected, can effectively reduce shock wave overpressure in tunnels. The influence of droplet sizes and concentration of water in mist on shock wave mitigation processes have been investigated by different authors through experiments and modelling. However, the effect of geometric dimensions of mist on shock wave attenuation in tunnels has not been sufficiently studied. This paper addresses the influence of water mist thickness on blast overpressure under identical mist properties and explosion conditions in the tunnel. The study of such influence is essential for the proper design of the protective system. Experiments were conducted in the tunnel of the underground experimental base of the Mining Institute of Georgia. The methodology employed envisaged the measurement of overpressures in the tunnel with the mist generated by the spray system. At different stages of experiments, the water mist thickness was 1.6 m, 2.6 m and 3.8 m. Experiments were carried under the following conditions: charge weight - 2 kg; distance from the charge to the mist - 3.5 m, from the charge to the sensors - 11.5 m, droplet size distribution - 10-260  $\mu\text{m}$ , mist density - 1.45  $\text{l/s}\cdot\text{m}^3$ . In the test zone the height of the tunnel was 2.2 m, width - 2.2 m, cross-section - 4.4  $\text{m}^2$ . The results of the experiments showed that the water mist thickness has an influence on the shock wave overpressure. Under the conditions of experiments carried out by us, the increase of the mist thickness by 3.1 times allowed to reduce the overpressure by 19-20%.

Corresponding Author: Edgar Mataradze

## **STUDY OF IMPACT MINE BLAST ON ARMOR VEHICLE OCCUPANTS BY PHYSICAL MODELING**

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### **ABSTRACT**

The paper presents similarity criteria for physical modelling of the mine blast under the armored vehicle and the results of study of dynamic load on occupants used Hybrid III 50th Dummy. Similarity criteria, established as a result of the analysis of the governing parameters and similarity theory, are adequate to the processes of blast impact on the vehicle. Modelling experiments were conducted in the underground experimental base of the Mining Institute especially designed for the study of explosion processes. The model contains four support stands, a bottom plate, an upper plate and extra mass. The plate has the following dimensions: 1920 mm x 790 mm, thickness - 8 mm. On the upper surface of the plate was mounted a seat with dummy. The following dynamic characteristics of the dynamic response are recorded in the model: axial compression force ( $F_z$ ) in the tibia, vertical acceleration ( $A_z$ ) in the pelvis, shear force ( $F_x$ ), axial compression force ( $F_z$ ) and extension bending moment ( $M_y$ ) in the neck. The expected injuries of the occupants of armored vehicle at various weights of the mine charge are estimated.

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**CREATION OF DETONATION CHAMBER FOR EXPERIMENTAL DETERMINATION OF THERMODYNAMIC CHARACTERISTICS OF MODERN EXPLOSIVES**

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**ABSTRACT**

The subject of investigation represents the designing data of explosion chamber and calorimetric device. The latter will allow the determination of the parameters of the detonation and energetic characteristics of low-sensitivity, emulsion and outdated explosives. Research methodology provides the study of standard explosives of published data only, which, at experimental investigations in the above-mentioned cases, do not agreed with the reality. The question problematical character is lied in the fact that the reduction of explosives sensitivity causes the increase of critical and limiting diameters of tested charge which, for its part, is associated with the increase of charge mass. Above-mentioned increases significantly the limiting values of designed dynamic loads, acting on the walls of explosion chamber and presents a serious hazard to the construction integrity. For problem, solving the new experimental explosion chamber together with calorimetric device was designed. In the chamber, for reduction of quasistatic pressures the unloading sections were designed the total area of their surfaces were calculated by theoretical methods together with other designed data of explosion chamber and calorimetric device. The procedure of the devise manufacturing is proceeding.

Corresponding Author: Sergo Khomeriki



**ASSESSMENT THE POTENTIAL USE OF LIME FOR OLIVE MILL WASTE WATER (OMWW)  
TREATMENT ON THE CROPS GROWTH AND DEVELOPMENT**

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**ABSTRACT**

The application of three types of lime; Calcium Oxide, Calcium Hydroxide and slaked lime, has experimentally studied to rise OMWW pH, and to enhance phenol removal. OMWW samples were collected from two different geographically and climatically locations, also different in the associated agricultural practices, which initiate different OMWW properties. The obtained results indicated that adding lime is quite effective in terms of raising pH, where it reach up to 12 using 0.85 g of CaO, 1.1 g of Ca(OH)<sub>2</sub> and 2.05 g of slaked lime for Irbid location samples, while it takes 0.4 g of CaO, 0.5 g of Ca(OH)<sub>2</sub> and 1.45 g of slaked lime for Mafraq location samples. Regarding to phenol content, the three types of limes has the capability to reduce the content to the half. The second stage of this research was to study the effect of raw (untreated OMWW) and lime treated OMWW on seed germination. The obtained results showed that seed germination was strongly inhibited using raw OMWW from both locations. While using slaked lime treated OMWW showed a significant decreased of the phytotoxicity effects in both locations, where the germination percentage highly increased among the three investigated species; *Leucaena leucocephala L.*, *Sorghum bicolor*, and *Vicia sativa L.* Lime has proved to be an effective treatment method to treat OMWW, in addition it can be consider as eco-friendly method to be used. Lime treatment can be used to reduce the farming cost through using non-conventional water resource, and reducing the cost of using fresh water, get rid of the transporting cost of OMWW and reduce the cost of chemical fertilizers, but further research should include several plant species using treated and untreated OMWW under field conditions.

Corresponding Author: Maher J Tadros

**CLIMATE VARIABILITY AND RESIDENTIAL WATER CONSUMPTION IN BEAU-SEJOUR CITY,  
ANNABA-ALGERIA**

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**ABSTRACT**

In human kind history, freshwater resources were the major factor that population based on to choose a city's location. After industrialization, these locations are chosen based on working needs that affects directly water resources. Knowing that freshwater is non-renewable resource, the necessity of optimization of water use arise. For this goal researchers try to identify parameters affecting households water consumption. In present time, water is an essential element of any short or long-term management plans, of socioeconomic and physical characteristics, urban planning strategies, infrastructures and public water policies. For short-term, many factors can affect water consumption in urban areas such as socio-demographic parameters, physical characteristics and climatic variables. The poverty of water resources around the world encourages us to investigate the parameters affecting water use in households in order to optimize water consumption. In short-term analysis the climatic factor represents the major continent of this investigation. The case study is the city of Beau-Sejour-Annaba, North-East of Algeria. A study of 6 years' period between 2012 and 2017 is carried out to get water consumption data and climatic data; rainfall, temperature and humidity; then a statistical examination was done to determine the dependency between water consumption and climatic variables in more than 100 households. The result of the regression analysis applied in the model shows a significant effect on water consumption. Thus, correlation coefficients between water use and mean temperature, mean precipitation and mean humidity are +0.80, -0.52, -0.61, respectively, over the study period. Not surprising is that residential water use significantly increases with higher temperature, lower precipitation and humidity. Model coefficients indicate that temperature, precipitation and humidity conditions certainly affect water use.

Corresponding Author: Menal Zeroual

**POTENTIAL BIODIVERSITY THREATS ASSOCIATED WITH THE METAL POLLUTION IN THE NILE-DELTA ECOSYSTEM (MANZALA LAGOON, EGYPT)**

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**ABSTRACT**

Heavy metals may pose a high risk to the ecosystem stability. To understand the mobility and distribution of these heavy metals and their consequence on the biodiversity, triplicate samples include sediments, water, and fauna at sixteen sites in the Manzala lagoon (Nile-Delta) were analysed. The samples were collected along a gradient from the main agricultural drain, which brings mixed industrial, domestic, and agricultural wastes. An exponential trend of increasing metals concentration towards the main agricultural drain was observed. For sediment and faunal samples this trend was statistically significant in most cases, however, this trend was not obvious for all metals in water samples except for Zn. Partial Least Square (PLS) model confirmed that the distance to the drain is a second major predictor of the observed metal concentrations after sediment grain-size, while other physicochemical parameters have minor effect. Moreover, a significant correlation was found between most metals in the fauna and their respective sediments. In contrast, neither sediment nor faunal metal concentrations did correlate with water samples. Collectively, all pollution indices (enrichment factor, contamination factor, and geo-accumulation index) indicate high pollution by Cd and Pb and moderate pollution by Zn and classified the sites in the lagoon into three main categories: 1) highly polluted southeast corner around the drain, 2) moderately polluted north-eastern corner, where the newly widened and deepened sea-outlet occur, 3) unpolluted northwestern part, which located away from the drain. These patterns are well-characterized and confirmed by means of UPGMA clustering and non-metric Multidimensional scaling (nMDS). Furthermore, the Pollution Load index (PLI) was significantly correlated with the diversity indices. Low diversity, higher dominance, and abundance of opportunistic molluscan taxa in the polluted sites are interpreted to be a negative consequence of the metal pollution.

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## **SOIL WATER REGIME EVALUATION AFTER BIOCHAR AMENDMENT**

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### **ABSTRACT**

In this paper, we have evaluated soil water regime in top soil layer based on agronomic classification. The study site was located in Malanta (near Nitra city, Slovakia). The whole site was divided into plots with the size  $6 \times 4$  m separated by 0.5 m bands. Our field experiment began on March 2014 when a certificated biochar was applied to a depth 0-15 cm of soil profile in different rates. We have compared two plots: one with application of biochar in amount of 20 t/ha (B20) and second plot was without biochar amendment (Control). The soil water content in 0-15 cm depth was monitored by 5TM sensors in 5-minute interval and stored using EM 50 data loggers. Two sensors were installed at each plot and average value was used based on good correlation coefficient between them. Monitored period was from 12.8. to 22.10.2015 and the experimental area was cultivated with maize. Average daily value of soil water content was used to soil water regime evaluation. Results showed that 1) soil water content was higher at Control plot (we had expected higher values of soil water content at B20 plot based on scientific studies); 2) year 2015 was extremely hot and vegetation period and monitored period as well, were very dry. Therefore was soil water content below the hydrolimit wilting point ( $\theta_{WP}$ ) during a dominant part of monitored period. These results reflected also soil water regime evaluation, when deficit of soil water for plants was during long time of monitored period. Optimal volume of soil water for plants was only 13 days at Control plot and 3 days at B20 plot. Our hypothesis, that this type of biochar (with specific characteristics) will improve soil water regime, was not confirmed.

Corresponding Author: Justina Vitkova

**THE INFLUENCE OF THE INFILTRATION DISK RADIUS ON DETERMINATION OF UNSATURATED HYDRAULIC CONDUCTIVITY OF NON-STRUCTURAL SANDY SOIL**

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**ABSTRACT**

Unsaturated hydraulic conductivity ( $K(h)$ ) is important soil-physical characteristic, especially by determination of infiltration intensity, irrigation regime, drainage proposals, simulation of pollutants and other agricultural and hydrological processes.  $K(h)$  is determined by soil structure and texture. Measurements are therefore considerably influenced by the heterogeneity of the soil composition. The disc infiltrometer has become a popular apparatus for measuring in situ  $K(h)$  of the soil at some prescribed potential. A number of different methods have been proposed for calculating  $K(h)$  using the flow rate ( $Q(t)$ ), from the infiltration discs with different radius. Measurements of  $Q(t)$  on a Sekule sandy soil were made using minidisc infiltrometer (Decagon Devices, Pullman W.A.) with radius of 22,5mm and disc tension infiltrometer (Eijkelkamp Soil and Water B.V.) with radius of 200mm. Measurements were made at potentials of  $-20\text{mm}$  with both devices.  $K(h)$  values were calculated using 2 different methods; according to Zhang (1997) and according to Wooding (1968). The aim of our work was to test two  $K(h)$  measuring devices with different size of infiltration ring in order to check how the differences affects  $K(h)$  determination. This would give an idea which method would be more appropriate to use regarding the time-consume, effort and better characterization of the soil heterogeneity. Statistically significant difference ( $p=0.05$ ) was found when applying both methodologies. However, there is still a need to understand how both methodologies influence the variation of the parameters.

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## **IMPACT EVALUATION OF RIPARIAN VEGETATION ON AQUATIC HABITAT QUALITY OF RIVERS**

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### **ABSTRACT**

The knowledge about the natural potential vegetation is important to ensure the ecological stability of the area in terms of the restoration of riparian vegetation. The natural generic and spatial arrangement of riparian vegetation helps to maintain aesthetic appeal and has a high biological value in the country. Therefore, this work analyses the qualitative stream characteristics. To classify the qualitative parameters of the stream the method of indexes was used. The following hydromorphological methods were used to assess the condition of the biotope: QBR method (Qualitat del Bosc de Ribera) that is based on qualitative analysis of riparian vegetation, the HMS method (Habitat Modification Score) that allows to examine the anthropogenic changes in the river, BEHI method (Bank Erosion Hazard Index) that is used to determine the vulnerability to erosion, RGA method (Rapid Geomorphic Assessments) that is used for assessing the stability and sensitivity of the stream in relation to sedimentation processes, and RCE method (Inventory of River, Channel and Environment) that is used to assess the physical and biological state of small currents. The above-mentioned methodologies reliably identify the extremes concerning the riparian and the accompanying vegetation of the rivers. The vegetation is an important parameter for assessing the quality of the stream and it points out the areas that should be restored as a priority. As expected, the qualitative and quantitative characteristics of riparian vegetation have shown better results in rural areas than in urban areas. The quality of the stream is degraded by anthropogenic interventions in urban areas as well as in rural areas, so the focus on the vegetation of the whole stream is substantial. The individual methods allow the restoration of data in case of more significant changes that could be caused, for example, by floods or more significant anthropogenic impacts. The importance of this issue is growing as the riparian vegetation represents a valuable element of ecological stability with multiple functions. The riparian vegetation care is set by the actual legislation at national and transnational level, regarding the admitted European strategic objectives and documents. The application of the methodologies reliably identifies extremes in riparian vegetation, which significantly affect the overall characteristics of the flow quality, and they should be the subject of the restoration. The biological, morphological and water state of ten representative parts of Slatina and Drietomica rivers were evaluated. The results show that these methodologies present an appropriate tool for assessing the quality of riparian vegetation and can be used for restoration measures.

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## **MAPPING INVASIVE PLANTS IN RIVERBANK VEGETATION**

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### **ABSTRACT**

Invasive plants are naturalised plants that create populations that are spreading rapidly and to the long distances from parent plants. Invasive plants are occupying a large amount of space in invaded habitats, expected to impose a negative impact on the native vegetation. This study is focused on bearing the invasive plants close to the river. Based on the field work and measurements there can be seen relation between riverbank vegetation and river. We are mapping the occurrence *Impatiens glandulifera* and *Fallopia japonica*. They are invasive plants that threat the natural riverbank ecosystems. We updated the database of localities showed in the research of State Nature Conservancy of the Slovak Republic and we identified a new locality of invasive plants. The focus of our research is the riverbank vegetation on the streams in region Malé Karpaty in Slovakia. *Impatiens glandulifera* and *Fallopia japonica* invate the riverbank vegetation very often. Natural vegetation is degradated and the balance state in nature is broken. The spread of the invasive plants is driven by the dispersal and the colonization capabilities of the vegetative and sexual propagules. Our study focus on how the water dispersal of stem and rhizome fragments have a share of the colonization dynamics of riverbanks. Watercourses are powerful vectors of species colonizing riverbanks. Invasion by these species is therefore likely to seriously affect biodiversity and reduce the quality of the riparian ecosystems for amphibians, reptiles, birds and mammals whose diets are largely composed of arthropods. The biodiversity is rapidly decreasing and therefore it is very important to decelerate the invasive process.

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## **THE QUALITY OF WATER IN THE DAM RESERVOIR FUNCTIONING IN THE FOREST MOUNTAIN CATCHMENT**

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### **ABSTRACT**

The research concerned the Wapienica dam reservoir, which is located in the Polish Carpathians, near the city of Bielsko-Biala. The dam of this reservoir was built in 1928-1932 in the valley of the Wapienica stream (49°46'22"N, 18°51'22"E). It closes the flow of water from the 11.1 km<sup>2</sup> catchment. The forests cover about 90% of the catchment area, while the rest of the catchment are grassland areas. The reservoir has a capacity of 1.05 million m<sup>3</sup>. The collected water is intended for supplying a water supply system. The aim of the research was the evaluation of the water quality in this reservoir, in it the recognition of its trophic state based on analyzes carried out in 2015. Due to the lack of the anthropogenic sources of the environmental pollution in the catchment area, the reservoir is a unique research object. The catchment is treated as semi-natural, because within its borders the only works related to forest management are carried out. The physicochemical and sanitary parameters were analyzed within the state environmental monitoring framework, the water for analyzes came from the part near the dam (12 measurement series). The trophy status was diagnosed on the basis of the own water analyzes, which was taken from the upper part and the part near the dam of the reservoir. The concentration of chlorophyll *a*, the mass of phytoplankton and its species structure were determined (5 measurement series). It was found that the water was of very good quality in physicochemical terms (f.e. suspension  $\leq 13$  mg/dm<sup>3</sup>, COD<sub>Cr</sub>  $\leq 11$  mgO<sub>2</sub>/dm<sup>3</sup>, conductivity  $\leq 82$   $\mu$ S/cm, phosphates  $< 0,05$  mg/dm<sup>3</sup>, nitrates  $\leq 5,1$  mg/dm<sup>3</sup>, dissolved iron  $\leq 0,12$  mg/dm<sup>3</sup>). The contamination with heavy metals and other micro-contaminants weren't ascertained. It is worse to assess sanitary indicators - in the reservoir water were bacteria of the Coli group and periodically also enterococcus. The chlorophyll content in the water of the upper part of the reservoir (from 0.38 to 0.89  $\mu$ g/dm<sup>3</sup>) indicated the oligotrophy, but periodically in the part near the dam of the reservoir the trophy increased to the level of eutrophy. The amount of phytoplankton biomass in the upper part of the reservoir changed within the limits characteristic for oligotrophy (below 0,68 mg/dm<sup>3</sup>) and mesotrophy (below 1,98 mg/dm<sup>3</sup>), while in the part near the dam the mesotrophy and periodically eutrophy. In the phytoplankton structure in the upper part of the reservoir the diatoms species dominated, which prefer oligotrophic environment. In the part near the dam the dinophyta and diatoms developed, which are characteristic for higher trophy levels. The quality of the water in the reservoir is so good, that before being pumped to the water supply network it is subjected to simple treatment – filtration and disinfection. The reservoir isn't homogeneous in terms of biological production. It is low in the upper part (which is fed by cold water of the mountain streams) and increases in the part near the dam. The reservoir can be described as oligo-mesotrophic. Retention of water in this reservoir is justified.

Corresponding Author: Andrzej Jagus



## **OPTICAL PROPERTIES OF DISSOLVED ORGANIC MATTER IN URBAN FOUNTAINS**

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### **ABSTRACT**

Optical properties of dissolved organic carbon compounds (DOC) in selected fountains in Olsztyn (Poland) were investigated. The DOC fraction was isolated using a membrane filter (Sartorius, pore size 0.45  $\mu\text{m}$ ). The amount of absorption for the DOC fraction was determined using the UV spectrophotometry method (UV range) at wavelength: 203 nm (A203), 250 nm (A250), 254 nm (A254) and 365 nm (A365). Then the absorption ratios were determined: A250/A365 and A254/A203. The aim of the study was to determine the contribution of macromolecules (hardly biodegradable, having an aromatic character) in the fraction of DOC. The variability of DOC compounds in the water of fountains was investigated depending on the water supply method (also subjected to disinfection) and depending on the period of research (season of the year) or the impact of the environment. The research was conducted from May to October 2017, on average at of 2-3 weeks intervals. Three artificial fountains were selected for the study - they were supplied with water from waterworks (permanently or periodically chlorinated). The fourth fountain had a semi-natural character and was supplied with water from waterworks (without disinfection) and with rainwater. The fifth was located on a natural reservoir. It was shown that the average A250/A365 values were three times lower in fountains not subjected to disinfection than in artificial fountains (7 against 22). The A254/A203 parameter was on average several times lower in artificial fountains (from 0.07 to 0.11) and in fountains, where the water was not chlorinated, it reached the average values of 0.32 and 0.34. The Kruskal-Wallis test confirmed that the differences between the artificial objects and the other two in the average values of A250/ A365 and A254/A203 ratios are significant. The values of these quotients indicate that natural and semi-natural fountains are characterized by a high share of aromatic compounds with high molecular weight. For artificial objects, the effect of the study period on differences in average values of A250/A365 and A254/A203 was not confirmed. The U Mann-Whitney test showed that there are differences in the mean values of A254/A203 between the semi-natural and natural fountain, and the changes of A250/A365 in these fountains are related to the date of sampling. After examining the influence of the catchment and anthropogenic pressure, it was found that in the semi-natural fountain, the quality of the DOC fraction changed due to the supply of allochthonous organic matter (leaves, waterfowl and its feeding by resting people). In the case of a fountain on a natural reservoir, the relatively high primary production and allochthonous inflow of DOC had significant influence on the DOC character (leaching from slopes with rainfall, groundbaits using by anglers). They were the first of this type of qualitative research on DOC compounds in fountains in Poland.

Corresponding Author: Katarzyna Parszuto

**MAIN ASSUMPTIONS AND PRELIMINARY RESULTS OF THE PROJECT – “GEOMORPHIC, SEDIMENTOLOGICAL AND PALAEOBOTANICAL RECORD OF ENVIRONMENTAL CHANGES, AS A SOURCE OF DATA FOR THE HISTORICAL RECONSTRUCTION OF THE SCARCELY RECOGNIZED METALLURGICAL ACTIVITY (IN THE SOUTHERN AND CENTRAL POLAND)”**

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**ABSTRACT**

Ironworks were located in the river valley floors as the water was the source of energy for the metallurgical technology. Trees growing in river valleys were a source of wood for charcoal production. Over the past centuries, ferrous metallurgy contributed to the transformation of the valley floor relief, where dams, canals, smelter ponds and charcoal kilns were constructed. Also the structure of the sediments was transformed. The subject of historical water-powered metallurgy in Poland is a poorly researched area from the perspective of natural sciences. The main research aim of this project, is a historical reconstruction of the scarcely recognized metallurgical activity, based on geomorphological, sedimentological and palaeobotanical changes in the environment. The project has two components complementary to each other. First part involves desk-based research during which digital data from air laser scanning is processed to determine the occurrence and distribution of potential forms related to the historical metallurgy, and an analysis of historical sources will be undertaken. In the next step, first fieldwork, and then the preparation of samples for radiocarbon and anthracological analysis will follow. During the fieldwork part, research will be carried out on a area of chosen river basins of the southern and central Poland. The research will be based on the geomorphological analysis in the places where potential or identified metallurgical centres were placed, along with the excavation of deposits and sampling for further analysis, both in the charcoal kilns and the former smelter ponds. If it proves possible, it is planned to expose the deposits in the weirs. Preliminary research contradicts the low invasiveness of historical metallurgy in the environment. According to the preliminary studies of the authors, it is known that in studied river valleys and adjacent areas, traces of former charcoal kilns have been found at a large scale (tens of thousands of forms). DEM images generated from airborne LiDAR data allow simple and relatively quick identification and inventory of the remnants past charcoal production. The large number of charcoal kilns, and the vast area they cover, indicate that the past charcoal production has had a significant impact on the environment of studied area. Analysis of the species composition of charcoals collected from kilns has shown the presence of pine wood mainly. Also the unexpected results of the first radioisotopic charcoals dating from the charcoal kilns, with dates of the twelfth and thirteenth centuries, provide a particularly strong motivation for examining more forms in order to find equally spectacular results and to confirm a new perception of the beginning of water-powered metallurgy in Poland.

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## FUNCTION OF CONVENTIONAL WASTEWATER TREATMENT PLANT ON THE REMOVAL OF THE AMINOGLYCOSIDE RESISTANCE GENE

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### ABSTRACT

Antibiotics have been used over a century to treat diseases. However, excessive and misuse of the antibiotics have led to formation of antibiotic resistance genes (ARGs). Aminoglycoside is one of the common used antibiotic groups. Aminoglycoside resistance genes, however, decrease the effects of the aminoglycoside antibiotics by enzymatic inactivation. Therefore, aminoglycoside resistance genes create a serious threat to public health. Even though antibiotics persist in both soil and aquatic environments, ARGs may arise after the removal of antibiotics. Moreover, these ARGs can spread through sea, river, drinking waters and wastewater treatment plants (WWTPs) with horizontal gene transfer. WWTPs, therefore, are considered as one of the main hotspots for the spread of ARGs. Conventional WWTPs are used worldwide to treat wastewaters. Their effect on removal of nutrients from water is very well known. However, studies about the impact of conventional WWTP on the removal of ARGs especially aminoglycoside type ARGs are limited. In this study, therefore, removal of the aminoglycoside resistance genes was investigated in a conventional WWTP. For this purpose water samples from influents and effluents were seasonally collected from a conventional WWTP. After total DNA extractions were performed from the collected samples, quantifications of aminoglycoside resistance genes were done with quantitative polymerase chain reaction (qPCR). In qPCR analyses *aadA* specific primers targeting aminoglycoside resistance were used. The results of qPCR analyses showed that conventional type WWTP removed *aadA* gene with 19-97% efficiencies. The removal efficiencies of conventional WWTP were high in spring and summer seasons. Removal efficiencies decreased drastically in autumn and winter. A reasonable explanation for that is low temperatures in autumn and winter seasons led to enzyme deactivation in microorganisms. Therefore, conventional WWTP could not remove aminoglycoside resistance genes efficiently in autumn and winter.

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## EFFECT OF VOLATILE FATTY ACIDS ON METHANE PRODUCTION IN OZONE PRE-TREATED ANAEROBIC DIGESTERS

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### ABSTRACT

Anaerobic digestion (AD) is a biological wastewater sludge treatment process which transforms organic matter into methane-rich biogas. AD involves four key steps as hydrolysis, acidogenesis, acetogenesis and methanogenesis, respectively. In hydrolysis, a rate-limiting step, large organic polymers are broken down into simpler monomers. AD with ozone pre-treatment is used for the acceleration of this rate limiting step by converting solids into more easily biodegradable matter. As a result, sludge biodegradability and biogas production can be enhanced. In acidogenesis, volatile fatty acids (VFAs) are formed while in acetogenesis, those VFAs are further catabolised for methanogenesis to produce methane. Accumulation of those VFAs in the system leads to pH drop and this inhibits the activity of methanogens in the digester. Therefore, one of the most important parameters to be considered in the operation of anaerobic digesters is VFA analysis. Hence, in this study, the relationship between total VFAs and methane production in anaerobic digesters pre-treated with different ozone dosages was examined. In the study, three anaerobic reactors pre-treated with different ozone dosages (0.03, 0.06 and 0.09 g O<sub>3</sub>/g TSS) and a control without pre-treatment were operated. Seed sludge for the reactors was obtained from ASKI Tatlar Central Wastewater Treatment Plant and the feed sludge was obtained from METU Vacuum Rotating Membrane. During the operation, methane production was daily measured daily by using graduated cylinder and gas chromatography. The total VFA concentration were measured for every other day by using titration method. While no significant increase in methane production was observed in the reactors pre-treated with 0.03 and 0.09 g O<sub>3</sub>/g TSS ozone dosages and control reactor, the highest methane production was obtained in the reactor pre-treated with 0.06 g O<sub>3</sub>/g TSS between the second and tenth days of operation. Similarly, the total VFA concentration increased in 0.03, 0.09 g O<sub>3</sub>/g TSS ozone dosed and control reactors and decreased in 0.06 g O<sub>3</sub>/g TSS ozone dosed reactor in the same time interval. In conclusion, there was a direct relationship between VFAs and methane production in practice too. In ozone pre-treated anaerobic digesters, low (0.03 g O<sub>3</sub>/g TSS) and high (0.09 g O<sub>3</sub>/g TSS) ozone dosages led to an increase in VFAs and so, a decrease in methane production. However, 0.06 g O<sub>3</sub>/g TSS ozone dosage indicated a meaningful reduction in VFAs by providing the highest methane production.

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## **MACROLIDE RESISTANCE DISSEMINATED VIA UNTREATED HOSPITAL EFFLUENTS**

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### **ABSTRACT**

Antibiotics have been used to treat infections since they first introduced in late 30s. Antibiotic resistance has emerged gradually after introduction of new antibiotics and today antibiotic resistance poses a great danger to the public health. The intensive use of antibiotics for medical, veterinary and agricultural purposes increases the dissemination of antibiotic resistance and limits the ability to treat various infections. Macrolides are antibiotics effective against many important Gram-positive bacterial infections and macrolide resistance in Gram-positive bacteria has increased all over the world recently. These antibiotics inhibit protein synthesis. One of the most common resistance mechanism developed by bacteria against macrolides is ribosomal modification encoded by the *erm* genes. These genes are usually located on transposons or plasmids. Horizontal gene transfer mechanisms are responsible for the dissemination of these genes in environment. Hospital wastewaters receive a cocktail of antibiotic compounds and bacteria that provide a perfect environment for the exchange of antibiotic resistance genes among clinical pathogens and environmental bacteria. Hospital effluents can contaminate water bodies used in agriculture and households. When untreated hospital effluents are discharged into receiving water bodies, antibiotic resistance genes and resistant bacteria can easily disseminate and cause great danger to the public health. The objective of this study, therefore, is to evaluate the potential impact of the untreated hospital wastewaters on the dissemination of the macrolide resistance genes. For this reason, total DNA were extracted from seasonally collected hospital effluents and quantification of macrolide resistance gene (*ermB*) was assessed by quantitative polymerase chain reaction. Quantification processes are still in progress.

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**THE PILOT STUDY ON WATER CHEMISTRY IN MUNICIPAL FOUNTAINS IN OLSZTYN  
(NE POLAND)**

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The aim of the study was preliminary identification of water chemistry in selected fountains located in town's parks (Olsztyn, Warmia and Mazury, NE Poland). These studies will be the basis for further analyzes, including microbiological and mycological ones - the authors assume that specific chemical composition of water is the environment of existence and growing of microorganisms and at the same time it can be modified by them. For the pilot studies 5 objects were selected and we conventionally divided them into artificial, semi-natural and natural fountains. Artificial fountains have a formed, embedded basin, they are supplied with tap water and work in a closed system. The water is disinfected with chlorine and replaced if necessary. The semi-natural fountains have an artificially formed basin, they are partly supplied with tap water and partly with surface runoff. Natural fountains are supplied only by surface drainage and collectors draining the area of the adjacent park. Water for testing was collected throughout the operating season, every 2 weeks, from 22.05 to 3.10.2017. Each time we made the photographic documentation, taking into account the current situation - feeding with waterfowl bread, spreading food for pigeons on the bank of the reservoir, anglers fishing (in the case of natural and semi-natural objects) and the presence of birds using these objects as a living environment. Physicochemical analyzes were performed in accordance with the methodology adopted in hydrochemical research. There were no significant differences in the water temperature between the different types of fountains, while the relationship between water temperature and air temperature was shown by the following equations:  $y = 0.9275x + 2.034$ ,  $R^2 = 0.6611$  (for artificial) and  $y = 0.4538x + 8.6301$ ,  $R^2 = 0.6642$  (for others) where  $x$  = water temperature in the fountain. It has been shown that chemical composition of water in artificial objects is definitely different from that which fills natural and semi-natural fountains. This is related to the type of basin and the method of water supplying. Water in artificial objects, compared to the other ones, was characterized by low color (0-19 HZ) and turbidity (0-31 NTU), lower concentration of iron (0-0.14 mg dm<sup>-3</sup>) and manganese (0.02-0.07 mg dm<sup>-3</sup>), constant, slight hyperoxia (maximum 116.7% O<sub>2</sub>) and higher total hardness. The content of organic matter determined as COD-Mn was lower than in other objects, and we have improved that changes in the lifetime were insignificant. A highly significant relationship was found between the electrolytic conductivity and the concentration of NO<sub>3</sub><sup>-</sup> and Cl<sup>-</sup> (Spearman: 0.92 and 0.82 respectively) and between the concentration of free chlorine (Cl<sub>2</sub>) and chlorides (Cl<sup>-</sup>). Probably this is due to the chemical changes of chlorine, but the explanation for this requires further research. It was found that chlorination of water takes place without prior determination of the proper demand for this component. The maximum concentration found during the studies was 21 mg Cl<sub>2</sub> dm<sup>-3</sup>, and the smell was organoleptically felt as intensive even within a teen meter, generally throughout the whole research period. In all objects, the concentration of chlorides increased systematically during the lifetime of fountains. Constant increase in conductivity was observed, which indicates increased pollution. In addition, natural and semi-natural objects are exposed to increased pollution not only from people. Animal faeces and remains of feed scattered by people feeding birds, leaves and pollen are a big problem.

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## **EXTERNAL LOADING OF PHOSPHORUS IN DEEP, STRATIFIED LAKE AFFECTED WITH DRAINAGE WATER**

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### **ABSTRACT**

The Water Framework Directive (2000/60/EC) requires from European countries to achieve environmental objectives. In relation to lakes, it is a good qualitative and quantitative status of all water bodies. Deep and stratified lakes resist anthropopressure for a long time, so they do not seem to require active protection. However, these types of ecosystems are also undergoing a degradation processes. This is particularly true for lakes with tributaries - potential outbreaks of nutrients. Even small streams with visually "clean water" can carry loads of pollution exceeding the self-cleaning capacity of water bodies. Our paper presents the impact of anthropogenic watershed (agricultural and urban management) on the environmental conditions in small (deep (15.3m) stratified lake (Lake Święte in Obra, Wielkopolskie Lakeland, Poland). In the research, loads of biogenic pollutants feeding the reservoir from the main external sources were compared: drainage water supply (Pintus watercourse), atmospheric deposition, surface load from direct catchment, angling, watering place. It has been shown that about 80% of the annual phosphorus load reaches the lake along with an inconspicuous watercourse (average flow  $0.04 \text{ m}^3 \text{ s}^{-1}$ , phosphorus concentration  $0.1\text{-}0.5 \text{ mgP l}^{-1}$ ), to which drainage water from the surrounding area is discharged. The second major source of pollution is surface runoff. The total load of phosphorus contaminants was compared with the load discharged outside the ecosystem and the so-called critical level, calculated in accordance with the Vollenweider model (1976). The results of our research indicate that Święte Lake is a trap for pollution transferred through a drainage and watercourses network. At the same time, the volume of external loading of phosphorus several times exceeds the critical level and indicates the scenario of further eutrophication of the lake. Unexpectedly for the local community and lake users, this pollution is primarily due to the inconspicuous mid-field stream. On the basis of the results obtained, a plan of protective measures was developed, the main element of which is the elimination of this source of pollution. The work also discusses the possible techniques of revitalizing the lake ecosystem. The research indicates the need to appreciate the role of small watercourses in the process of eutrophication of lakes and the role of early conservation measures taking place before the appearance of symptoms of ecosystem degradation, especially before the achievement by lakes of the turbid state - dominated by phytoplankton.

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**VERTICAL AND HORIZONTAL CHANGEABILITY OF CHEMICAL FEATURES OF BOTTOM SEDIMENT IN RIVERINE AND LACUSTRINE SECTIONS IN LAKE-RIVER SYSTEM**

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**ABSTRACT**

Bottom sediment is regarded as an important element in water ecosystem, playing the role of a nutrient “trap” but also of the potential and practically inexhaustible source of nutrients. A various transformations of mineral and organic components (diagenesis, dehydration, recrystallization, cementation, chemical reactions) take place in sediment, leading to the migration of nutrients compounds from sediment to water. The bottom sediment is composed of mineral and organic substances removed from the water during the processes of precipitation, sorption and sedimentation. Bottom sediment, that fills river beds, is characterized by a completely different chemical composition comparing to lake sediment. This is caused by the constant flow of water in the river and its good oxygenation. The aim of study was analysis of chemical composition of riverine and lacustrine bottom sediment. Research of bottom sediment was carried in the lake - river system of upper Pasłęka. The upper Pasłęka basin is situated in the north-east of Poland. The river Pasłęka flows into Vistula Lagoon. The total area of the upper Pasłęka River basin is 246.7 km<sup>2</sup>, while the length of the upper part of the river is 40.5 km (total area of Pasłęka catchment is 2294.5 km<sup>2</sup>, total length of river is 211 km). The average fall of the upper course of Pasłęka is 1.70 ‰. Pasłęka River in upper course flows through the lakes with different morphometric properties: Pasłęk, Wymój, Sarąg, Łęguty and Isąg. The surface of lakes range from 8.5 to 397.5 ha, and a maximum depths - 5.0 to 54.5 m. The research showed a clear spatial differentiation of the content of silica, organic matter and carbon dioxide in the bottom sediments of particular river and lakes sections. The percentage share of other bottom sediments components i.e. macroelements (Ca, Mg, Fe, Mn) and nutrients (P, N), was also various in river and lake sediment. The dominant component of river sediments was silica (56.9 to 96.7% d.w.). With the flow of the river, the share of silica in the sediment was higher. In lake sediment, silica was also predominant, but not in such a wide range as in the river (24.8 to 53.2% d.w.). The content of organic matter in river sediment did not exceed 27%. In the sediments of the lakes Pasłęk and Sarąg organic matter was the second component of sediments and ranged from 19.5 to 30.1%. In other lakes the content of organic components ranged from 12.3 to 20.3%. In lake sediment a high proportion of carbon dioxide was noted - between 14.4 and 24.2%, while in river sediment, this component did not exceed 6.3%.

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**TEMPORAL VARIATIONS IN TREE-RING GROWTH RESPONSE TO CLIMATE OF EUROPEAN LARCH  
(*LARIX DECIDUA* MILL.): AN EXAMPLE FROM SUDETES, POLAND**

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**ABSTRACT**

The temporal stability of climate–growth relationship is a basic assumption and requirement of climate reconstruction using tree rings of trees. However many recent studies showed change in tree-ring growth response to climate for the last decades. The temporal stability of relationship mentioned above can depend on the local factors, e.g. slope aspect. In presented study the tree-ring growth response to climate of larch from Polish part of Sudetes was analysed over time. The aim was to investigate its temporal variability, existence of trends and influence of local factors. The relation between tree-ring growth of larches from six sites located at comparable altitudes (about 700-750 m.a.s.l.) and climatic factors that mainly control the tree-ring growth of larches in the study area over time was analysed. The Pearson correlation between tree-ring width site chronologies and climatic data for the study area (the average monthly air temperature and total monthly precipitation series from high-resolution gridded dataset CRU TS v.4.01) was calculated in 40-years moving intervals for the period 1902–2010. The results showed variations in the tree-ring growth response to climate over the analysed time period. Although in general, similar trends were observed for all sites, some differences in trends and magnitudes among sites were also spotted. Interesting is, that the response of sites became more consistent and similar for the last decades. The discussion of the received results with respect to currently observed climatic trends in the region and local factors that can explain the differences in response between particular sites is presented.

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## **THE EFFECT OF DISCOUNT FACTOR ON THE COST OF MEDICAL WASTE MANAGEMENT SYSTEM**

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### **ABSTRACT**

This paper describes the optimization study aimed to analyse the impact of the parameter describing the discount factor on the cost of the system and its structure. The study was conducted on the example of the analysis of medical waste management system in north-eastern Poland, in Podlaskie Province. The scope of operational research carried out under the optimization study was divided into two stages of optimization calculations with assumed technical and economic parameters of the system. In the first stage, the lowest cost of functioning of the analysed system was generated, whereas in the second one the influence of the input parameter of the system, i.e. the discount factor on the economic efficiency index (E) and the spatial structure of the system was determined. With the assumed discount factor in the range of 0.980 to 0.909, the highest cost of the system was achieved at the level of PLN 2332.60/t (increase of economic efficiency index E by ca. 46% in comparison with run 1, with discount factor = 0.980).

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## **DECOUPLING ECONOMIC GROWTH FROM EMISSIONS IN POLAND ON THE BACKGROUND OF EU COUNTRIES**

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### **ABSTRACT**

Nowadays studying CO<sub>2</sub> emissions play a focal role in the current debate on environment protection and sustainable development. CO<sub>2</sub> has been recognized by most scientists as a major source of global warming through its greenhouse effects. Another reason is that CO<sub>2</sub> emissions are directly related to the use of energy, which is an essential factor in the world economy, both for production and consumption. Access to relatively cheap electricity determines economic competitiveness on the market. Therefore, the relationship between CO<sub>2</sub> emissions and economic growth has important implications for environmental and economic policies. The main aim of the article is researching the dependencies between emissions and economic growth. The phenomenon of decoupling the economic growth from the emission level in European Union countries has a very complex nature. As a test sample, seven largest electricity producers in the European Union were presented, responsible for 75% of CO<sub>2</sub> emissions in the entire European Union. As a measure of economic growth, the widely used Gross Domestic Product per capita was adopted; which is currently heavily criticized due to the fact that its average value per capita of the country does not really show real income due to significant differentiation of income levels among various social groups. The examination of Pearson correlation coefficient between emissions and economic growth for the seven European Union countries such as: Germany, UK, France, Italy, Poland, Spain, and Netherlands confirmed that developed countries would have been able to achieve economic growth and at the same time decrease of emissivity was achieved.

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**TOXICITY OF Pb IN THE HEPATOPANCREAS OF *LYMNAEA STAGNALIS* (GASTROPODA, PULMONATA)**

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**ABSTRACT**

Based on levels of lead (Pb) accumulations, the study aims to determine histopathological changes taking place on hepatopancreas tissues in the treatment of Pb in sublethal doses (0.08, 0.82 ve 1,64 µg/L) and in different time points (7, 14 and 21 days) to *Lymnaea stagnalis*, a freshwater snail. As an experimental material, samples of *Lymnaea stagnalis* were adapted to the laboratory conditions for 15 days. After that, snails were divided to 4 groups in the manner described hereafter; Group I: no Pb treatment, Group II: 0.08 µg/L, Group III: 0.82 µg/L, Group IV: 1.64 µg/L Pb treatment. All groups, except Group I (control), were subjected to sublethal doses of Pb for 21 days. Snails from control and experimental groups were dissected on Day 7, Day 14 and Day 21 with a view to determining histopathological changes. Histological preparations of hepatopancreas tissues taken in the course of dissection were done. Histopathological changes were examined under a light microscope and representative pictures were taken. Histopathologic changes in hepatopancreas were found to increase with dose and duration as a result of exposure of the *Lymnaea stagnalis* specimens to Pb sublethal concentrations (0,08, 0,82 and 1,64 µg/L Pb) for 21 days. At the end of the experimental period, expansion in hemolymphatic fields and tubule lumens in hepatopancreas; vacuolation in basophilic cells and digestive cells; increased lipid vacuoles and amoebocyte counts in the connective tissue between the tubules; increased number of pyknotic cells and necrotic changes were determined. Histopathological findings provide information about changes in structural and biological functions of the specimens. Consequently, this study shows that sublethal concentrations of Pb cause damage to the body tissues of *Lymnaea stagnalis*. The data may help to avoid heavy metal pollution in the coming years and to find different solutions.

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## PLANT CELL, TISSUE AND ORGAN CULTURE

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### ABSTRACT

Plant cell and tissue culture is a technique that involves propagating/cloning plant cells /plants from individual cells, organs or tissues (explants) in a nutrient medium under controlled/sterile physical and chemical conditions indefinitely. These conditions allow explants to be fed in a semi-solid or liquid nutrient medium with appropriate pH, including vitamins macro- and micro-nutrients, nanoparticles (NPs) and carbohydrates. Researchers/propagators use these techniques extensively to create exact genetic copies of a plant or generate large quantities of clone cells/organs for further research or industrial purposes. The use of cell and tissue culture has resulted in dramatic advances in plant science and forms an essential component of scientific research on plants. Today, plant tissue culture technologies are considered to be an important tool widely used in commercial plant production as well as in basic and applied research, which underlie conditions that encourage cell division and re-genetic programming in vitro conditions. There are five main areas of research and application where in vitro cell and tissue culture techniques are used as a tool. These are: (1) Plant cell physiology, (2) Production of genetically modified crops, (3) Mass production of genetically superior material, (4) Preservation of endangered plant species, (5) Production of valuable chemicals from plants. The aim of this study is to present the latest developments in plant cell, tissue and organ culture techniques reported in the literature, basic principles and history of plant tissue culture, cell, tissue and organ culture types, in vitro plant regeneration methods and commercial applications of plant cell and tissue culture techniques.

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## DETERMINATION OF VOLATILE OIL CONTENT FROM OAT SEED (PEGANUM HARMALA L.) BY SUPERCRITICAL CO<sub>2</sub> EXTRACTION METHOD

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### ABSTRACT

Turkey is one of the countries within the world's richest flora in terms of the number of plant species. Herbal medicines are of great importance because they are less toxic, have fewer side effects and are more economical. The use of herbal medicine is increasing day by day. The seeds of *Peganum harmala* L. (Syrian rue) (Zygophyllaceae) are commonly known to be "Harmal" or "Üzerlik" among the Turkish people. Although the seeds of this plant were used as powder, decoction, maceration, or infusion for fever, diarrhea, abortion, and subcutaneous tumors and in the treatment of infertility in the different parts of the World, the fruits of this plant are also used as amulet, while the seeds are used as incense against "evil eye" in our country among the folk. The aim of this study is to determine the content of essential oil of samples obtained from *P. harmala* L. seeds by supercritical extraction method. Extracts obtained at constant temperature conditions of 35°C at 100, 200, 300 and 400 bar pressure and extracts obtained from classical extraction method were compared in supercritical CO<sub>2</sub> extraction device. As a result of the studies; It was determined the highest capric (C10:0) acid (1,41%), myristic (C14:0) acid (0,7%), palmitic (C16:0) acid (7,68%), stearic (C18:0) acid (2,45%), linoleic (C18:2n6c) acid (7,19%), gamma-linolenic (C18:3n6) acid (2,06%), cis-11,14-eicosadienoic (C20:2) acid (5,42%) at 100 bar pressure; the highest caproic (C6:0) acid (2,52%), pentadecanoic (C15:0) acid (0,3%), cis-10-pentadecanoic (C15:1) acid (6,22%), elaidic (C18:1n9t) acid (4,27%), linolelaidic (C18:2n6t) acid (7,35%), linolenic (C18:3n6) acid (3,93%), cis-13,16-docosadienoic (C22:2) acid (4,3%), cis-5,8,11,14,17-eicosapentaenoic (C20:5n337),6 acid (2,41%) at 200 bar pressure; and the highest caprylic (C8:0) acid (0,52%), undecanoic (C11:0) acid (0,85%), lauric (C12:0) acid (0,86%), tridecanoic (C13:0) acid (30,66%), myristoleic (C14:1) acid (1,6%), palmitoleic (C16:1) acid (11,6%), heptadecanoic (C17:0) acid (3,33%), cis-10-heptadecanoic (C17:1) acid (3,37%), oleic (C18:1n9c) acid (6,22%), arachidic (C20:0) acid (0,63%), heneicosanoic (C21:0) acid (5,23%), lignoceric (C24:0) acid (5,8%) at 400 bar pressure. In the conventional method, however, the highest caproic (C6:0) acid (10,45%), tridecanoic (C13:0) acid (31,77%), Pentadecanoic (C15:0) acid (10,96%), cis-10 palmitic (C16:0) acid (18,1%) and arachidic (C20:0) acid (2,8%) were obtained.

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## INVESTIGATION OF ADAPTATION OF LAVENDER PLANT AND IN VITRO MICROBIAL POSSIBILITIES IN DIYARBAKIR CONDITIONS

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### ABSTRACT

In recent years, the popularity of herbal medicines for therapeutic purposes, the perfumery of medical and aromatic plants, the formation of the main raw materials of the food and cosmetic industry and the emergence of new areas of use have increased the interest and demand for medical and aromatic plants. Raw materials obtained from these plants have recently been cultivated as food, in paint, ornamental, insecticide pharmacology and perfumery industry, in etheric oil production and ornamental plant, and are used in industrial sectors and started to spread (Seçmen et al., 2000, Kan et al., 2006). The lavender plant is from the family Ballibagiller (Labiatae) and is grown in northwest and southwest Anatolia. Between June and August, blue or purple flowers open, 40-60 cm in length, aromatic smelling, perennial, herbaceous or fruiting plants. More widespread in the western regions of the sea. There are two species that grow in Turkey. These are *Lavandula x intermedia* and *Lavandula angustifolia*. In the study, the cultivars of '*Lavandula x intermedia*' Giant Hid cote ', 'Dutch 'and' Supera 'lavandin varieties of Raya ', 'Silver 'and' Vera 'lavander varieties belonging to *Lavandula angustifolia*, was selected and the type of 'Super A' lavandin belonging to the *Lavandula x intermedia* line that could be grown in Diyarbakır conditions was chosen. The seedlings were planted in the area of the Dicle University Medical and Aromatic Plants Application and Research Center in 4 areas and in the field on April 6-7, 2017. The seeds of the "Super A" lavande belonging to the *Lavandula x intermedia* line were placed 1 m above the row and 3 m apart. A total of 1900 seedlings were planted in the test area and maintenance and irrigation were followed up continuously. At the beginning of June some of the fidelites were found dead. The survival of the remaining fidelites was maintained and 60% adaptation occurred in the field. Flowering the flowers were harvested 3 times between June and October, which began in June. MS medium containing IBA was used in vitro in vitro to root shoots from the cotyledon node explant of the 'Super A' lavandin plant of the *Lavandula x intermedia* line. There was a 0.05 difference in the root formation rate between the media after 8 weeks, but no difference was found between the media in terms of root length and plant height. The root formation rate obtained in MS medium containing IBA at different ratios varied between 30-86.7%. A maximum of 86% root formation rate (%) was observed in MS medium containing 1.25 mg / l IBA. In addition, the results obtained from root length ranged from 1.35 to 2.33 cm, and the longest 2.30 cm root was found in MS medium containing 1.25 mg / l IBA. Root development also affected plant height and, although statistically insignificant, the longest plant height varied from 3.0 to 4.5 cm. The average longest plants were 5.5 cm in the MS medium containing 1.25 mg / l IBA.

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## **SELECTION OF OPTIMAL GRIDDED DATASET FOR APPLICATION IN POLISH SUDETES MOUNTAINS**

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### **ABSTRACT**

High quality measured weather data (MWD) are limited or not available for many areas. Also their time coverage can be relatively short. That is why the use of gridded climatic data (GCD) in environmental studies is very popular. However, GCD are valuable source of information, their accuracy can be sometimes insufficient for particular study. That is why GCD applicability should be checked before the study run. The objective of this study was to check the applicability of gridded data for dendroclimatological studies of larch from Sudetes Mountains. To do so we compared GCD with available MWD from several weather stations located in the mentioned area. Because many gridded time-series datasets are available, we also wanted to check which dataset is the best to use for the mentioned area. In the analysis high-resolution gridded data on monthly mean temperature and total precipitation, which cover the common period 1901-2013, in 0.5° x 0.5° network, created by: a. Center for Climatic Research Department of Geography University of Delaware Newark (UD; model V4.01 for precipitation and temperature data), b. Global Precipitation Climatology Centre Deutscher Wetterdienst (GPCC; model V7 for precipitation data), c. Climate Research Unit, University of East Anglia ((CRU; model CRU TS v.4.01 for precipitation and temperature data) were used. The available MWD data from several weather stations provided by Institute of Meteorology and Water Management (IMGW) started in 1951(56). The common period for the analysis covered years 1951(56)–2013. For a given precipitation and temperature agreement and biases between GCDs and MWDs were assessed with the absolute mean error (ME) and root mean square error (RMSPE), L1- norm and Pearson correlation coefficient. Finally, linear regression analysis was performed to detect biases in the relationship between GCD and MWD, and the coefficient of determination ( $R^2$ ) was also calculated. GCD for precipitation show high similarity to MWD. Mean Pearson correlation coefficient values equal to 0.87 for GPCC, 0.82 for CRU and 0.8 for UD GCDs. For temperature the received values of Pearson correlation were relatively high and very similar, i.g. 0.97 for CRU and 0.96 (UD). L1-norm, ME, RMSPE and regression model confirmed small differences between analysed GCDs, but with better fitting of CRU GCD.

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## **THE TIME VARIABLE AS A FACTOR TO DETERMINE THE ACOUSTIC CLIMATE IN THE RECREATION AND LEISURE AREAS**

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### **ABSTRACT**

The noise is commonly referred to as built-up areas and in the vicinity routes giving rise to the measures to mitigate its effects on adjacent areas. It is rarely investigated noise nuisance in green areas from the belief that they are silence zones. This position is not justified. Recreational areas are differentiated according to the destination, location, and availability. Their main task is to create comfortable living conditions, because spaces assessed by tourists as calm, more often cause a higher level of relaxation. One of the factors affecting the decreasing in comfort are excessive, troublesome, sound stimuli. Implementation of appropriate noise study for these areas can be the basis for the proper management of these areas. It should take into account the multiplicity of sound sources and elements affecting the propagation of noise. It is connected with the selection of the appropriate number of measuring points, which affects the duration of a single cycle. Acoustic conditions in these areas change depending on the time of day, so it would be required to simultaneously measure the equivalent sound level at all control points. The aim of this paper is to identify an optimized method of measuring noise, allowing the determination of the sound level results for clearly defined point of time. It covers how to select the control points, the measurement technology, and the calculation method. the selection of points analysis should be based in the first place on the zones separation with similar development, which will affect the optimization of the number and position of control points. Measurement method based on the simultaneous measurement of several noise level meters will preferably reduce the measurement time and adjust the connection and subsequent stations and the whole measurement series. In the calculation method presented, the use of corrections considering the influence of time and variable acoustic conditions has been proposed. The theoretical analysis was based on noise measurements in the spa park. It was implemented in different time periods. The final result is to indicate a method to the noise measurements of different spatial arrangement and purpose areas.

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## **ANALYSIS OF DISPLACEMENT AND DEFORMATION OF A STEEL FOOTBRIDGE**

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### **ABSTRACT**

In in-service structural diagnostics, besides the monitoring of changes in physical properties of materials it is essential to determine the dimensional stability of the structure as a whole. This is particularly important in the case of non-building structures exposed to variable and dynamic loading, such as overhead cranes, bridges, flyovers, telecommunications towers etc. Moreover, precise determination of the extent of deformation of structural elements enables quick identification of any weak points or damaged areas which need to be further tested and assessed. The object of the analysis carried out in this article is a steel footbridge over the River Brda in Bydgoszcz. The main part of the structure stretching between the river banks comprises nine pin-jointed bridge decks suspended on pylons using steel cable stays. The jointed bridge decks make up the top slab. The structural design of the footbridge is simple and clear. The footbridge is rather susceptible to static loading and dynamic ambient excitations. The research involved displacement and strain gauge measurements of the footbridge subjected to a test load. The test loading was applied by moving a loaded hand truck along the centre line of the footbridge deck and stopping it at predefined locations on deck segments. Vertical displacement was measured for each load setting at selected specific points of the bridge and the strain of the cable stays was determined on the basis of the measured values of displacement. Precise surveying technology was applied to measure the vertical displacement, enabling the location of control points with an accuracy of 0.25mm in three dimensions, whereas deformations and strains were determined using strain gauges. This article also includes an account of changes in the geometric features of the footbridge resulting from its long-term use. A simplified static load analysis of the load-bearing system of the footbridge was performed (2D model) with simulated test loads. The loads applied in the FEM model were equivalent to the load values determined through geodetic measurements. The developed model was then used to identify the displacement of control points. A comparison of the measurement results with the results of the numerical analysis revealed inconsistencies, both as regards the vertical displacement of the footbridge deck segments and the cable stay strains. An attempt was made in the article to explain the differences.

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**THREE PILLARS OF SUSTAINABILITY – ECOLOGICAL, SOCIOLOGICAL AND ECONOMICAL IN THE INTEGRITY OF URBAN LINKAGES IN GREEN INFRASTRUCTURE**

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**ABSTRACT**

The city sprawl phenomenon, responsible for incorporating new suburbs into cities, is constantly changing our landscape. The results of this phenomenon are the rapid decrease of forest cover, fragmentation of green areas and loss of biodiversity. The paper examines studies and contemporary Green Infrastructure practices in response to find a solution for an increasing demand for new residential and recreational green areas in urban environment. The subject of the analysis is related to the problems of, both, nature protection and well-balanced development of the built-up areas. This paper was motivated by the three pillars of sustainability – environmental, economic, and social to take an interdisciplinary approach to GI in the context of system of GI linkages. It is focused on the role of green linkages in the integrity of GI network, and their influence on ecological, cultural and landscape functions, in extremely transformed and polluted urban environment. The research makes an attempt to define the role of landscape linkages in the Green Infrastructure.

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**ALLOTMENT GARDENS AS SIGNIFICANT ELEMENT INTEGRATING GREENERY SYSTEM OF THE CITY**

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**ABSTRACT**

The greenery system of the city is an extremely important element of the urban structure. It is responsible for the proper functioning of the city in the ecological and natural aspect, but also supports social functions. The dynamic development of urbanized areas and the pressure of investment causes often the reduction or elimination of allotment gardens area. The paper presents example of the system of city with particular reference to allotment gardens. It is focused on the contemporary role of allotment gardens as an element of green areas in the city. It is attempted also to determine the factors that affect the integrity of the Green Infrastructure and sustainability development of the urban structure.

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**EXPERIMENTAL RESEARCH OF NON-AUTOCLAVED FOAM CONCRETE WITH THE UNCONVENTIONAL REINFORCEMENT**

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**ABSTRACT**

Foam concrete is classified as a lightweight concrete. It is a cementmortar in which air-voids are entrapped by foaming agent. Its practical application is mainly limited to non-structural material. For many years, the application of foamed concrete has been limited to backfill of retaining walls, insulation of foundations, roof tiles and sound insulation. However, in the last few years foamed concrete has become a promising material also for structural purposes. When the marginal loads are reached, all of alveolar concrete, included foam concrete, are destroyed without previous deformations. So, the main condition for the safe and reliable foam concrete use in the structures elements is to increase its strength characteristics for short and long loads. Span constructive elements of foam-concrete are performed similar as usual, reinforcement is performed by steel armature smooth or periodic profile. Experimental and theoretical research of comprehensive light concrete span elements and other types of reinforcement, their use in the methods of calculation such the constructions with untraditional reinforcement are not explored and used enough. One way to solve the problem – replacing traditional reinforcement to untraditional one (for example, organic or biological materials, different kinds of grids). The results of experimental and theoretical research of foam non-aerated concrete elements, the features of their work under the load are presented in this article. In this article are proposes one of the methods of increasing the strength of non-autoclave foam concrete making use of secondary waste. The results were compared with the results of tests of unreinforced elements.

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## **MAPPING INVASIVE PLANTS IN RIVERBANK VEGETATION**

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### **ABSTRACT**

Invasive plants are naturalised plants that create populations that are spreading rapidly and to the long distances from parent plants. Invasive plants are occupying a large amount of space in invaded habitats, expected to impose a negative impact on the native vegetation. This study is focused on bearing the invasive plants close to the river. Based on the field work and measurements there can be seen relation between riverbank vegetation and river. We are mapping the occurrence *Impatiens glandulifera* and *Fallopia japonica*. They are invasive plants that threat the natural riverbank ecosystems. We updated the database of localities showed in the research of State Nature Conservancy of the Slovak Republic and we identified a new locality of invasive plants. The focus of our research is the riverbank vegetation on the streams in region Malé Karpaty in Slovakia. *Impatiens glandulifera* and *Fallopia japonica* invate the riverbank vegetation very often. Natural vegetation is degradated and the balance state in nature is broken. The spread of the invasive plants is driven by the dispersal and the colonization capabilities of the vegetative and sexual propagules. Our study focus on how the water dispersal of stem and rhizome fragments have a share of the colonization dynamics of riverbanks. Watercourses are powerful vectors of species colonizing riverbanks. Invasion by these species is therefore likely to seriously affect biodiversity and reduce the quality of the riparian ecosystems for amphibians, reptiles, birds and mammals whose diets are largely composed of arthropods. The biodiversity is rapidly decreasing and therefore it is very important to decelerate the invasive process.

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**MICROFILTRATION IN WATER TREATMENT FOR REMOVAL OF SUSPENDED SOLIDS AND NATURAL ORGANIC MATTER**

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**ABSTRACT**

Membrane separation processes are increasingly being used not only for water treatment of sea water during last years, but in the treatment of ground, surface and waste water as well. In consideration with a classic treatment (such as coagulation and classic filtration) the reason of increasing popularity of use of membrane processes in a treatment of drinking water is mainly in a water quality of a treated water that is being achieved by using membrane technologies. Membrane processes solve a lot of requirements connected to tighter specifications for various undesirable substances. These substances are presented in water which makes them a reasonable issue in obtaining a quality drinking water. The biggest advantage of these processes represents their ability to remove completely the pathogenic organisms resistible to the disinfection based on using chlorine. Membrane technologies are very efficient also in combination with a proper pre-treatment of water in removal of presented natural organic matter (NOM) whose presence is responsible for an ineligious colouring of the water, the odour and taste of the water. These substances mainly act as the pre-cursors for formation of the disinfection by-products. At this article are presented membrane separate processes – microfiltration, ultrafiltration, nanofiltration in water treatment and materials and modules used in application of various membrane technologies. Theoretical part is completed with results from pilot plant experiments realised in water treatment plant Klenovec, where was used the microfiltration technology for removal of insoluble substances (expressed by a number of particles) from water. Over the last years water quality has deteriorated in water-supply reservoir Klenovec and this technology was tested for the purposes of modernization of the inefficient technology in water treatment plant. The pilot-plant tests for membrane filtration examination were carried out by using the microfiltration unit AMAYA 5 with a performance of 5 m<sup>3</sup>/h. Coagulation and flocculation run in two stages. At the first stage, the coagulant is dosing into a static mixer, which led the mixture to the second stage from. The second stage represents the tubular flocculator. In the membrane module, there is placed one ceramic element with a membrane surface of 25 m<sup>2</sup>, pores size of 0.1 µm, and consisting of 2000 tubules with a diameter of 2.5 mm. The results obtained from pilot plant experiments in WTP Klenovec supported theory, that this process with high efficiency of treatment surface water is suitable for this kind quality of water to obtain water for drinking purposes.

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## THE SELECTED SORPTION MATERIALS FOR REMOVAL OF HEAVY METALS FROM WATER

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### ABSTRACT

Increased pollution of water resources leads to deterioration of surface water and ground water quality and it initiates application of various methods for water treatment. Passing the Decree of the Ministry of Health of the Slovak Republic No. 247/20174 on requirements for drinking water and monitoring of drinking water quality have determined the limit of heavy metal concentrations in drinking water. Based on this fact some water resources in Slovakia became unsuitable for further use and they require appropriate treatment. The present research related to removal of heavy metals is focused on introduction of natural materials as well as industrial and agricultural waste that can be used as cost-effective sorption materials. Arsenic and antimony are present in the aquatic environment as result of rock weathering reactions, biological activity, geochemical reactions, volcanic emissions, mining operations and anthropogenic activities. The objective of this work was to verify the sorption properties of granular filter materials READ-As (hydrous cerium dioxide adsorbent) in removal of heavy metals from water. This material was developed in Japan for removal of arsenic from water. One part of experiments was carried out in ground water source Dúbrava, where a high concentration of antimony in water is caused from mining activities as well as from rain falling on antimony-rich waste rock piles and a sludge-settling pond has led to higher concentrations of antimony in the relevant water resources. At the other part of article there are presented results with the same material READ-As for removal of arsenic from ground water source in Jasenie. The values of the bed volume and the adsorption capacity for this sorption material when reaching the limit concentration of antimony and arsenic were determined. READ-As material has shown to be more efficient in antimony removal from water in Dúbrava locality than GEH, for average antimony concentrations of antimony in a raw water 27.73 µg/L, filtration rate 5.579 m/h reached the antimony concentration of 5 µg/L in the outflow from the adsorption column of high level 48 cm,  $V/V_0$  (bed volume) 3967 and adsorption capacity of a value 128.4 µg/g. Limit concentration of antimony 5 µg/L was exceeded after 336 hours of operation of the model equipment while the amount of the water that flowed through the equipment was 3,74 m<sup>3</sup>. Lower efficiency of the GEH material in Sb removal from the water was observed in consideration with currently published results (by an impact of pH change of the raw water). By pilot plant tests in Jasenie locality was determined adsorption capacity 354 µg/g and ration  $V/V_0$  (bed volume) 5130 µg/g for water with arsenic content of 55-60 µg/L and filtration rate 5.35 m/h, two steps filtration with READ-As material. These values were determined when the limit concentration of arsenic in water outflowing the columns (10 µg/L) was reached. Mentioned values are significantly higher than it was in a case of antimony.

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## **EVALUATION OF TEMPORAL LEACHABILITY OF STRONTIUM FROM BUILDING MATERIALS TO THE ENVIRONMENT**

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### **ABSTRACT**

The presented article covers very current issues regarding the assessment of trace element release from building materials to the natural environment. Strontium belongs to the trace elements mentioned in the group of potential reference chemical markers of the building materials. The leachability of strontium from monolithic samples was determined on sedimentary and igneous stone materials as well as ceramic materials: bricks. 40 samples were analyzed in which the leachability of the subjective element for 8 temporal fractions was determined. The research methodology was implemented in accordance with the applicable standard requirements. Execution of water extracts took place in accordance with NEN 7375: 2004 standard. The mineralization of aquatic eluates was prepared according to the PN-EN ISO 11885 standard. The strontium concentration was determined using the ICP sequential plasma-emission spectrometer. Research for pH measurement was performed using a pH-meter CP-105 waterproof IP67 ELMATRON calibrated with buffer solutions of pH 4 and 7. The highest strontium content in the aquatic eluates was identified in bricks ranging from 0.01 - 0.45 ppm. From the group of the sedimentary rocks the highest leachability of this element was determined in the opoka-rocks at its maximum content of 0.15 ppm and in the sandstones 0.05 ppm. Water extracts from the igneous stone materials did not show the presence of strontium.

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**RESEARCH ON TEMPORAL LEACHABILITY OF TRACE ELEMENTS FROM OPOKA – ROCKS IN THE ASPECT OF GEOCHEMICAL ENVIRONMENTAL INDICATORS**

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**ABSTRACT**

As part of the work on the trace element concentration in building materials and their leachability to the environment, the analyses of the temporal release of the trace elements group that could play a role as environmental chemical indicator were carried out. For a period of about half a year, in water eluates with different temporal fractions the leachability for: Sr, Ba, Mg, Mn, Zn were determined. Lumpy varieties of the opoka-rocks from the pre-industrial deposits and historical buildings were the material subjected to the analyses. The research methodology covered studies using broad analytics. The phase methods were used in order to uniquely identify the crystalline components of the studied rocks. Mineralogical and petrographic investigations were performed using Olympus BX-51 polarizing microscope and (SEM) FEI Quanta 200FEG electron microscope equipped with an X-ray spectrometer (EDX Genesis) and a backscattered electron detector (BSE). The concentration of these trace elements in water eluates in 8 temporal fractions was carried out in accordance with NEN 7375: 2004 and PN-EN ISO 11885 standards using the ICP sequential plasma spectrometer. The pH measurement tests were carried out using a pH-meter type CP-105 waterproof ELMATRON IP67 acc. PN-ISO 10390: 1997. It was found that the series of leachability of the studied elements in decreasing succession is as follows: Mg > Sr > Zn > Ba > Mn. The highest leachability from the selected elements was found for Mg, which ranged from 0.22 to 1.14 ppm.

**TRACE ELEMENTS IN SEDIMENTS TRAPPED BY FLUVIAL POTHOLES IN A SMALL BEDROCK RIVER (NW SPAIN)**

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**ABSTRACT**

The research about the contamination of waters and sediments was focused mainly in large rivers and estuaries. There are lack specific studies from the small rivers in inland areas, particularly in the case of small bedrock rivers. This study presents the first results about the contents of trace elements in sediments trapped by fluvial potholes in a small bedrock river. The river potholes were studied as landforms linked to mechanisms of water erosion and valley incision, but the environmental assessment of their sediments related to contamination was scarcely explored. Considering the sand fraction of the sediments trapped by potholes in the Loña River, the purpose of research was to obtain site-specific data for small bedrock rivers, to assess their contamination degree, and to provide relevant information for the reference of a local background level. The Loña River is a first-order tributary of the mainstream in the NW of Spain (the Miño River). It is 19.96 km long and drains a small basin (138.48 km<sup>2</sup>) over granitic rocks. The survey area was a reach delimited upstream of a dam. The basin embraces a rural area, classified by the Eurostat criteria as sparsely populated, where forestry and farming are the main land uses. Six potholes developed in the bedrock channel were selected for the purpose of research. Sampling of sediments took place at the summer (July 2014). Once determined the concentrations of trace elements (Cr, Mn, Ni, Cu, Zn, Rb, Sr, Y, Zr, Ba, Pb) in the lab of the Scientific and Technological Centre to Research Support (CACTI, University of Vigo), the statistical analysis of the data was developed using of no parametric techniques. The Silica was the principal element of the mineralogical composition of the sand fraction. The statistical analysis reported the greater variability in concentrations for Zr and Sr. The results from the rank correlations indicated strongly positive associations as follows: Rb whit Sr and Y whit Cr. Clustering of the data provided the groups (Y, Zr, Cr); (Rb, Sr); and (Cu, Ba, Pb, Zn). The lithological source of the sands, the mineral stability during weathering processes that affect granitic rocks and the human pressures (land uses) may be related to these preliminary results; and provide significant information in order to test the environmental conditions in small bedrock rivers.

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**METHOD DEVELOPMENT FOR DETERMINATION OF EDTA IN WATER BY USING TRADITIONAL SPLIT/SPLITLESS INJECTOR – COMPARING EXTERNAL AND INTERNAL STANDARD METHODS OF QUANTIFICATION**

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**ABSTRACT**

Ethylenediaminetetraacetic acid (EDTA) has increasing potential as an environmentally hazardous material. Although EDTA exhibits relatively low acute toxicity, it has been found to be cytotoxic and weakly genotoxic in laboratory animals. In addition, oral exposures can cause reproductive and developmental effects. EDTA is commonly used in wood industry, pulp and paper industry, textile industry, cement industry and food industry. It is also widely used in laundry applications in order to reduce the water hardness and in many cleaning solutions. Due to chemical properties of EDTA (polarity, relatively good solubility in water, chelating ability towards metal ions) it cannot be efficiently removed on common water treatment plants. As a result, the EDTA can be observed in the aquifer downstream near the outputs from water treatment plants of larger industrial entities. Therefore, the reliable monitoring of EDTA in water samples is of great importance. Commonly, the chromatographic methods are used for EDTA analysis with dominance of liquid chromatography coupled with UV-VIS or MS detectors. However, these methods suffer often from the lack of sensitivity towards EDTA at ppt levels. The combination of gas chromatography with high resolution MS can offer significantly lower detection limits (units of µg/l) as well as powerful identification tool. However, the derivatization of EDTA is required when GC-MS is being used. In addition, according to the Czech standard for EDTA determination the Programmed Temperature Vaporising (PTV) injector or cool on-column injection are recommended. In our paper we report on the GC-MS method development for determination of EDTA in water by using traditional split/splitless injector. We compare the external and internal standard methods of EDTA quantification for several different internal standards. The developed method was applied to analysis EDTA in real aqueous samples.

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## **SEASONAL AND FLOOR VARIATIONS OF INDOOR RADON CONCENTRATION**

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### **ABSTRACT**

Radon is a naturally occurring, colourless and odourless radioactive gas, with a half-life of 3.8 days. Dangerous is not radon itself, but its progeny (daughter) products. The radon decay products irradiating of the lung. There is a strong correlation between radon exposure and lung cancer. The indoor radon concentrations in residential buildings are monitored. The study is performed in eight storied blocks of flats and also in family houses. The contributed deals with the radon concentration depending on a year season and floor level. Radon concentrations are varying with the characteristics of the building and its ventilation. Statistical analysis of the results shows that the probability that a weekly measurement represents the yearly radon concentration is significantly higher (twice) in winter and in summer than in summer and autumn. The maximum values of radon concentration is obtained in the first and second-floor rooms might be due to the contribution of radon emanation from the soil, entering into the living spaces from the ground.

Corresponding Author: Michal Kraus

**THE EFFECTS OF PROCESS PARAMETERS ON THE CO-LIQUEFACTION OF ELBISTAN LIGNITE  
AND APRICOT KERNEL SHELL**

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**ABSTRACT**

Since it is causing environmental pollution and not economic, direct use of coal with high ash and sulfur content is not preferable. Before such fuels are used, the ash and sulfur ratios can be reduced to a certain amount or an alternative fuel can be obtained by liquefying the fuel. Usage of biomass as an energy resource alternative to petroleum is a topic of investigation today since it is renewable and does not cause environmental pollution. Use of biomass as diverse raw materials like plants, household wastes, animal wastes and microorganisms is considered to be a potential resource for energy generation. The apricot kernel shell is thought to be a useful biomass source for the liquefaction process, due to the relatively small amount of ash and moisture contained therein. Various processes are being applied to convert biomass resources into a fuel effectively alternative to the petroleum. Some of these processes are gasification, liquefaction, supercritical gas extraction and pyrolysis. However, the most preferable method for generating a fuel direct alternative to petroleum is liquefaction. In this study, the co-liquefaction of Elbistan lignite and biomass investigated by using apricot kernel shell as a biomass type. The liquefaction experiments were carried out under inert atmosphere and non-catalytic conditions. The effect of particle size, coal/biomass ratio, and reaction temperature were examined as a process variable to determine the effect of process parameters on total conversion of products obtained by liquefaction and the conversion of liquefaction products.

Corresponding Author: Hüseyin Karaca

**THE CHARACTERIZATION OF THE PRODUCTS OBTAINED BY CO-LIQUEFACTION OF ELBISTAN LIGNITE AND APRICOT KERNEL SHELL**

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**ABSTRACT**

The direct use of coal with high ash and sulfur content is not preferable due to environmental pollution and the fact that it is not economic. High ash and sulfur-containing fuels can be enriched by processing them in a variety of ways before they are used or liquefied to obtain a new fuel alternative to the petroleum. Besides, the reserves of fossil fuels are limited. Therefore, it is of utmost importance to obtain a new fuel as a basic chemical raw material and in place of conventional energy sources, i.e. as an alternative to the petroleum. The biomass as a renewable resource sets an important research topic of today, because it is relatively advantageous to fossil fuels in terms of continuous energy demand and environmental pollution. Use of biomass as diverse raw materials like plants, household wastes, animal wastes and microorganisms is considered to be a potential resource for energy generation. In this study, the characterization of products obtained with the co-liquefaction of Elbistan lignite and biomass is made by using the apricot kernel shell as the biomass. The liquefaction tests were carried out in an inert atmosphere in non-catalytic conditions. The calorific value, proximate and elemental analyses of the solid products and the calorific value, elemental analyses and the qualitative and quantitative analysis of the liquid products obtained with the liquefaction were made. The qualitative and quantitative analysis were made by the gas chromatography-mass spectrometry. After the characterization process, the effects of the process parameters on the composition of solid and liquid products were also determined.

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## ELEMENTAL ANALYSIS AND CALORIFIC VALUES OF ELBISTAN LIGNITE AND LIQUEFACTION PRODUCTS

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### ABSTRACT

In this study, the chars obtained from alone Elbistan lignite (EL) and EL+manure liquefaction analysed both by elemental and calorific analysis comparing to  $(H/C)_{atomic}$  and  $(O/C)_{atomic}$  ratios and calorific value changes. Liquefaction experiments carried out with 0-12% of catalyst concentration, 1/1-9/1 of liquid/solid ratio, 30-120 min of reaction time, 1/1-1/9 of manure/lignite ratio, 375-400 °C of reaction temperature, the stirred speed of 400 rpm, and the initial nitrogen pressure of 20 bar was fixed. During the past four decades, various methods have been developed to determine the thermal coal characteristics and these depend mainly on its chemical composition, rank, maceral analysis, grade and origin. Elemental compositions,  $(H/C)_{atomic}$  and  $(O/C)_{atomic}$  ratios determined due to the elemental analysis results and calorific values of chars. Elemental analyses and calorific value results recommend a polarity, calorific values and greater aromaticity of co-liquefaction of EL with manure than alone EL liquefaction. Hence, the raises in the calorific value most likely happens throughout the procedure due to the removal of oxygen functions. It describes the favorable aspect of co-liquefaction process towards alone EL liquefaction. The results explain that  $(H/C)_{atomic}$  ratio and calorific value of EL liquefaction enhanced when co-liquefaction of EL with manure by the manure/lignite ratio of 1/4. On the other hand,  $(O/C)_{atomic}$  ratios were reduced.

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## PETROGRAPHIC AND PROXIMATE ANALYSIS OF ELBISTAN LIGNITE AND LIQUEFACTION PRODUCTS

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### ABSTRACT

In this study, Elbistan lignite (EL) (East region of Turkey, 35% of Turkish lignite reserves) characterized by petrographic analysis. The higher exinite value obtained. Even though lower liquefaction properties of EL combined with manure liquefaction conducted to determine how manure effect on liquefaction of EL. In addition, proximate analysis of EL and manure and co-liquefaction products (chars) conducted to compare how manure combination with EL effect on liquefaction results. Microscopic constituents of coal call as inorganics (minerals) and macerals. Coal petrology also has direct industrial applications such as predicting metallurgical coke quality and the properties of coal blends, coal preparation practices, degree of coal oxidation, coal briquetting practices, land evaluation and mine development, and monitoring the properties of the feed to an electricity generator. The chemical composition of coal is commonly estimated by proximate analysis, which reveals the percentage of moisture, volatiles, ash, sulphur, and the calorific value. Moreover, proximate, and petrographic analyses are made in order to classify coal and evaluation of gaseous hydrocarbons retained by coal. According to petrographic outcomes, random reflectance below of 0.38 is lignite and below of 0.40 is sub-bituminous lignite so as to the formation of EL describes as subbituminous character. A few of the clay minerals, and a couple of quantity of pyrite minerals included with the technique of the ASTM D2798. Vitrinite+lignite content which is 70% means lower conversion of EL alone by liquefaction procedure. However, the results of the oil+gas yields and the total conversion increasing presents the EL liquefaction with manure enhances the liquefaction properties of EL.

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**THE CO-LIQUEFACTION OF ELBISTAN LIGNITE AND BIOMASS PART: THE EFFECT OF  
COLEMANITE AND Fe<sub>2</sub>O<sub>3</sub> CATALYST BLENDING**

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**ABSTRACT**

In this study the colemanite (a natural calcium borate mineral, NCBM) and Fe<sub>2</sub>O<sub>3</sub> used as a catalyst on the liquefaction of Elbistan Lignite (EL, which has the most reserves in the east of Turkey) combined with waste paper. The liquefaction experiments were carried out at the reaction temperature of 400 °C, reaction time of 90 min, solvent/solid ratio of 3/1, lignite/biomass ratio of 2/1, stirring speed of 400 rpm, and initial nitrogen gas pressure of 20 bar. Fe<sub>2</sub>O<sub>3</sub> and colemanite were together prepared as a new catalyst. Research has been made the recent observation that the highest liquefaction product yields especially from a series of valuable fractions obtained, with the highest mineral content of a lignite. According to that model colemanite mixed with Fe<sub>2</sub>O<sub>3</sub> to decide if mineral content effect on total conversion if mineral substances added separately from coal. In our previous study, Fe<sub>2</sub>O<sub>3</sub> selected as the most suitable catalyst type and waste paper as the most suitable biomass type so in this study waste paper used as the biomass with EL co-liquefaction experiments. To understand how effect colemanite (as an economical catalyst source and also has high reserves in turkey) on the liquefaction of EL with waste paper. The experiment conditions fixed as same as our previous study and so compared due to the total conversion values.

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## AN OVERVIEW ON THE URANIUM-235, URANIUM-238 AND RADON-222 DISTRIBUTION IN GROUNDWATER IN THE SOUTH-EASTERN ARABIAN PENINSULA

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### ABSTRACT

Quantifying environmental impact of naturally produced radionuclides on the human health and mapping their distribution in groundwater among the different aquifers are an essential aspects of groundwater quality assessment. We here present a study that was conducted in the south-eastern Arabian Peninsula to examine the uranium-235 (U-235), uranium-238 (U-238) and radon-222 (Rn-222) concentrations in groundwater aquifers. Many groundwater samples were collected from three types of aquifers: sand dunes, alluvial clastics and carbonate rocks. The results indicate average values for U-235 at 0.2 mBq/L, 1.4 mBq/L and 2.0 mBq/L in the groundwater of the sand-dunes, alluvial clastics and carbonate rocks respectively. The averages of uranium-238 in the groundwater are 4.6 mBq/L for sand dunes, 29.2 mBq/L for alluvial clastics and 42.4 mBq/L for carbonate rocks. The averages of radon-222 in the groundwater are 6.9 Bq/L for sand dunes, 14.2 Bq/L for alluvial clastics and 160.7 Bq/L for carbonate rocks. The highest averages of all measured radionuclides were found in the groundwater of carbonate aquifers. In terms of environmental impact, the concentrations of the radionuclides exceeded the World Health Organization permissible limits for drinking water in only few samples. The effective dose was also calculated for all the samples to estimate a possible health impact in case of direct ingestion. Negative impacts were mainly assigned for some groundwater samples of the carbonate aquifers. The data suggest a relation between the aquifer type and some elevated concentrations of certain radionuclides. In addition, it was observed that the soluble radionuclides concentration increases with increasing distance from the water recharge area. This feature can be explained as due to the longer rock-water interaction pathway or longer resident time of the water in the aquifer.

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## LIFE CYCLE ASSESSMENT OF THE BIO-MITIGATION IN A STEEL AND IRON INDUSTRY USING MICROALGAE

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### ABSTRACT

Pulverized Coal Injection (PCI) used for the first time in 1850 by a French and a Belgian entrepreneur. Because of its increasing use, today, PCI has become the most traditional method decreasing the amount of coke consumption in high ovens. To increase capacity of coal burning process results an increase in ore/coke rate and a decrease in greenhouse gases (CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>) emissions, in terms of environmental effects, it constitutes significance. Life cycle Assessment (LCA) methodology is preferred in many studies as an evaluation method for economic and environmental effects used in production areas at present. Microalgae are important for the bio-mitigation of carbons/biological sequestration due to their property of under greenhouse gases and under flue gas effectively. Steel and iron industry is known for its high capacity of these kind of gases and microalgae pond integrated to a steel and iron industry can be a good way of struggling the unwanted impacts of these gases. Our project aims to develop a technology to burn Turkish coal and microalgae biomass resources and their mixtures at certain proportions under LCA. In our study, SimaPro® LCA simulation will be used to find out the most ideal burning conditions of the coal and microalgae biomass mixtures. The results obtained in this study will be used to create a database on LCA evaluations in energy areas of Turkey.

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## **SUSTAINABLE MICROALGAE-BASED BIOFUEL PRODUCTION USING ADAPTIVE STRESS STRATEGIES**

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### **ABSTRACT**

Sustainable environment management is a concert action in which renewable energy sources, pollution and non-renewable energy sources are combined to solve environmental problems in economic and social perspectives. While non-renewable energy sources such as nuclear, fossil fuel are depleting, the renewable energy sources wind, water, biomass and the others becomes more desired. Whenever the scarcity of energy sources started, usage of microalgae as an alternative fuel production becomes attractive solution because of high lipid storage capacity and using the light as an energy source. Conversely, the production cost of the fossil fuels is still lower than the fuel production from algae. In the economical point of view, algae are not suitable for the biodiesel production. To be economically efficient, lipid production efficiency of microalgae should be increased in somehow such as adapting the microalgae to the more lipid producing conditions. During adaptive evolution and adaptation period, microalgae have genetic alterations and physiological acclimation to the new growth medium and the changes in the metabolism of the microalgae can even be identified in genomic level. In this study, the adaptation of microalgae to the excess amount of trace elements and NaCl was monitored. To create a genetically rich mutant pool, UV mutation procedure was applied to microalgae. The change in the biomass and lipid quality was evaluated.

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## DETERMINATION OF MICROPOLLUTANTS IN WASTEWATER TREATMENT PLANT SLUDGE BY LC-MS/MS

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### ABSTRACT

Human drug residues are chemicals that can be observed in water, soil and waste sludge at very low concentrations, such as  $\mu\text{g} / \text{L}$  and  $\text{ng} / \text{L}$ , and are particularly accessible to sources of drinking water by various ways (discharges, flows, transports etc.). Although micropollutants are observed at low concentrations, they have potential treat to water environment and human health. There are several studies about the fate of micropollutants in wastewater treatment plants such as Olofsson (2004) analyzed the daily changes of the Umeå Treatment Plant by analyzing 5 selected micropollutants compounds (norfloxacin, ofloxacin, ciprofloxacin, sulfamethoxazole and trimethoprim). Jelic (2102), on the other hand, observed 43 micropollutants in 3 different biological wastewater treatment plants belonging to Catalonia region for about 2 years. Within the scope of this study, the fate of micropollutants in treatment plants was monitored monthly in selected wastewater treatment plants in Turkey. The main goal of this study to obtain information about the presence of human drug residues in the wastewater treatment plants and to get data about whether there is biodegradation or bioaccumulation of micropollutants during the treatment processes. Analysis of samples was performed on the ThermoScientific brand LC-MS / MS with the EPA 1694 procedure. According to Annex IV of the Waste Management Regulation, the treatment sludge is considered as non-hazardous, but the human medicines and micropollutants are not included in this assessment. Therefore, the human drug content and potential effects of the treatment sludge was identified in this study.

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**WASTE HEAT RECOVERY IN A STEEL HOT-FORGING INDUSTRY UTILIZED IN AN ORGANIC RANKINE CYCLE**

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**ABSTRACT**

Waste heat recovery in industrial activities is virtually an “energy saving method” which can be introduced into a productive system with successful results as far as technical, economic and environmental aspects are concerned. It is now in fact evident that a careful heat waste management leads not only to primary energy savings, but also to a reduction in greenhouse gas emissions, often with economic sustainability. The case presented here refers to a steel hot-forging industry situated in the Nord-west of Italy that is equipped with steel hot processing devices, and, in particular, with methane ovens for the hot cutting machines. Therefore, the objective of the present work was to carry out a project aimed at the recovery of the hot flows exiting from the ovens in order to produce electric and thermal power that could be used in the same industrial activity or in tertiary activities near the factory itself. After an in-depth analysis in this technological activity inside the factory concerning the electricity and natural gas consumption and hot gas flow-rate availability, different power plant solutions were considered and evaluated. At the end of the analysis process, the choice fell upon an Organic Rankine Cycle with a power of 50 kW<sub>el</sub>. The technical and economic analysis of this powerplant furnished a pay-back period of 20 years, as far as electrical energy is concerned, which was considered excessively long. An acceptable pay-back period, that is, of less than ten years, was instead found for the recovery of the thermal power of the ORC plant, which could be utilized, through a remote heating system, for public buildings, such as elementary/primary schools and the City Hall, which are located very close to the factory. In short, with this plant solution, it will be possible to produce more than 150 MWh/year of electric energy and about 600 MWh/year of thermal energy, with a reduction in CO<sub>2</sub> emission of around 50 tons per year

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## **REMOVE THE PHARMACEUTICALS FROM WATER USING SELECTED ADSORBENTS**

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### **ABSTRACT**

As part of the project of specific university research at the Institute of Municipal Water Management of the Faculty of Civil Engineering, Brno University of Technology, a laboratory test was carried out to try and remove to pharmaceuticals from water using selected sorption materials. The goal of the laboratory test was to compare two selected adsorbents as Filtrasorb F100 and Bayoxide E33 in terms of pharmaceutical removal effectiveness from water. Salicylic acid was selected as a pharmaceutical; which is a colourless organic acid, which is of great importance in the field of dermatology and is a proven tool for various dermatological problems including acne. This is a pharmaceutical that is obtained from the bark of a willow white. Sorbent Filtrasorb F100 is in practice commonly used for the removal of micropollutants, as opposed to the sorbent Bayoxide E33, which is used to remove metals from water. In order to remove pharmaceutical from water, two glass columns were used with internal diameter 4.4cm filled with said sorption materials. Height of sorbent was elected as recommended by the producer of filter material at least 75 cm. Model water was prepared in laboratories by mixing liquid pharmaceutical into drinking water. Samples of filtered water were taken after 0.5 minute and after or 1, 2, and 4 minutes respective. Totally 9 samples including model water were taken. The analysis of water samples after filtration from individual columns with said sorption materials showed found that Filtrasorb F100 reliably removed to concentration of salicylic acid after half a minute, while Bayoxide E33 started remove the acid but from one minute higher concentrations were onwards measured again. This means that the latter material was oversaturated, and therefore gradually ceased to remove the acid.

Corresponding Author: Daniela Šíblová



## **USE OF SORPTION MATERIALS FOR REMOVING CADMIUM FROM WATER**

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### **ABSTRACT**

Groundwater and surface water sometimes contain substances that do not occur frequently in such water. Such substances include some of the metals. Increased iron and manganese content is expected in groundwater; however, metals such as cadmium, nickel or arsenic in high quantities are not typical of this water. Still, there are sources where the occurrence of cadmium, arsenic and other metals is in concentrations exceeding the prescribed values for drinking water. Because of the toxicity of heavy metals, authors dealt with the possibilities of removing cadmium from water. There are many ways to remove heavy metals, however today iron hydroxide based granulated sorption materials are used due to their simplicity, efficiency and low economic demands. The laboratory experiments of the removal of cadmium from water were carried out at the Institute of Municipal Water Management, Faculty of Civil Engineering in Brno as part of a specific university research project. The aim of the experiment was to compare the ability of three sorption materials CFH 0818, Bayoxide E33 and GEH on the removal of cadmium from water. These materials were primarily designed to remove arsenic from water. Filtration columns filled with the mentioned sorbents were used for filtration. Drinking water was used as raw water during the measurement from the municipal water supply system in which increased cadmium concentration was achieved artificially by adding a chemical solution. During the experiment, the flow rate was set to reach the required retention time of 2.5, 5, 10 and 20 minutes taking into account the porosity of the media. The results of the laboratory measurement show that all three materials were able to reduce the concentration of cadmium deep below the limit laid down by Decree No. 252/2004 Coll. already at the shortest delay time. Contact filtration occurred unequivocally in all sorption materials during the removal of the cadmium.

Corresponding Author: Renata Biela

## EXPERIMENTAL STUDY OF THE GAS HYDRATES DISSOCIATION EFFECT ON THE PROPERTIES OF THE HOST MARINE SEDIMENT

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### ABSTRACT

Gas hydrates consist of small molecules trapped in crystal lattices of water molecules in a form resembling to common ice. Light hydrocarbons from methane up to butane are suitable for forming hydrates in the presence of water at low temperatures as well as under elevated pressures and at temperatures exceeding 20°C such as the conditions prevailing at the seabed of deep seas. The hydrate forming components are abundant in subsea sediments at conditions inside the hydrate stability zone, leading thus in estimations of the natural gas quantities trapped in the crystal lattices that are orders of magnitude greater than the ones of the conventional reserves. The vast majority of natural gas hydrates is expected to be hosted at the subsea sedimentary geo-environment of clayish sediments. Despite the fact that such hydrates are not exploitable under the current technology, they can pose an environmental risk in case of uncontrolled dissociation. Such dissociation can occur due to either a temperature rise, as a result of global warming, or to the reduction of hydrostatic pressure, caused by geological movements. In this work, the effect of gas hydrates dissociation on the mechanical properties of a muddy clayish sediment retrieved from the “Anaximander” subsea mud volcano area and on its ability to conduct flow, was studied. This area is known to contain several active mud volcanoes (MV) that host gas hydrates in sediments very close to the seabed. In particular, one of the area’s MV can be especially sensitive to climate changes since it is located at the boundaries of the stability zone. A marine sediment was reconstituted in vitro with in-situ retrieved mud, water and hydrocarbon gas mixtures of compositions similar to the ones measured just above the seabed and was brought at conditions favouring the formation of hydrates. Geomechanical tests were conducted on the reconstituted clayish sediment before and during the dissociation of the guest hydrates, by isobaric heating and by isothermal depressurization. The changes inflicted on the permeability, compressibility and on the overall volume of the clayish sediment were measured and related to the extent of the dissociation of the guest hydrates. The way by which the dissociated gas was released from the porous media was also observed. Permeability was found to increase moderately during hydrate dissociation, possibly due to the high effective stress, similar to the one applied at depths of a hundred meters below the sea floor. The consolidation of the formation was increased up to a maximum – just before the hydrates start to decompose – and then collapsed when the free gas was produced. The bulk sediment volume was reduced by around 15% when the liberated gas was released from the formation in sudden “bursts” which occurred sporadically. The experimental results presented in this study seem to support the possibility of subsea landslides and the hydrate gun hypothesis for similar areas as a result of hydrate dissociation.

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## CADMIUM REMOVAL FROM AQUEOUS SOLUTION USING NANO-IRON DOPED LIGNITE

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### ABSTRACT

In the present study the removal of Cadmium (Cd) from spiked aqueous solutions using a low quality lignite (LG) was studied. A comparison between the adsorption capacity of activated carbon (AC) and lignite is presented, while the enhancement of the adsorption capacity, by adding nano-scale zero valent iron (nZVI) onto AC and LG was investigated. To study the enhancement of adsorption capacity, two materials were synthesized (LGFe, ACFe). The sorbents were characterized by Scanning Electron Microscopy (SEM-EDX), while their sorption efficiency, for Cd removal, was investigated with kinetic and equilibrium studies performed in batch conditions. With the proposed procedure nZVI was successfully “loaded” onto lignite and Cd removal from solutions reached 90%. The addition of iron nanoparticles in organic materials significantly increased adsorptive capacity, which was more drastic in the case of lignite. The experiments showed that sorption equilibrium was achieved within 12 h for all materials and that maximum adsorption capacity of LG, AC, LGFe, and ACFe was 25.5 mg/g, 30 mg/g, 34.7mg/g, and 36.5mg/g, respectively. The results of the equilibrium experiments proved to fit better to the Freundlich equation.

Corresponding Author: Despina Pentari

## HOW TO COPE WITH WATER CRISIS? THE USE OF WATER FOOTPRINT INDICATOR TO IMPROVE THE USE AND CONTAMINATION OF THIS RESOURCE IN A TEXTILE INDUSTRY

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### ABSTRACT

Freshwater inventories around the planet are being rapidly depleted and contaminated due to human activities. Quantity and quality of this precious resource are already compromised. A water crisis is already happening and if we continue to use and contaminate our freshwater resources at the current pace, the consequences will be catastrophic for life on the planet. Nonetheless, it is possible to delay and even stop this problematic if their origins are correctly addressed, by creating understanding and awareness of the situation, particularly where the impacts for freshwater resources are bigger. Among the activities that consume and contaminate more water are agriculture, industry and domestic consumption, all of them human-made. In particular, some industries have a more drastic impact of freshwater such as textile manufacturing, where processes involve washing and dyeing of fibers, threads, fabrics and end-products such as shirts and similar items. The amount of water involved in this kind of industry is extremely high. As many of the textile industries are located in developing countries, it is important to create awareness about the problem in order to seek solutions. In the present study, the consumption and contamination of water was assessed for the first time in an Ecuadorian textile factory. This was possible through the application of a water footprint analysis as indicator, based on the ISO 14046 and the methodology of Hoekstra, where, in this case, the processes of fabric dyeing and serigraphy were carefully evaluated in order to estimate improvements in water use and awareness related to consumption and contamination. The water footprint indicator, suggests a more efficient and eco-friendly environmental production. The goals and scope of the research were defined by combining an industrial and an environmental point of view in order to improve and optimize the resource exploitation in such way that it does not sacrifice profit or productivity. For the estimation of the water footprint, independent water-balances were applied on each critical point. The inputs and output of water were defined for each process, and most important, water waste or misuse and contamination were in detail determined; afterwards, an evaluation of the environmental and economic impact was developed. Based on the results, a route for the optimization of water use was proposed. The present study revealed high levels of contamination in water as part of the total water footprint indicator. As part of the proposal for solutions, a redesigning of the process was developed using new technologies to reduce freshwater consumption and individual water treatment systems in each process. The proposed alternatives allowed a considerable reduction in water use and exploitation, as well as a remarkable reduction in freshwater contamination. If the proposed assessment and application of mixed industrial and environmental techniques are applied in other industries, the water crisis might have a solution.

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**TREATMENT OF WELL DAMAGE WITH DRILLING FLUID OF THE SIEGENIAN RESERVOIR  
(LOWER DEVONIAN), BIR BERKINE REGION, ALGERIA**

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F.H.C / University of Boumerdes, Laboratory of Mineral and Energical, Boumerdes, Algeria

**ABSTRACT**

When production starts some wells have shown a debit decrease compared to the one evaluated in the well drilling tests. Assumed that production lack results from damaged caused by drilling mud, first acidification is done within the well BBK-16 and BBKN-07 using mud-acid Hcl of 6% - Hf of 1,5%. However due to negative results, there was perforated in order to undertake initial potential. Simulation operation or acid treatment of rock reservoirs (lower Devonian) of Bir Berkine region aims to increase permeability related to wells clogging problems with migration of fined particle, shale swelling and asphalts precipitation. Effectiveness of thus treatments is based upon petrographical analysis, choice of acid fluid, determination of acidification parameters and results analysis. In this research article, we found that mud of Invermul and Versapro used during drilling are damaged, the rate of clogging is estimated at 80% within the two wells therefore and acid treatment is requested. Knowing that mineralogical composition of sandstone within the unit C of Siegenian, the mud and the different shifting tests, the Mud-acid «12-2» is considered as a treatment model. Further the use of Mud-acid «12-3» would promote sandstone grains faulting around the two wells.

Corresponding Author: Rabah Chaouchi

**ANALYSIS OF THE TENDANCY EVALUATION COMPLEX OF THE DIFFERENT CAMBRIAN  
RESERVOIR « Ra » 1A ZONE HASSI MESSAOUD FIELD, ALGERIA**

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**ABSTRACT**

The Hassi Messaoud field has a large anticlinal form covering an area of 4200 km<sup>2</sup>. The Cambrian deposits are composed of Ra, Ri, R1 and R2 reservoirs related to sandy fractured quartzites, eroded beneath the Hercynian unconformity covered with thick Triassic deposit. This sandstone reservoir is characterized by heterogeneity traduced by extreme variation of petro-physical parameters reflecting production variation from zone to zone and also from well to well. The extension of the Hassi Messaoud involves variability of production within its different parties. This is well noted within the cumulated production history to this day. This study concerns the 1A zone with the object of analyze and distribution of the different heterogeneity. Ra reservoir is the focus of this study and consists on analyzing different tendency variation of reservoir parameters and determination of different anomalies allowing doing a projection of the best simulation and hydrocarbons recovering. Following this study, the best producing zones are located within the Western zone of D2, central and southern D4, all the eastern part, southern and a part of the northern D5, western and south eastern D4, central D5 north eastern and southern D3. The most producing zones are located in western drain D4, central D5 and north eastern D3. Medium producing zones are located in norther, south eastern and south western D5, western D2 north eastern, central and south D3 and north-west central and south-western D4.

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**World**

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**Multidisciplinary Earth Sciences Symposium**

**THE IMPACT OF THE ASH USAGE FROM INDIVIDUAL STOVES ON SELECTED PHYSICOCHEMICAL PROPERTIES OF CULTIVATED GROUNDS**

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**ABSTRACT**

The purpose of the work was to determine the suitability of adding ash from household furnaces to agricultural soils. The author took into account the properties of ashes and their usefulness in various fields. The paper presents the soil specification and the effect of ash on it. Also, the impact of ash on the growth of plants that have been fertilized and deficiencies and hazards resulting from this method of fertilization has been shown. The analysis of samples in which soil mixtures were made of ashes from hard coal and wood ashes was carried out. Research has been carried out in the presence of elements that have the greatest impact on plant growth.

**ON THE REALIZATION OF A COMMUNICATION SYSTEM FOR ATMOSPHERIC PROBES BASED ON LORA TECHNOLOGIES: PRELIMINARY MEASUREMENTS AND RESULTS**

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**ABSTRACT**

Characterization of atmospheric properties remains a latent ambiguity for weather forecasting and climate models since their characteristics depends on multidisciplinary processes in a wide range of natural scales. The development of ultra-small light disposable radio probes is important to understand this properties Being light-weighted, the probes will have a fluid-dynamic behavior to allow them to “float” inside clouds or fall through different atmospheric layers after been released, thus simulating the behaviour of small particles (e.g. drops). Each disposable probe is equipped with compact size microprocessors (presently the first prototype uses Arduino© Nano), controllers, and a set of sensors for the measurement of atmospheric parameters (e.g. velocity, acceleration, pressure, temperature). The probes collect, store and then send the coded information to a base station located at the ground through a dedicated radio transmission link. It is to be noted that long-range communication link (10 km) should be assured with low power consumption technology: a network based on the Long Range (LoRa©) technology to connect and exchange data within the end-modules and the base station is the potential adopted solution. In order to realize the communication system for the atmospheric probes, some prototypal links and networks have been realized using the Adafruit Feather 32u4 LoRa Radio RFM95 modules. It is an embedded module, which contains a LoRa transceiver RFM95 and an ATmega32u4 microcontroller. The radio module can be powered using 3.3 volts either by using a micro USB or an external battery and it can transmit from +5 dBm to +20 dBm, which are theoretically enough for the purpose of this study. The present work presents the preliminary measurements made both in indoor and outdoor environment considering different configurations (spreading factors, transmitted power, bit rates, antennas...) in order to find the best set of parameters to work in the harsh environment to acquire information about warm clouds and send them to the ground receiver. Particularly detailed measurements have been made in harsh environmental conditions (e. g. rain, fog, drizzle...) in order to simulate a set of possible environmental conditions that can be found inside a warm cloud. The measurements techniques and results are presented together with the realization of a first operational prototype of both probes and ground receiver.

Corresponding Author: Lorenzo Carosso



**STUDY OF LOSS OF CIRCULATION OF DRILLING MUD: CASE STUDY HASSI-MESSAOUD FORMATION**

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**ABSTRACT**

The purpose of our research is to study and analyze the problems of loss of circulation at the 8 ½ " phase in the Algerian oil fields of the South region and to propose solutions. In order to eliminate or at least greatly reduce the loss of circulation, the first remedy is to locate the exact location of the circulation losses thanks to different methods (thermometry, acoustic measurement, radioactive trace, turbine measurement, logging, monitoring of fluid tendencies during drilling and to pump clogging products (granular, lamellar, fibrous, cementitious) in order to block the pores or cracks of loss formations, to determine the type of losses (partial or total), to determine the category of formations drilled and causes related to losses that may be due to the rheological characteristics of the drilling mud (density, viscosity, yield value, and gels), causes related to the characteristics of the formation (permeable, cavernous, naturally cracked or fractured by the pressure of the mud), the overpressure and depression due to the maneuvers too fast, to the brutal reprises of pumping, sudden changes in flow patterns and a high speed of advancement. First of all, plugs of clogging products of 5 and 6 m<sup>3</sup> of LCM (Losses Circulate Material) were injected, it was noted that the volume of loss increase as a function of the increase with the rate, which means that the plugs injected did not clog the area of loss. The unsuccess of these two LCM plugs to seal the area of loss is mainly due to the delay in sending these plugs and it becomes imperative to send them from the beginning of the appearance of these losses of circulation in the formation and thus reduce non-productive time (NPT). We decided later to put in place a cement plug to permanently eliminate this problem. The characteristics of the standardized "G" class cement plug, specific gravity of 1.90, plastic viscosity of 42 cp, Yield value of 28 lb / ft<sup>2</sup> and pumpability time of 6 hours. This injection reduced the losses slightly without really stopping them. This study shows that, generally, the majority of circulation losses are caused by overpressures and depressions due to too fast upward and downward movement of the drill string as well as the high hydrostatic pressure caused by a high density of the mud drilling acting on the walls of the well.

Corresponding Author: Abderrahmane Mellak

## HEAVY METALS ASSESSMENT OF THE BOTTOM SEDIMENTS AT RAS AL KHAIMAH COASTAL AREA, UAE

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### ABSTRACT

At many coastal areas especially where prolonged marine activities occur, a heavy metals pollution is a matter of concern. This study is testing this concern at Ras Alkaimah (RAK) coastal area in UAE. 15 samples of bottom sediments were collected from marine border to border in a distance of more than 60 km long. Analytical results from ICP-MS analyzer of the following heavy metals (Mn, Zn, Cu, Pb, Co, Cr, Ni, V, Fe, As, Sb, Cd and Mo) show a noticeable concentration of these metals in the collected samples. To evaluate the risk assessment and the level of contamination, the contamination factor (CF), enrichment Factor (EF), geo-accumulation index (I<sub>geo</sub>) and pollution load index (PLI) were calculated. The pollution load index and geo-accumulation index have revealed that the sampled sediments are unpolluted for all elements (except Cd). A different profile was given by the data of the contamination and enrichment factors. They indicate that most heavy metals (Mo, Cu, Pb, Zn, Co, Fe, Mn, and V) in the study samples are in permissible level to low level of contamination or enrichment, whereas, the other elements (As, Cd, Ni and Cr ± Sb) show moderate contamination to moderate-severe of enrichment. Although the relatively high concentration of some heavy elements at RAK coastal area is expected naturally due to the mountainous hinterland, the increase of the other metals may indicate anthropogenic sources probably from the existing marine activity. However, the environmental impact of these metals is probably not researching a high risk level as indicated by the calculated factors.

Corresponding Author: Sulaiman Alaabed

## **EUROPEAN UNION LEGISLATION AND STRATEGIC ENERGY POLICY OBJECTIVES**

Lidia Lenuta Balan, Anca-Marina Vijdea

Geological Survey of Romania, Romania

### **ABSTRACT**

Competitiveness, sustainability and security of supply of the population are among the major objectives that the European Union must address through a consistent, coherent and sustainable energy policy in all Member States in order to ensure a decent living standard for present and future generations European space. In reporting that many Member States of the European Union depend on energy imports, energy efficiency measures and those related to the exploitation of renewable energy sources are very important for ensuring and maintaining security of energy supply. Renewable energy sources, such as geothermal energy and biomass, are an important alternative to fossil fuels, and efficient use of these sources not only helps to minimize greenhouse gas emissions from energy production and consumption, but also a significant decrease in the European Union's dependence on imports of fossil fuels, such as oil and natural gas. European Union legislation on the energy sector, especially geothermal energy, is based on the international agreements to which the European Union is a member and its Member States, as well as the competence of the European Union in the area of the internal market and the environment. However, we note that, with the inclusion of this theme as a section in the Treaty on the Functioning of the European Union, this sector gains a prominent position with shared competence between the institutions of the European Union and the Member States and plays a particularly important role for the policies of the European Union. Although a number of European legal instruments have been lent for the energy sector, especially for geothermal energy, from other sectors (see water, greenhouse gases and environmental assessment), however, they are not enough to regulate the whole the carousel of the activities required to produce, efficiently and efficiently manage, and in particular, the challenges of contemporary society.

Corresponding Author: Lidia Lenuta Balan

## OVERVIEW OF NATIONAL LEGISLATION IN THE GEOTHERMAL FIELD IN DANUBE REGION'S COUNTRIES

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### ABSTRACT

The regulatory framework regarding exploration, exploitation and use of geothermal water was analysed and compared in six countries of the Danube Region (Bosnia and Herzegovina, Croatia, Hungary, Romania, Serbia and Slovenia), which are partners in the European co-funded project DARLINGe (Danube Region Leading Geothermal Energy). In order to provide an overview of the rules and regulations governing geothermal development, a set of questions in the field of energy in the countries involved in the project was developed. These took into consideration the following aspects: definition of geothermal energy in the national legislation, ownership and access to geothermal resources, allowed exploitation (without license), role and voice of landowner in licensing, criteria for granting a license, duration of licenses and renewal, terms/contents of licenses, termination and revision of licenses, regulatory and information obligations, heat purchase agreements, environmental impact assessment (EIA), other licenses. Common features and differences were identified in the analyzed countries. One important common feature is the fact that mineral resources (including geothermal waters) belong to the State, and the use of geothermal waters by private parties or private persons is made in accordance with the provisions of the concession law of that country, through the bidding procedure. Exploitation of mineral resources, in particular geothermal waters, is subject to licensing, with the existence of own norms that contain elements of differentiation and particularization regarding the way of granting the license. Different aspects identified consist in, for example, the fact that the exploration license do not directly translate into exploitation licenses. In all the countries, there are different procedures requiring different documentations. There were no legal conflicts between the normative acts in the geothermal field in Romania, Federation of Bosnia and Herzegovina, Republika Srpska and Serbia. In contrast, in Croatia and in Hungary there were overlapping provisions on the exploration side. In Slovenia these conflicts concerned document management, lack of co-operation between authorities during the grant process and different requirements for the licenses. There are no obligations regarding reinjection (except for Slovenia, where this is clearly stated). In Hungary, there is no law imposing reinjection, but practically reinjection must be done, in order to avoid conflicts with other legislative acts.

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**FORMAL AND LEGAL REGULATIONS GOVERNING THE AWARD OF CONCESSION CONTRACTS IN  
POLISH OPEN CAST MINING**

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**ABSTRACT**

This paper presents current legal conditions related to the procedures of awarding concession contracts in Polish open cast mining industry. It lists legal acts which regulate mining activity and the concession-awarding institutions. It additionally discusses the types of awarded concession contracts. The focus is placed on the difference between minerals under mining property and minerals under land property. The paper also deals with the stages of the process of obtaining a production license. These stages include primarily planning and environmental procedures. The planning procedure allows the new function of the terrain for open cast mining to be specified in the local land development plan. The environmental procedure, on the other hand, closes by either granting or denying the so-called environmental decision. Both procedures are performed with the involvement of civil society. The purpose of the environmental procedure is to select such a variant of mineral production which keeps the environmental burden to a minimum. The last stage of the concession process is to file a concession application to the competent authority. The duration of the concession process depends individually on the legal and actual situation. In practice, the procedures are long-lasting and may take as much as several years. This article also discusses some problems of the Polish concession system. Considerations include the burden of both the planning and the environmental procedures, as well as the problems caused by the number of legal regulations and their frequent changes, or by the reluctant acceptance that mining projects win in local communities. Another problem addressed in this paper relates to the protection of documented deposits, as investment projects having different protective status are not equally protected in the law. No adequate measure exists, either, which would protect documented resources from building development.

Corresponding Author: Urszula Kazmierczak

**POVERTY, SOCIAL JUSTICE AND ECOLOGICAL PROBLEMS WITHIN THE SCOPE OF  
SUSTAINABILITY**

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**ABSTRACT**

The literature over the past 50 years has been the concept of "sustainable development". Sustainable development, "future generations of their own needs without sacrificing because until we're affording today's can meet the needs of development" is defined as. In other words, human nature by establishing a balance between the natural resources consumed, until the end of the next generation in a way that will permit you to meet the needs of today's and future lives and development programming. Social structure (social justice), economic (poverty) and ecology (environmental issues);sustainable development is based on three components of the approach. Economic sense in the process of economic development; escape from poverty, social justice and environmental issues. The aim of the study, sustainable development approach involving the social, economic, and environmental dimensions of policy planning for the realization of these three dimension together reveal the necessity. *Material and Methods:* Research related to the subject of domestic and foreign literature scanned, conceptual analysis. Method and method, analysis of the data obtained from the literature and reorganization method has been adopted. The data have been obtained from internet sources and academic studies. *Results and Conclusions:* the study of domestic and international sustainable economic development programs has been investigated, but in the last fifty years the fact that sustainable development programs that are implemented. As a result, the process of sustainable development; social justice, poverty and ecological planning and application requirement in a way that will take into account the structure has emerged.

**RELATIONSHIP BETWEEN HEAVY-METAL CONCENTRATIONS IN JAPANESE KNOTWEED  
(*REYNOUTRIA JAPONICA* HOUTT.) TISSUES AND SOILS IN URBAN PARKS IN SOUTHERN POLAND**

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**ABSTRACT**

This study focuses on the concentrations of trace elements and macroelements in soils, leaves, stems, rhizomes and seed of *Reynoutria japonica* in 5 urban parks with different levels of disturbance (high, medium, low). The sampling locations within each park were chosen along river banks or forest edges. The soil samples were taken only in the humus horizon which averaged about 15 cm in thickness. Concentrations of Ca, Mg, K, Na, Fe, Al, Zn, Cd, Pb, P, S, Cr, Cu and Ni in plant material and soil were measured using ICP-OES – Inductively Coupled Plasma Optical Emission Spectrometry. The orders of average heavy-metal abundances found are Zn>Cu>Pb>Cr>Ni>Cd in leaves and Zn>Cu>Pb>Ni>Cr>Cd in a park soils showing a high levels of disturbance. In cases of low disturbance levels, the orders of average abundances for leaves are Zn>Cu>Cd>Ni>Pb>Cr and, for soil, Zn>Cr>Ni>Pb>Cu>Cd. The highest enrichments noted for Zn in topsoil was about 501.2 mg/kg in soil and, in leaves, 540 mg/kg. The lowest concentrations of Cd (0,14-0,21 mg/kg, Cu (5,9-6,9 mg/kg) and Ni (4,6-14,5 mg/kg) in soil were observed in a parks with low levels of disturbance. Similar patterns of regularity were also observed in leaves, stems and rhizome. Different concentrations of metals in each park result from the degree of diversity of the parent rocks on which soil was formed. In the case of soil material transported from elsewhere, the concentrations of heavy metals are higher than in soils formed from local rocks. In a park located near a road, the concentrations of metals found also reflect traffic emissions and other sources of pollution. Surface waters flowing from surrounding roads and arable areas also affect the composition of the river water through the transport of detergents and increases in phosphorus and other microelements which, after periods of flooding, are deposited on the river banks. Thus, the river banks constitute a very fertile habitat for the vigorous growth of *R. japonica* which may accumulate a variety of different metals originating from elsewhere.

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## HOUSING, MIGRATION AND COHABITATIONS: NEW EXPERIENCES IN NORTHERN ITALY

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### ABSTRACT

This paper deals with the question of immigrant housing starting from the observatory of some innovative experiences in Northern Italy. It specifically tries to investigate the local significance of unconventional forms of cohabitations, not based on the home/family correspondence, and not based on the recognition of individual needs. The Turin case study shows some limited but significant experiences (AlloggiAMI and StessoPiano projects) in which a plurality of subjects, public or private with social aims, are promoting new behaviors of living together. Such simple experiences are some of many and show how couples of elderlies with a medium or large surface apartment welcome one or a few students of different nationalities, or families with children in compulsory school age propose to share and enrich their own phase of life by hosting a mother and a daughter just arrived in Italy. The public housing in the recent past was conceived above all for families or for individuals conceived as carriers of characters, rights and needs. The migrant hospitality on the other side was mainly linked to procedures of classifying migrant people in relation to the recognition or rights (refugees, first hospitality, rescue, assistance) and the militarization of housing condition. Today the situation can, at least in part, be considered significantly different. Sociality, familiarity and affectivity are expressed through an overlapping of networks of belonging, of different variety and intensity. The hospitality has begun to include new individuals within a supporting family structure, which plays a role of inclusion and acceptance. The purpose of the essay is, first of all, to describe some living spaces through a careful investigation of the conditions of living and urban themes, of the connected social, economic and anthropological dimensions. The city of Turin is emblematic for the history of inner migrations in Italy and can be considered as a privileged place to observe the stratification of misunderstandings of the conditions and forms of living. Furthermore, the research investigates the relationships between the new living spaces and the local urban context, describing it in terms of its overall residential consistency, the themes, the real estate values, the constitution of public spaces, the identity groups and the conflicts. The attempt is to verify whether through the systematic connection between experiences that are distant from each other, the incipient traits of a new general form of living can emerge, with evident relationships, also symbolic and declarative, with the question of immigrants or people in movement.

Corresponding Author: Fabrizio Paone



**PARKING IN CITIES IN RELATION TO BUILDING REGULATIONS**

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**ABSTRACT**

Parking - a big problem of today's large settlements. Together with the development of the economy and faster technological progress, there has also been development in automotive transport in the Czech Republic and there has been an increase in the volume of transport both freight and passenger transport. When looking at transport, it is possible to distinguish between interurban and urban transport. Regarding means of transport, the Czech Statistical Office (hereinafter referred to as the CSO) is divided into transport by rail, road, urban mass, air and inland waterway. In the article we will focus on the car transport, personal in relation to the possibilities of parking in the cities in connection with the building legislation. As part of the processing of the article, building authorities were also asked to ask about the legislation in force on the design parameters of parking in towns when approving new parking options. The questions also included a question of "satisfaction" with the current state of legislation - whether design authorities seem to have sufficient design parameters. The parameters, options and responses of building offices are summarized in this article.

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**REGIONAL INEQUALITIES IN ROMANIA BEFORE AND AFTER THE EU ACCESSION**

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**ABSTRACT**

In the last two decades the effects of inequality on economic growth have become one of the most popular research topics among scholars and policy makers. Growing inequalities have also represented one of the main concerns of the EU Member States. Although European Regional Policy specifically addresses the issue of regional inequalities, so far empirical research has shown its constant persistence, with a deepening tendency in the last two decades at smaller territorial units. Furthermore, the recent economic and financial crisis has aggravated the pre-existing regional problems even more, not only at regional but also at local level. The aim of the paper is to present some actual connections of the Romanian spatial structure and the characteristics of spatial inequalities before and after the EU accession. For this, the analysis uses the existing territorial statistical data obtained from the Romanian National Institute of Statistics, including the 2011 Census and the Tempo Online website. Moreover, the study illustrates the importance of using some representational methods in answering different questions regarding territorial inequalities.

**SEARCHING FOR HOUSING MODEL OF 21st CENTURY: ANALYSIS OF CHOSEN POLISH AND DUTCH CONCEPTS**

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**ABSTRACT**

The question about design of contemporary cities is one of the most important in the field of architecture and urban planning, particularly in the context of sustainable development, theory of compact city, processes of shrinking cities, etc. Also it is very important the role of housing estates and their place in the city space. During last twenty years in Poland and Netherlands there were constructed many interesting housing estates. Standard of housing environment, standard of flats are growing, also urban solutions are developing. Some of these realizations show new directions and give a new quality of housing in the 21st century. The purpose of study is characteristics of the housing environment of the three large housing projects: two from Poland and one from Netherlands. All mentioned concepts are different, that is why the author asks about the problem of city planning and the relation of new housing space to the city space. The study is based on very important examples chosen by the author: Marina Mokotów Estate in Warsaw, Eko Park Estate in Warsaw and Westerpark Urban District in Amsterdam. Marina Mokotow Estate - housing project in Warsaw - was created in the first decade of 21st century; huge concept with different types of housing buildings, kept in modernism style and urban solution. In spite of creating an artificial world with artificial lake, it became "city in the city", a product of alienated, it became gated community. Eco Park Estate - housing project in Warsaw - designed in the beginning of 21st century; has a legible urban plan, which is the consequence of imposed and adopted regulations. The quarters are partially open to the public spaces, and a general plan of the settlement assumed from the beginning of a very conscious shaping of public spaces with good integration with the city. There was provided the location of trade, services, on the ground floors of buildings and public facilities. Through the multi-functionality Eko Park Estate has become an example of heterotype in the urban structure (mixed-used development). Eco quarter Westerpark Urban District in Amsterdam was designed in the last decade of 20th century. The whole concept was based on the paradigms of sustainable development and was created in the frame of revitalization of the area of old water supply company. In the project we can find e.g. the idea of reducing energy consumption, materials friendly to environment, the idea of green gardens with lots of plants, etc. The analysis includes: urban composition of mentioned above estates, solutions of the wheeled and walking transport, standards of semi-public spaces, recreational spaces and provided ecological ideas, the quality of architecture. The analysis showed significant differences in urban development of housing estates and the different relations to semi-public spaces and the city space. They represent different typology in creating city planning of 21st century.

**EVOLUTION OF MODERNIST URBAN TYPE SETTLEMENTS - A CASE STUDY**

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**ABSTRACT**

The urban type residential housing is a type of settlement unit that existed in the 20th century Polish legislation and concerned housing, service and industrial complexes, which did not have the status of a town, but were not a village. This term was used in particular in relation between nearby located industrial estates or mining and housing estates providing human resources for servicing them. In the course of changes, these settlements evolved into towns of various sizes or remained in an unchanged or impoverished form. The article describes a specific case of these changes - the evolution of an urban type of residential housing into a small town (in Poland it has been assumed that a small town is a town with a population of up to 20,000). A characteristic feature of such settlements is a number of elements such as: lack of historical identity, modernist pedigree, urban tissue composed mainly of multi-family buildings in simple compositional arrangements, often axial or secondary educated public space. Two towns were selected to discuss and compare changes in the spatial structure: Wojkowice located in the Śląskie Voivodship and Nowa Dęba located in the Podkarpackie Voivodship. These towns combine the period of formation but divide the main catalyst for development. In the first case, it is mining service and in the second one it is the creation of an employee base for defense plants.

## **SOFT MOBILITY AS AN URBAN DESIGN SOLUTION FOR RIVER BANKS**

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### **ABSTRACT**

Soft mobility is on the top of the agenda as a strategy for cities livability. It refers to non-motorized transportation solutions in order to promote the human mobility. In this domain pedestrian and bicycle paths have a pivotal interest on behalf of urban design solutions. This paper presents an urban design project focused on soft mobility solutions having as case study a Portuguese city. The area called Train Station surroundings in São Pedro do Sul, makes the link in between the urban fabric and the Vouga river banks. This city is very well-known because of its thermal baths that are coming from the roman times. The presented urban design project is a result of the agreement in between the University team, on behalf of the Urban Planning Unit of the Master Degree in Architecture and the Municipal authority. The students were organized in several international groups (including Portugal, Greece, Brazil, Slovakia, Lithuania and Poland) in order to propose their urban design projects, ensuring the continuity of the urban fabric with the river. The city hall has offered prizes (1<sup>st</sup>, 2<sup>nd</sup> and honour awards) for the best projects, which was an extra motivation for students. Regarding the presented solution, the conclusions show that the main strategy was to propose soft mobility pathways for pedestrians and bicycles in order to link the main natural element which was the river with the urban fabric such as the existing low density housing neighbourhoods and the most relevant historical landmark, the nineteenth-century train station building.

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## **AN URBAN DESIGN SOLUTION FOCUSED ON RIVER SPORTS**

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### **ABSTRACT**

Touristic activities are growing all-over the world. The number of people traveling abroad to visit places and having adventures is increasing. Even though the most popular cities and countries in touristic terms are the most visited places, the small cities in rural areas are also defining strategies in order to improve their performances in tourism. The Portuguese city of São Pedro do Sul, very well-known because of its thermal baths with roots in the roman times, is not an exception on this domain. This is a high potential area for touristic purposes linking the consolidated urban fabric of the city with the river Vouga banks. Therefore, it has all required features to become a touristic spot focused on river sport activities. In this sense this paper aims to present an urban design project having as pivotal goal to promote the sport activities related with the river. This solution was the result of an international team background (Portugal, Slovakia, Brazil, Greece, Poland and Lithuania) with their different understandings about the sensitive areas such as the river banks in an urban context. The conclusions show that the historical buildings can have a new life and use, which was the case of the nineteen-century train station transformed into a multicultural centre. The proposal main strategy is the creation of a set of facilities and public spaces such as the camping or a nautical centre in order to promote the touristic activities related with the river.

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## **FUNGAL SPORES CHARACTERIZATION IN SIZE SEGREGATED ATMOSPHERIC AEROSOL**

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### **ABSTRACT**

Fungal spores and their components form majority of bioaerosol, inseparable part of atmospheric aerosol, omnipresent colloid dispersed in the Earth atmosphere. Recently, the impact of bioaerosol on atmospheric processes has been studied with increasing intensity. Therefore, analysis of fungal spores became indispensable part of comprehensive aerosol characterization studies at nowadays. The first stage of a High Volumetric Cascade Impactor - HiVol (BGI-900), used for sampling of aerosol particles larger than 10 micrometers in aerodynamic diameter, was tested for bioaerosol sampling. Low air flow-rate and low pressure-drop at the jets of the first stage and high air volume are advantageous parameters, which favor the use of the first stage for bioaerosol sampling. The sampling went in urban, rural and background localities, Prague, Brezno and Láz respectively, in the Czech Republic in summer and autumn. Method of fungal spores and their components separation from the impaction substrate, polyurethane foam, into homogeneous deposit on Nylon filter was optimized. Representative portion of the deposit was analyzed by a scanning electron microscopy - SEM. There were taken 485 SEM images from 12 samples in 3 localities. Fungal spores were identified in 200 SEM images and determined into 9 genus, 1 family and 1 species. The total number of fungal spores were about 860, 1204 and 960m<sup>-3</sup>, in urban, rural and background locality respectively, with *Cladosporium* spores found with the highest frequency in all the localities. Fungal spores deformities were quantified to be 42, 17, 12% for Prague, Brezno and Láz localities. There were also identified rather unique insect secretion products brochosomes in the samples from background locality.

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**TRENDS OF CHANGES OF SELECTED CHARACTERISTICS OF PRECIPITATION IN THE CITIES  
ABOVE 100,000 RESIDENTS IN POLAND, 1966-2015**

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**ABSTRACT**

Contemporary climate change causes an increase in the sensitivity of urban areas to the effects of this change, manifested in the increased threat of periods of both shortage and excess of water or a higher probability of flood or drought occurrence. That is why Polish Ministry of the Environment is currently implementing project aimed at developing Urban Adaptation Plans in major Polish cities with more than 100,000 inhabitants that would reduce the city's vulnerability to climate change. One of the elements of preparing such plans is the assessment of the city's exposure to the effects of changes in rainfall conditions. Therefore, it is extremely important to know the trends of these changes. The analysis of the variability of selected precipitation characteristics was carried out for 24 Polish cities with more than 100,000 inhabitants. The tendencies of annual and seasonal precipitation changes, the number of days with precipitation, the number of days with extreme precipitation (events exceeding the 1971-2000 95<sup>th</sup> percentile of daily precipitation) as well as the fraction of annual total precipitation due to extreme precipitation have been characterized. Annual trends were calculated using standard linear regression method and its statistical significance at the 95% confidence level was assessed with the help of F Snedecor probability distribution. Changes in precipitation characteristics show mixed patterns. In the majority of analyzed cities, annual precipitation totals tend to decrease, however, there is no clear spatial pattern. In general, seasonal tendencies of summer and winter precipitation, and especially autumn precipitation, also show negative tendencies. However, the sums of precipitation in the spring season are generally characterized by positive tendencies. In the vast majority of analyzed cities, the number of days with precipitation decreases, as well as the number of days with extreme precipitation. The fraction of annual total precipitation due to events exceeding the 1971-2000 95<sup>th</sup> percentile is also characterised by negative tendencies. Decreasing precipitation together with increasing air temperature may result in water insecurity in many Polish cities.

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## COMPARISON OF COMPUTER PROGNoses GIVEN IN 1997 WITH THE REAL SANITATION RESULTS FOR THE ILUKSTE OIL PUMPING STATION, LATVIA

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### ABSTRACT

LatRosTrans is the company that provides diesel fuel transportation in Latvia through the pipeline of Polotsk-Ventspils. The oil pumping station Ilukste receives and stores petroleum products pipelined from Polotsk. During 1970-1996, the station also filled railway tanks. This caused oil leakages that contaminated groundwater under the railroad terminal routes. The mobile oil plume reached the steep bank of the nearby located Ilukste river. A special pool was built to prevent straight dripping of oil into the river. In 1996, the remediation works of the contaminated site started and continued till present. Remediation has been supervised and financed by LatRosTrans. Since 2000, the clean-up job was performed by the environmental company VentEko. The horizontal drain was installed before the pool for intercepting the water-oil emulsion from which water was separated. Before discharging the water into the Ilukste river, dissolved oil fraction was removed using different clean-up methods. For the area of the railway terminal, the pump and treat method was applied. There the set of wells was installed for oil recovering from the contaminated aquifer. In 1997, scientists of Riga Technical University (RTU) established the hydrogeological model of the contaminated area. Due to use of the model and the program ARMOS, the disposal of main oil leakage area was determined and the oil plume self-cleaning time was predicted. It was expected that it would happen for about 20 years, due to natural oil underground runoff process into the pool. In 2018, LatRosTrans asked RTU to assess results of the oil remediation, in order to make decision on necessity to continue the active clean-up process of the site. It was found out that the sanitation process had reached its final stage, as the intensity of oil recovery was becoming too low. During the last 21 years, about 160 m<sup>3</sup> of oil was recovered. Due to the natural run off, about 70m<sup>3</sup> of oil (~44%) was intercepted by the drain. By considering the modelled cumulative oil recovery graphs on oil pumping from wells, it was confirmed that since 2003 till 2014 considerable repeated oil leakage (about 65m<sup>3</sup>) in the railway terminal area had been present. About 100m<sup>3</sup> of oil cannot be recovered by the simple pump and treat technology, because it is trapped (adsorbed) in the aquifer. Comparison of the real sanitation with the predicted course of the self-cleaning of the oil plume shows that the both processes differ mainly due to the considerable repeated oil leakage in the area of the railway terminal. The case of the Ilukste pumping station area sanitation shows that close cooperation between the owner (LatRosTrans) and the work performer (VentEko) has resulted in the notable achievement. It also confirms considerable value of the results that were obtained by using mathematical modelling.

Corresponding Author: Aivars Spalvins

**RHEOLOGICAL PARAMETRIC STUDY OF AN ALPINE WET DEBRIS FLOW EVENT (NOVALESA, TORINO, ITALY) APPLYING THE FINITE VOLUME METHOD (FVM): COMPARISON WITH AVAILABLE EXPERIMENTAL DATA**

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**ABSTRACT**

The Marderello torrent, located at an altitude ranging from 3538m to 900 m above sea level (Novalesa, Cenischia Valley, in Province of Turin) is known for its peculiar capability to generate, with relative frequency, important mud flows and debris (muddy debris flow). Accordingly, the CNR-IRPI of Turin, since more than twenty years ago, selected this site in order to carry out field observations and measurements campaign. In this paper the muddy-debris flow event, occurred and monitored on July 22, 2016, was considered. The simulation of debris flow phenomena was performed by a 2D Finite Volume Method, solving PDE (Partial Differential Equation) based on the shallow-water approach, through a commercial numerical software. The mathematical-numerical model included also solid transport and movable river bottom. First of all a morphological vectorial model of the basin under study was created and implemented as inputs. The inflow and outflow boundary conditions, deriving from the hydrogram consisting of values measured at the monitoring gauge were considered. Several parametric analysis were performed in order to individuate the best values fitting the experimental data concerning the speed reached by the flow over time, the flow rate and the estimated height of the front. To this purpose, different available rheological options such as Turbulent-Coulomb, Turbulent-Yield, Turbulent- Coloumb-Yield, and Full Bingham were selected and tested. The comparison with the values collected by the monitored event allowed to define the best values of the parameters to be used. The selected approach and the related model construction can be considered useful and suitable tools in order to study and to simulate this kind of phenomena.

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## **APPLICATION OF COPULAS IN FORECASTING OF REAL PROPERTY PRICES**

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### **ABSTRACT**

In the building of the simulation models it is equally important the estimation of random variable distribution parameters and the inclusion the dependencies between variables. The use of Pearson's linear correlation coefficient or Spearman's rank-order correlation coefficient in variables modelling in which there is a real dependency between them, may result in the reproduction of the incorrect data structure, especially in the case when at least one of the variables has the distribution with a strong asymmetry. In this case, a better representation of the dependence can be achieved using models based on copulas. Copula is a function that links a cumulative distribution of a multi-dimensional random variable to its one-dimensional marginal distributions. In practice, it means that the random number generator simultaneously simulates independently random variables and combines them with a vector of the copula function that reproduces the relationship between variables. In this paper, we test application of copulas in real property prices forecasting as opposed to simple but also well-known multiple regression models. In many real property valuation models the relationship between several predictor variables and a dependent variable, which is in this research unit price per square meter of residential properties, are based upon not necessarily correct linear assumptions. Whereas the copula approach is a useful method for deriving joint distributions given the marginal distributions, especially when the variables are non-normal and real estate prices tend to evolve in a nonlinear manner over time. Rich transaction prices dataset proves usefulness of copulas use in real property prices forecasts.

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**PARAMETRIC STUDY OF AN ALPINE WET DEBRIS FLOW EVENT (NOVALESA, TORINO, ITALY)  
APPLYING THE FINITE VOLUME METHOD (FVM): COMPARISON WITH AVAILABLE EXPERIMENTAL  
DATA**

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**ABSTRACT**

The Marderello torrent, located at an altitude ranging from 3538m to 900 m above sea level (Novalesa, Cenischia Valley, in Province of Turin) is known for its peculiar capability to generate, with relative frequency, important mud flows and debris (muddy debris flow). Accordingly, the CNR-IRPI (National Research Council) of Turin, since more than twenty years ago, selected this site in order to carry out field observations and measurements campaign. In this paper the muddy-debris flow event, occurred and monitored on July 22, 2016, was considered. The simulation of debris flow phenomena was performed by a 2D Finite Volume Method, solving PDE (Partial Differential Equation) based on the shallow-water approach, through a commercial numerical software. The mathematical-numerical model, beside hydrodynamic model, may also include solid transport and movable river bottom, not explored yet at this stage of the research. First of all a morphological vectorial model of the basin under study was created and implemented as inputs. The inflow boundary conditions, deriving from the hydrogram consisting of values measured at the monitoring gauge were considered. Several parametric analyses were performed in order to individuate the best values fitting the experimental data concerning the estimated height of the front over time. To this purpose, different available rheological options such as Turbulent-Coulomb, Turbulent-Yield, Turbulent- Coulomb-Yield, and Full Bingham were selected and tested. The comparison with the values collected by the monitored event allowed to define the best values of the parameters to be used. The selected approach and the related model construction can be considered useful and suitable tools in order to study and to simulate this kind of phenomena.

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**PROGRAM SUPPORTING THE ASSESSMENT OF OCCUPATIONAL RISK - HARMFUL FACTORS**

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**ABSTRACT**

In Poland as well as in most European countries one of the most important problem, is still high rate of occupational diseases among workers of different branches of national economy. It is caused by many factors such as: high percentage of workers exposed to one or a few harmful factors in technological process, exceeding acceptable limits of a factor in a workplace, inappropriate identification of harmful factors and long-term effects of exposition to them. This chapter presents basic assumptions of computer system supporting health risk evaluation in mining. The computer system uses assumptions of rating method of health risk evaluation worked out in Institute of Ergonomics and Safety Management in Technical University of Silesia. The advantages of presented computer system supporting health risk evaluation are: the easiness of registration and documentation of all activities in the range of health protection of workers in the work process, the possibility of determining aims and priorities of activities in the field improving work conditions, enabling controlling hazards by showing the necessity of undertaking activities essential for their reducing, obtaining a up-to-date information which leads to taking fast preventive actions.

**TECHNOLOGICAL AND PRODUCT INNOVATION IN THE MANUFACTURING PROCESS OF  
ECOLOGICALLY ACCEPTABLE LIGNOCELLULOSIC MATERIALS**

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**ABSTRACT**

Innovative products from the assortment of wood based panels – fiberboard composites are characterized by considerable diversification potential, which also gives them adequate development opportunities and predetermines their perspective. Besides the possibility of variable application and modification of disintegrated wood with chemical auxiliaries, the development potential is determined, in particular by using their dimensional diversity of wood particles - the degree of wood disintegration, which at the same time determines the level of transformation of the natural properties of wood into a large-scale wood product. By optimizing the manufacturing process of the preparation of fibrous wood composites by chemical modification with apply of waste lignocellulosic preparations, as a new innovative product – fibrous based environmentally acceptable wood composites with the higher qualitative and hygienic characteristics can be prepared to expand the assortment of required products currently required by the woodworking industry. An important aspect of the sustainable ecologically acceptable production of wood fibrous composites is to reduce the formaldehyde emission content of used adhesives by adding lignocellulosic additives. The aim of our research was the proposal, experimental preparation and evaluation of the selected properties of fibrous wood composites with the addition of substances based on modified lignocellulosic waste (from pulp and paper industry). The result of the research is the proposals for innovation of existing technologies in the production of environmentally acceptable innovative products, thus expanding the range of wood products demanded from furniture industry and customers.

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**EFFECTIVE RECOVERY OF INDUSTRIAL PULP WASTE IN THE INNOVATIVE PRODUCTION  
OF ENVIRONMENTALLY ACCEPTABLE WOOD COMPOSITES**

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**ABSTRACT**

However, as a result of efforts to improve the environment, while maintaining the required qualitative characteristics, global developments in the field of wood materials (as raw materials of the 21st century) have led to the development of new or effective modifications of existing technologies, focusing on reducing the emission of formaldehyde and other toxic components in polycondensation adhesives applied to the preparation of composite wood materials. The suggested problem means reciprocal replacement of the toxic components of currently produced polycondensation adhesives (especially phenol-formaldehyde), e.g. kraft black liquors, which can be isolated as a secondary raw material from the pulp and paper industry in the production of sulphate pulp. Sulphate liquors are characterized by a relatively low reactivity to formaldehyde, thus are requiring their incorporation into the polymeric matrix of mixed lignin-phenol-formaldehyde polycondensate. For this reason, it is necessary to modify the reactivity of the original kraft black liquors by the modification reactions. New methods of processing sulphate liquors are focused only on the use of some components of black liquors or on the production of high-price products, which can be applied economically but especially "eco-friendly" in the preparation of wood composite materials as adhesives. The article deals with the problem of effective utilization waste of kraft black liquor from pulp and paper industry, which are possible apply in various modification treatment as reciprocal replacement of polycondensative adhesives for preparation of wood based composite materials. In our research, we focused on proposal of innovative adhesives mixtures which were applied for production of eco-progressive wood based composite materials with better hygienical properties and significantly reducing the content of toxic formaldehyde in adhesive mixtures.

## **INNOVATIVE ECO-TECHNOLOGIES TO REDUCE EMISSIONS IN THE MANUFACTURING PROCESSES OF SPECIAL WOOD PRODUCTS**

Eva Ružinská, Lukáš Polanecký, Daniel Kučerka

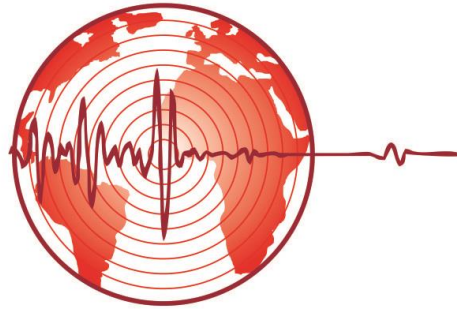
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### **ABSTRACT**

In the processes of surface treatment of specific wood products, a variety of coatings are used, which even in small-scale production represent the presence of certain hazardous chemicals. Risk substances from the group of volatile organic compounds (VOC) in surface treatment processes of wood products constitute a large number of contaminants that negatively affect both the working and the environment. These are, in particular, still used solvent-based coatings (CN, PUR, PES). The presence of solvents, thinners for consistency and viscosity treatment in coating processes and curing of these coatings a serious environmental risk even in small surface treatment operations in the production of special wood products (sporting goods, musical instruments, artistic and solitary wood articles). Implementation of the current legislation on the reduction of emissions of volatile organic compounds (VOC) aims to control and reduce the negative impact of these hazardous chemical substances produced from different sectors of industry and activities generating their generation in a coordinated way to ensure the improvement of the health and safety of employees and the general public in the EU while protecting the environment by avoiding air, water and soil contamination. From the point of view of the emission quantification of the sectors involved in the formation of volatile organic compounds, the major producers are the surface treatments of materials and the processes of degreasing the surfaces of the materials with organic solvents. To solve the suggested problem, it is necessary to analysed all aspects that could reduce the production of these hazardous chemical substances. The proposal of environmentally acceptable method of reducing the occurrence of hazardous substances in surface treatment processes of special wood products is a comprehensive solution to these aspects. The result of our research is the eco-technical proposal of a complex facility for the separation of hazardous pollutants for small operations of surface treatments of special wood products. We have proposed a variety of eco-technical separation devices: using adsorption technologies with (or without) regeneration of adsorbent for effective capturing of pollutant emissions. Our research has been comparing the effectiveness of capture of pollutants (VOC) in small scale model plant surface treatments of special wood products.

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