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Mining

Determination of Methane Content at Mao Khe Coal Mine from Current Mining to -450 Level in Vietnam

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abstract

Methane gas is one of the most serious dangers of underground coal mining as its buildup can lead to methane gas explosion. In Quang Ninh province- Vietnam, several coal mines such as Trang Khe II-III coal mine, Khe Cham coal mine, especially MaoKhe mine that have high methane content. At the Mao Khe coal mine, experimental data showed that the concentration of methane in coal seams at different depths were not similar. In order to ensure safety, this report has been undertaken to determine a pattern of changing methane contents of coal seams at different exploitation depths in Mao Khe underground coal mine.

Keywords: methane, Mao Khe coal mine



A Lasso and Elastic-Net Regularized Generalized Linear Model for Predicting Blast-Induced Air Overpressure in Open-Pit Mine

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abstract

Air overpressure (AOp) is one of the products of blasting operations in open-pit mines which have a great impact on the environment and public health. It can be dangerous for the lungs, brain, hearing and the other human senses. In addition, the impact on the surrounding environment such as the vibration of buildings, break the glass door systems are also dangerous agents caused by AOp. Therefore, it should be properly controlled and forecasted to minimize the impacts on the environment and public health. In this paper, a Lasso and Elastic-Net Regularized Generalized Linear Model (GLMNET) was developed for predicting blast-induced AOp. The United States Bureau of Mines (USBM) empirical technique was also applied to estimate blast-induced AOp and compare with the developed GLMNET model. Nui Beo open-pit coal mine, Vietnam was selected as a case study. The performance indices are used to evaluate the performance of the models, including Root Mean Square Error (RMSE), Determination Coefficient (R²), and Mean Absolute Error (MAE). For this aim, 108 blasting events were investigated with the Maximum of explosive charge capacity, monitoring distance, powder factor, burden, and the length of stemming were considered as input variables for predicting AOp. As a result, a robust GLMNET model was found for predicting blast-induced AOp with an RMSE of 1.663, R² of 0.975, and MAE of 1.413 on testing datasets. Whereas, the USBM empirical method only reached an RMSE of 2.982, R² of 0.838, and MAE of 2.162 on testing datasets.

Keywords: GLMNET, empirical, air overpressure, blasting, open-pit mine



Estimation of Truck-Shovel Dispatching in Cao Son Open-Pit Coal Mine and the Ability in Applying Information Technology for Increasing its Efficiency

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abstract

With many types of trucks and shovels for hauling large volume of waste rocks to the dump sites and coal to the storages, the truck – shovel dispatching in Cao Son open pit coal mine is the operation which needs to be improved. At present, the combination between trucks and shovel is usually assigned at the beginning of shift and adjusted during the operation at the mine. The GPS tracking system are integrated into each truck to monitor the position in real time, but applying this information to find the best destination to send the truck to satisfy the production requirements and to minimize truck operating costs is still not used. This paper presents the estimation of the information system, data, the remaining problems of truck – shovel dispatching system, from that proposes the application of available information technology for increasing the efficiency of this activities at the mine.

Keywords: truck-shovel dispatching, Cao Son surface coal mine, truck operating cost



Study on Relationship of Duct Leakage and Parameters of Ducts in Quang Ninh

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abstract

Air leakage of auxiliary ventilation ducting systems is the most common reason for the insufficient fresh air in the working face in underground mine. This value is important design parameter for mine auxiliary ventilation system that operates more effectively, with lower cost.

Therefore, determination of leakage along auxiliary ventilation ducting systems has been examined. Also, factors which affect leakage of air from ducting have been investigated. The measurements are made on 0.6 m and 0.8 m diameter fabric ducts over sections of ducts installing towards the working face in Quang Ninh mine.

Based on these results, research has been undertaken to derive an analytic function which depends on duct leakage and parameters of ducts.

Keywords: air leakage, auxiliary ventilation, duct, analytic function, working face

Study on some Solutions for Enlarging the Application Scope of the Fully Mechanized Longwall Coal Mining Technology According to Seam Dip Angle at Underground Coal Mines in Quang Ninh Coalfield

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abstract

The paper summarizes the applied experience, the technical solutions to limit the adverse effects of slope angle in the mechanized longwall mining at underground mines in the world. The paper proposes some solutions for enlarging the application field of the fully mechanized longwall mining technology according to seam dip angle at underground coal mines belonging to Vinacomin.

Keywords: underground mining, coal mining technology, mechanization



The Possibilities of Revitalization of Post-Mining Areas – the Polish and Vietnamese Examples

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abstract

Poland and Vietnam are the countries where mining activity plays a significant role in national economy. For centuries they have been determined by traditional industries, in relation therewith, have to face with restructuring processes after mining operations. The article presents examples of post-mining areas from Poland and Vietnam, which would require the exceptional revitalization projects, because of their surroundings. The discussed examples show that post-mining areas have potential for development for tourism, recreation and nature functions. The article indicates that it is necessary to balance the interests of beneficiaries of revitalization processes and, therefore, to keep of the overriding principle of planning - sustainable development. Authors emphasize that revitalization projects give a new quality to post-mining areas, becoming a trademark of even entire regions and building their new identity. Polish and Vietnamese experiences, supported by numerous examples, can become a mutual inspiration for revitalization projects, but also a warning of making similar mistakes in their implementation.

Keywords: degraded areas, revitalization, reclamation, polish mining activity, vietnamese mining activity



Experimental Research of the Supply Air Stream to Limited Space

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abstract

The article presents the results of experimental tests of the supply air flow to limited space. The presented laboratory model was made at a geometric scale of 1:10. It is a simplification of the real object. Simplification applies to both the geometry of the facility and the air flow conditions. The presented model exist in mining. The results obtained for various examined cases are presented. For the measurement of velocity fields, the (PIV) Particle Image Velocimetry method was used. The experimental results allow to determine the shape of the air stream supplied to the tested space. This will allow better determination of the ventilation conditions of the tested object.

Keywords: particle image velocimetry, ventilation, velocity fields

Assessing the Current Status of Underground Mine Ventilation System in Thanh Cong-Cao Thang Area, Hon Gai Coal Company, Quang Ninh Region, Vietnam

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abstract

In underground mine ventilation, there are many causes affecting the efficiency of mine ventilation, even affecting mine safety. In order to have an effective mine ventilation system, the research and evaluation of mine ventilation, in order to get timely solutions to improve the efficiency of mine ventilation, is essential and must be done regularly.

Thanh Cong - Cao Thang coal mine area of Hon Gai Coal Company, Quang Ninh region, Vietnam is a mine exploited underground. The nature of this mine is the consolidation (connecting) of Thanh Cong areas and CaoThang areas in the period of 2016. After consolidation into Thanh Cong - Cao Thang mine, many factors in the mine ventilation system of The mine site is altered and affects the efficiency of mine ventilation. This article has analyzed and evaluated the current status of Thanh Cong - Cao Thang Area Ventilation System to help research and select appropriate solutions to promptly improve the efficiency of mine ventilation and ensure security, ensure a safe environment and reduce the cost of mine ventilation.

Keywords: mine ventilation, working mode of air fan, main air fan, Thanh Cong-Cao Thang area



Study on the Possibility of Using Artificial Pillar to Replace the Coal Pillar Protecting Roadway During the Process of Exploitation in Underground Coal mines in Quang Ninh, Vietnam

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abstract

The coal reserve of pillar protecting mine roadways, which is expected to leave (losses) in the mining process, is relatively large in the Quang Ninh underground coal mines, about 93.5 million tons, accounting for over 10% of the total coal reserve (924.2 million tons). This is a readily available coal reserve and currently had prepared by the roadways in longwall mining. If we exploit coal pillar, it will not only allow for saving non-renewable coal resources, but also make use of the available facilities. So there is no depreciation charge of opening the mine, contributing to reducing the cost of preparing excavation, thereby allowing for the extension of the mining age and increase the efficiency of construction investment. In the world (as in Poland, in China and in Russia), in order to reduce the loss of coal in the pillar protected roadways, the mining technology schemata using artificial pillar is widely used. Accordingly, in order to simultaneously both exploit the coal in the pillar and maintain the roadway along the reservoir for ventilation of the longwall below, the coal ribs will be replaced with artificial pillar formed from the strips of stone, metal roof support, chemical materials or low-grade concrete mixes formed from fly ash, bottom ash from coal-fired power plants, combined with crushed stone and some cement additives. This paper will evaluate the ability and proposed some mining technological schemata as well as the type of construction materials suitable artificial pillar.

Keywords: artificial pillar, coal pillar; underground coal mining; mining technology



The Impact of Asymmetry to the Operating Efficiency of 3 Phase Induction Motors

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abstract

Going parallel with the development of technology in electrical engineering field, many nonlinear loads are connected to the power system. Those loads, such as electric power devices, saturated coil, arc furnace and others, result to asymmetry in the system. It also have bad influence on electric apparatus, in general, and on induction motors, in specific. Some impacts are auxiliary torque on motor shaft which makes the motor vibrate and increase motor losses. Base on the electromagnet analysis the paper shows the impact of asymmetry to the normal operation of 3 phase induction motors. The results are verified by simulation software to point out solutions for improving the motor operating efficiency.

Keywords: asynchronous motors, asymmetry, efficiency of electric motors



Power Quality Analysis of the Grid-Connected PV System Using Microinverter

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abstract

At present, small-scale grid-connected PV system is increasingly developed and used in many households. These small-scale PV system are often connected to grid using microinverter, because its advantages are low maintenance investment costs, ease of installation and operation and do not cause environmental pollution. The content of the article focuses on power quality analysis of the non-stored grid-connected PV system using microinverter. The research method in the paper is based on experiments on models and laboratory measurements. The analytical results will assess the power quality of grid-connected PV system using microinverter, thereby managers and operators to take measures to improve the power quality of the electrical system with grid-connected PV system.

Keywords: power quality, PV, grid-connected



Improving the Operation of Earth Fault Relays by Auto Earthing-Connection at Earth Fault Situations in 6kV Mining Grid of Quang Ninh

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abstract

Single phase earth-fault in MV grids usually causes overvoltage that harm to human being and electric equipment. In 6kV mining grids of Vietnam, earth fault which is majority incident accounts 55% to 73% of the total faults. When earth fault occurs many grids' eco-technical parameters will be affected. Moreover, the overvoltage and earthing current can lead to serious electric shock accidents caused mainly by stepping-overvoltage or touching-overvoltage. One of earthing relays requirements is to trip in minimum time duration in order to reduce the magnitude of earthing currents and overvoltage. Base on the simulation in Matlab, the paper suggests a prior connection diagram that allow an auto earthing-connection for improving the better performance of relays. The utilization of the diagram will help to decrease the tripping time of relays, reduce the amplitude of internal overvoltage as well as enhance the safety for human being in case of earthing incidents.

Keywords: earth fault, over voltage, 6kV grid, Auto Earthing connection



Impact of Load Capacity on Voltage and Current Waveform Distortion in Mining Power Grid

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abstract

Recent years, many kinds of power electronic devices, such as inverters and soft-starters, are applied largely in both low voltage (LV) and high voltage (HV) grid in mining power grids. Apart from the advantages of utilizing such apparatus, the consequence of voltage and current wave form distortion is always the managers' and operators' confusing consideration. Many methods could be applied to reduce the disadvantage effect of waveform distortion on power grids. But all methods must rely on understanding about the impact and relation between those power electronic devices and their operation modes. The paper focus on analyzing the impact of load capacity on power electronic devices leading to voltage and current wave form distortion in mining power grid. The simulation implemented on Matlab will be compared with the lab-model-measurement to deduct conclusion. The outcome will be used to form curve presenting the relation of load capacity and THD in mining grids. The conclusions based on curves will be done to help managers and operators to have the best choice for grid operation with minimum/acceptable THD.

Keywords: THD, load capacity, voltage waveform, current waveform



Developing an Advanced Soft Computational Model for Estimating Blast-Induced Ground Vibration in Nui Beo Open-pit Coal Mine (Vietnam) Using Artificial Neural Network

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abstract

The principal object of this study is blast-induced ground vibration (PPV), which is one of the dangerous side effects of blasting operations in an open-pit mine. In this study, nine artificial neural networks (ANN) models were developed to predict blast-induced PPV in Nui Beo open-pit coal mine, Vietnam. Multiple linear regression and the United States Bureau of Mines (USBM) empirical techniques are also conducted to compare with nine developed ANN models. 136 blasting operations were recorded in many years used for this study with 85% of the whole datasets (116 blasting events) was used for training and the rest 15% of the datasets (20 blasting events) for testing. Root Mean Square Error (RMSE), Determination Coefficient (R²), and Mean Absolute Error (MAE) are used to compare and evaluate the performance of the models. The results revealed that ANN technique is more superior to other techniques for estimating blast-induced PPV. Of the nine developed ANN models, the ANN 7-10-8-5-1 model with three hidden layers (ten neurons in the first hidden layer, eight neurons in the second layers, and five neurons in the third hidden layer) provides the most outstanding performance with an RMSE of 1.061, R² of 0.980, and MAE of 0.717 on testing datasets. Based on the obtained results, ANN technique should be applied in preliminary engineering for estimating blast-induced PPV in open-pit mine.

Keywords: artificial neural networks; multiple linear regression; blasting; ground vibration; open-pit mine



Coal Resource/Reserve Potential in Quang Ninh Basin, Northeastern Vietnam

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abstract

Quang Ninh coal basin has been investigated, explored and exploited for over 100 years (from 1840 to 2018). However, during this period (especially from 1986), many research projects such as works of geological surveying or exploration have been carried out, moreover, there has not been any comprehensive works on coal resource/reserve potential in this area. The purpose of this paper is to provide an overview of the geological and quality characteristics, as well as the coal resources/reserves estimated in the basin by using combined investigation methods as data collecting, matching, analyzing, modeling and knowledge-driven. The results will play an important role for northeastern Vietnam in planning for coal exploration and exploitation effectively in the future.

Keywords: Quang Ninh basin, coal, resource/reserve potential, exploration, exploitation

Green Growth in Mining – the Trends of Southeast Asia and Lessons for Vietnam

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abstract

Against the serious consequences of climate change, a new growth model has been established. The green growth or low carbon growth focuses on the efficient use of natural resources, it also enhances the use of renewable energy and environmentally-friendly technologies. Therefore, the green growth is now a trend with new global rules being shaped. This paper presents the trend of Southeast Asian countries on green growth in mineral mining, one of the economic growth activities which has a negative impact on the environment so that draw lessons for Vietnam.

Keywords: green growth, minerals mining, Southeast Asia



A Case Study on the Determination of the Excavated Trench Depth in Unsaturated Soil Constructed by Trench Method Without Supporting Structures

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abstract

Together with the excavated width, the depth of trench play a vital role in stability as well as economics effectiveness of a trench constructed by open trench method. It is widely recognized that a steeper angle of an open trench, a smaller amount the excavated soil required; however, the trench is unstable. In this case, an external supporting structure system is obliged to prevent the trench from falling into the excavation zone. In addition, an open trench is normally located above the water table, hence under unsaturated condition. One of the most important characteristics of unsaturated soil is negative pore water pressure which brings about the matric suction, higher negative pore water pressure, higher matric suction; consequently, higher shear strength of soil. On the other hand, there is a few theories and research works have been reported on the method of determining a suitable depth of a trench under unsaturated condition. Previous works tend to assume that the distribution of matric suction is either constant or linear with depth; as a result of this, the designed results are often overestimated compared to practical results. In this paper, the effect of distribution of matric suction was taken into account to propose an equation to estimate the depth of a trench that can be applied without supporting structure. Finally, an example of numerical calculation of a depth of the open trench was described.

Keywords: stability, supporting structure, excavation zone, unsaturated soil, depth of open trench, matric suction



Recovery of Clean Coal from the Contaminated Waste of Coal Mines in Quang Ninh Province

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abstract

The contaminated waste is a by-product generated during coal mining process. This type of products may contain more or less 20% of clean coal, thus their ash content may vary in a wide range of 55% to 75%. This waste normally is stockpiled separately at "temporary disposal dumps" as they would not be regarded as waste in the full meaning, however, it is very sensitive for the miners who attempt to process such a waste. Based on the results of the coal characteristics survey at some surface coal mines of Vietnam, the studying authors have collected a large quantity of representative samples, such as Ha Tu, Nui Beo, Coc Sau, Tay Khe Sim, Ha Rang mines and have carried out a number of experiments using low cost and highly efficient separating equipment. These are semi-industrial movable screen jig, fluidization separator, some samples of -0.5 mm size using flotation method. Products of processing include clean coal, which has ash content obtain quality standard of Viet Nam (clean coal is consumed easily) and tailings have ash content over 80%, which can waste. The study results showed that the application of the new machines could allow significant recovery of clean coal from the contaminated waste. This may significantly contributes in reduction of environmental pollution while ensuring the production viability and economic efficiency for the miners.



Models of the Ore Deposit Cutting by Means of Room and Pillar System with the Use of Computer-Aided Design

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abstract

The article presents the models of the ore deposit cutting by means of the room and pillar system, taking into account the coefficient of deposit utilization and the maximal range of the zone of rock destruction in the roof of the excavation. With the help of the MineScape software, an ore deposit model in the form of a lens with a thickness of 30m and a diameter of 200m was created. Then a cut of ore deposit in the first layer with a height of 5m, with a room and pillar system with variable geometry was designed. Dimensions of width and length for rooms and pillars were respectively; 4m x 4m 5m x 5m and 6m x 6m. After determining the area occupied by pillars in a given mining field, a spatial model was made for three geometry variants of rooms and pillars in the numerical program Examine 3D based on the boundary element method and a two-dimensional model in the Phase2D program based on the finite element method. Strength, strain and structural parameters of the rock mass were determined on the basis of laboratory tests of rock lumps taken from the zinc and lead mine "Olkusz – Pomorzany". Rocks with a diameter of 50mm and a height of 100mm were cut from rock lumps, which were tested on a testing machine at the Department of Underground Mining at AGH. The purpose of numerical simulations was to determine the maximal extent of the zone of destruction of rocks around workings according to the criterion of Strength Factor. In the summary, it was stated that designing a cutting with room and pillar system, should be taken into account both the coefficient of deposit utilization and the arrangement of rooms and pillars due to the expected load on the rock bolt support.

Keywords: room and pillar, computer aided design in mining, numerical modelling



Geotechnical Mechanisms of Roof Fall Ahead of Face Support in Longwall Mining

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abstract

Longwall mining is one of the most productive methods for extracting underground coal seams. Although the understanding of longwall mining-associated geotechnical mechanisms has been significantly improved that contributes to better ground control, roof rock/top coal fall (roof fall) ahead of support has not been fully understood that causes severe damage to worker and equipment at face. Empirical, analytical and modelling methods were successfully applied in past studies to understand the mechanisms driving roof fall; however, due to limitation of each method, key mechanisms and their interactions during the fall were not satisfactorily investigated. This study aims to gain a systematic understanding of roof fall mechanisms in longwall operation. An extensive review of past studies on roof fall is implemented with an emphasis on the fundamental principles of the applied research methods. The current study demonstrates that the interaction between roof strata, coal seam and face support largely controls roof fall while numerical modelling shows great potential in representing complex mechanisms during the fall. The paper's findings are useful for a more effective control of roof stability in longwall face.

Keywords: longwall mining, roof fall, geotechnical mechanism, numerical modelling



Solution for Reduce Air Temperature in the 7.3.1. Longwall of Halam Coal Mine, Vietnam

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abstract

Ha Lam coal mine is located in Ha Long city, Quang Ninh province, Vietnam. Currently the mine is exploiting up to -300 and is the deepest mine in Vietnam. During the mining process, market 7.3.1 measured the temperature in the longwall reached 330C, so it exceeded the Vietnam National Standard of 3.50C. That means the longwall will have to stop production. The analyzed article identifies the cause of the temperature rise in the longwall and offers solutions to reduce the temperature in the longwall so that the oven can operate normally.

Keywords: Ha Lam coal mine, Longwall, temperature

Forecast of Coal Seam Methane Escape when Exploiting at Khe Cham 1 Coal Mine in Vietnam

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abstract

Khe Cham 1 Coal Mine is located in Cam Pha City, Quang Ninh Province, which is ranked 3rd in methane according to the regulations of the Ministry of Industry and Trade of Vietnam. The third rated mine of methane is rated to have a high degree of danger when exploited. Therefore, before conducting the longwall operation, it is necessary to calculate the amount of methane released from the coal seam, to have a basis to calculate the appropriate clean air flow to dilute methane. On the other hand, it is also the basis for selecting solutions to ensure safety about gas methane when exploiting. The paper has calculated the concentration of methane gas emitted from coal seam 11 in Khe Cham 1 Coal Mine based on the coal seam methane storage capacity and the mining technology of the longwall designed.

Keywords: methane, Khe Cham 1



Status and Prospects of Underground Coal Mining Technology in Vietnam

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abstract

Underground coal mining in Vietnam plays an important role to not only the sustainable coal industry but also the energy and social security in this country. Although the Vietnam coal industry has produced 35–45 million tonnes of raw coal per annum in past ten years, a great volume of coal resources remains distributed in complex geo-mining conditions and mostly unmined. This paper presents a brief review of the current and potential technologies for cutting coal and controlling roof in Vietnam underground coal mines. From the review, it is concluded that there is an urgent demand on improvement of current technologies as well as on investigation for effective application of more advanced mining methods into the industry, especially for deep mining at Red River Delta—the largest coal basin in Vietnam.



Comparison of Vietnam and Poland Industrial Wastewater Regulation: A Study of Trang Bach Coal Mine Wastewater Treatment

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abstract

The research about wastewater treatment in laboratory scale of Trang Bach coal mine in Vietnam was carried out in the year of 2016. We concluded the content of chemical compound that needed to treat the pH, Fe, Mn component and Turbidity & Suspended Solids (TSS) in the wastewater to meet the requirement of the Technical Regulation for Industrial Water of Vietnam. In this article, we suppose to compare the Vietnam and Poland regulations for industrial wastewater based on the result of our research about Trang Bach coal mine wastewater treatment before and then assess the potential to exchange the scientific works about wastewater treatment between Vietnam and Poland.



The Use of Computer Programs to Solve Ventilation Issues in Vietnamese Coal Mines

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abstract

Having enjoyed an economic upsurge in recent years, Vietnam is now recording increased demand for electrical energy. Its production, for the most part, relies on the coal mining industry, thus resulting in a strong upward trend in mining volumes. Being geologically complex, Vietnamese mines are characterised by a complicated structure of their headings. The local ventilation systems are also affected by there being very few automatic dams and an by increases in airflows delivered to the mine. For this reason, in order to analyse airflows and maintain the proper control of ventilation systems, computer software is required. The article offers a comparison of computer programs – Kazemaru, VentGraph and VentSim – as employed for use in Vietnamese mines. The assessment covered the manner in which these programs are used and how their output data are presented, as well as their range of applications in the conditions of Vietnamese coal mines.



Comparison of Vietnam and Poland Coal Resources & Coal Demand in the Past and How it Will Change in Future

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abstract

The article in individual chapters discuss domestic coal resources in Poland and Vietnam, types of coal occurrence in both countries, the processing status and main domestic mining companies. The last part will be a comparison of mining prospects and plans for the development of coal mining in both countries and a summary of positive practices in both countries.

Keywords: coal, demand, resources, Vietnam, Poland



Determining for an Output Capacity of Dimension Stone Exploitation from the Computer Simulations to Generate the Fracture Network in 3D: Case Study in some Dimensional Stone Quarries in Vietnam

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abstract

In dimension stone quarry exploitations such as the marble quarry, a literature review of the existing numerical modelling techniques has been carried out. According to Distinct Element Method, discontinuities have been treated as boundary conditions between blocks and, consequently, an accurate knowledge of joint distribution and orientation was required. The result of analysing data and simulating in the fracture rock environment, which is applied to a mining condition of the dimensional stone quarries. The research we introduce in the output capacity of the dimension stone quarry from the computer simulations to generate the fracture network in 3D with an aim of evaluating the size of the blocks. The results of numerical models have been used to optimize some of the technical parameters for dimensional stone extraction and ensuring stable bench in the mining operation.

Keywords: discontinuities, fracture network, modelling, dimension stone quarry



The Status and Prospect of Mining Technology in Vietnam Underground Coal Mines

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abstract

Vietnam has the 13th largest hard coal reserves globally, with the reserves totaling 2.22 billion tonnes, and estimated resources of 4.07 billion tonnes. Coal use is playing an increasing role in the energy mix and according to current planning, this role is to increase further. In parallel with the development of the Vietnamese coal sector, underground mining also underwent many stages of improvements, especially in the last two decades. This paper analyzes the achievement and the state of the mining technology applied into the underground mining by the Vietnam National Coal - Mineral Industries Holding Corporation Ltd. (VINACOMIN) during 20 year period and proposes the recommendations for the sustainable development of Vietnam underground mining.

Keywords: underground mining, coal mining technology, mechanization



Climatic Hazard Assessment in Selected Underground Hard Coal Mines in Vietnam

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abstract

The article discusses the possibility of improving the microclimate in underground hard coal mines in Vietnam. Vietnamese underground mines are shallow mines which extract coal deposits accumulated up to 500 m below ground. According to the current Vietnamese laws, coal deposits can be mined if air temperature does not exceed 30°C, although this rule is not always observed, especially during summer. This article analyses the impact of air parameters on the climatic conditions in headings and the use of the air temperature reduction method in selected underground mines in Vietnam.



Rational Grinding Circuit for Siliceous Apatite Ore Type III of Lao Cai Vietnam

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abstract

Apatite ores type III of Lao Cai area, Vietnam is a class of weathered siliceous apatite ores, which may have most variable composition and primary slime content according to the weathering level and location. The three operating flotation plants use similar single-stage grinding circuits to process the highly weathered siliceous apatite ores and to achieve the concentrate grade requirement of 31% P₂O₅ with the aimed average recovery of about 70%. Single stage grinding circuits have worked well in the past as the designed criteria were achieved, however, mine production has increased sharply and deeper ores are being mined recently, so that the material composition of the run of mine ores have become more complicated and are the ores become more difficult to be floated. As a result, processing criteria of these plants become critically unstable and low. The study is to investigate the suitability of two-stage grinding circuits for Lao Cai apatite ore type III. The report presents the results of the study on middlings regrinding of hard floatable apatite samples of Bac Nhac Son flotation plant, where high loss of valuable apatite has occurred due to low grinding performance. Research results show that regrinding of all middlings to the fineness of 75% -0.04mm not only improves recovery but also help to stabilize technological operations and their processing criteria. The final concentrate grade of more than 31% P₂O₅, tailings content of less than 5% P₂O₅ and recovery of over 70% were achieved.



Choice of Powered Roof Support FAZOS-15/31-POz for Vang Danh Hard Coal Mine

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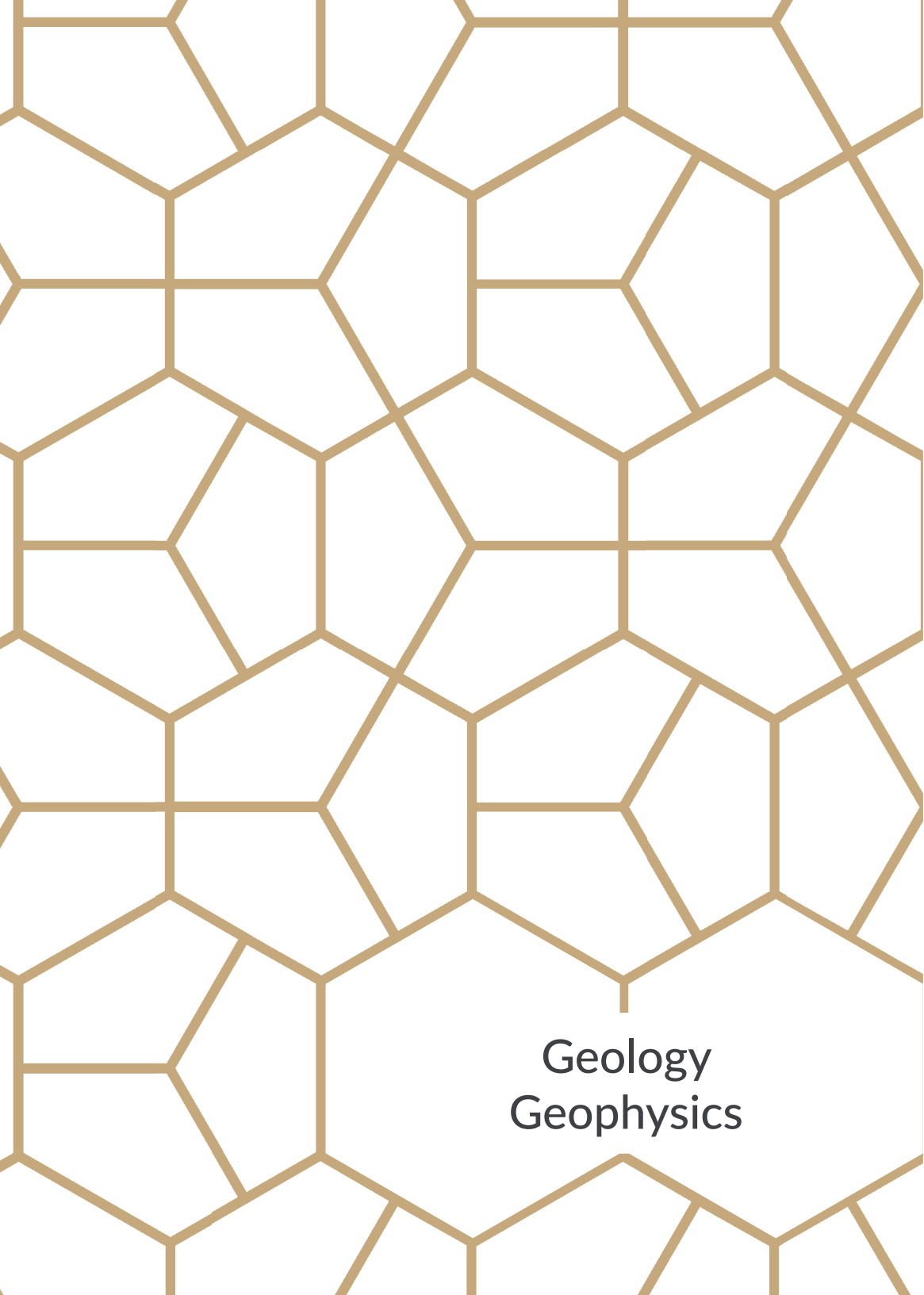
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abstract

The article presents the choice of a Polish powered roof support from FAMUR Group for the conditions of one of the hard coal mines in Vietnam. In the analytical calculations, the strength and structural parameters of the rock mass from the Vang Danh mine region were adopted. The longwall face is 93 m long and the thickness of the coal layer is equal 3 m. For the needs of the choice of support, the load of the longwall face determined and the capacity of the powered roof support were determined. On the basis of the permissible roof deflection method, the condition of excavation maintenance was characterized. In the calculations, it was assumed that the condition of using a powered roof support type FAZOS-15/31-POz, except in addition to complying of the working range and permissible value of longwall face inclination, is to ensure proper roof maintenance conditions, which are determined by the index of load capacity of the roof „g”.





Geology
Geophysics

Origin and Closure of the Paleotethys Ocean in Indochina

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abstract

Paleotethys Ocean existed during Late Paleozoic and Early Mesozoic times. It was located between the Gondwana continent and ribbon of terranes that broke-off Gondwana and moved north toward Laurussia and Siberian. The timing of Paleotethys opening is a subject of controversy, but it certainly followed the Ordovician – Silurian Caledonian orogeny, formation of Laurussia and it existed during Devonian times. The ocean is quite wide in its central part and narrow in eastern and western parts. Assuming the movement of the Meguma plate approaching the Laurussian margin, the western branch of Paleotethys is located between Western Africa and Meguma. The subduction, which caused formation of the Variscan Orogenic Suture, extended along Laurussia Margin from Turkey to Mexico, so a part of Paleotethys could also reach Mexico, in a way similar to Mesozoic Neotethys.

East of Europe, the Paleotethys Ocean was quite wide between Gondwana, Scythian-Turan and Junggar- South Kazakhstan terranes and narrow between Gondwana and Tarim – North China plates. The branch of Paleotethys divided South China plate and Sibumasu terrane that belong to Gondwana. During Late Devonian, Indochina was located north of South China between two branches of Paleotethys. The Upper Devonian spreading-related volcanics and ophiolitic sequences are located in Song Ma zone in Vietnam and map, Lancangjiang zone in western Yunnan and Loei Fold Belt in Thailand. Both branches of Paleotethys were closed during Indosinian orogeny in SE Asia. The Indosinian orogeny was related to the amalgamation of Indoburma, Shan-Thai (Sibumasu) and Indochina terranes and closure of Paleotethys Ocean along Raub-Bentong, Sra Kao and Nan-Uttaradit suture between Sibumasu and Indochina and Ailaoshan suture between Sibumasu and South China. The collision between South Chinese plate and the North Chinese block began during the Late Permian and continued during the Triassic. The Qinling orogenic belt records this collision. The Shangdan zone between the North and South Qinling belts is the suture separating the convergence and collision between North and South Chinese plates. The post-suturing plutons were emplaced along the suture zone and on the adjacent plates. The new large Chinese-SE Asian plate including North and South China, Mongolia and eastern Cimmerian plates was consolidated at the Triassic – Jurassic boundary.



Structural Development of the Lao Cai Basin in Vietnam, Red River Fault Zone

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abstract

We present a model of the structural development (middle Miocene to recent) of the Lao Cai Basin located along the Red River Fault Zone in northern Vietnam. The model is constructed on the basis of the thermal history obtained from mixed-layered illite-smectite composition and vitrinite reflectance analysis of middle Miocene strata, structural analysis of small-scale brittle tectonic structures and C14 dates of Quaternary river terraces. Our results show that the Lao Cai Basin is a graben formed during the left-lateral shift along the Red River Fault Zone due to oblique slip on graben-bounding faults and subsequent formation of graben-cutting normal and strike-slip faults. The exhumation of the middle Miocene strata filling the graben might have amounted up to 2.4 km and took place during the right-lateral shift along the Red River Fault Zone, possibly being affected by the reversal of slip on graben-bounding and graben-cutting faults. Recent surface uplift in the Lao Cai Basin shows a rate of ca. 7 mm/year.

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Keywords: tectonics, neogene, quaternary, Red River Fault, Vietnam



Comparing Composition and Bulk-Rock Characteristics of Raw Material for Decorative Stone in Suoi Giang Area (Yen Bai) and Sa Nghia Area (Kon Tum)

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abstract

Among the decorative stones produced in recent years, products from Suoi Giang (Yen Bai) and Sa Nghia (Kon Tum) areas are highly valued in the market because of their beautiful colors and patterns. The decorative stones in both areas are mainly represented by metacarbonate rocks with the major mineral composition of the carbonate minerals (calcite, dolomite) and mafic silicate minerals (olivine, pyroxene-diopside) and their derived products (serpentine group minerals - mainly chrysotile), in addition to other minerals such as tremolite, chlorite, mica. Although rocks from both localities seem to be products derived from the metasomatic processes triggered by action of the hydrothermal solutions to the surrounding carbonate-rich rocks of Cha Pa Formation (Suoi Giang) and Kham Duc Formation (Sa Nghia), significant difference in bulk-rock composition was noticed between them. The results of chemical analysis indicated that in materials from Suoi Giang area, the SiO_2 content ranged from 5.10 to 40.56 wt%. In the rocks enriched in serpentine and chlorite, SiO_2 content varied to a lesser extent (5.1- 12.14 wt.%). The content of Al_2O_3 is quite low (0.61-2.43 wt.%); the rocks show low iron (0.47-2.21 wt.%) and high magnesium content (13.10- 40.71 wt.%). Total alkalis concentration is low (0.51-1.03 wt.%), the sodium content is often by 2-5 times higher than those of potassium. In the Sa Nghia area, the rocks are rich in silica: SiO_2 content varied from 5.30 to 51.68 wt.%, with 28.92 wt% on average. The rocks' contents of MgO and CaO are highly fluctuated, CaO are ranging from 3.55 to 25.87 wt.%, with averaged 14.05 wt.%; MgO from 18.58 to 40.53 wt.%, averaged 29.21 wt.%. Low alkalis content (0.80-0.99 wt.%), where K and Na do not have clear predominance over each other. The contents of Ti and Mn are quite low (0.03-0.16 wt.%).

This study was supported by the research Grant No. 11.11.140.158 from AGH University of Science and Technology in Krakow, Poland.

Keywords: decorative stone, metacarbonate, serpentine, calcite, olivine



Meionitic Scapolite from Cho Don Gabbro, NE Vietnam - Constraints from Mineralogical and Geochemical Data

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abstract

The meionitic scapolite (73.10-80.51 Me%) has been recognised as a main component in gabbro from the Cho Don complex of the alkaline Bang Phuc massif in northeast Vietnam. It forms quite fresh, large (up to 3 mm), and massive (subhedral) oikocrysts occupying the interstitial space between the pyroxene (Ti-augite with frequent amphibole coronas), Ca-rich plagioclases, K-feldspar, fluorapatite and biotite. At least two generations of scapolite marked by slight differences in optical characteristics and chemical composition were distinguished. One type is characterized by the first-order interference colours and enrichment in Na (av. 0.82 apfu). The latter species reveal second-order interference colours and a relative depletion in Na (av. 0.73 apfu). Although both scapolite species show some variations in luminescence colours, their CL spectra are nearly identical. The slightly Na-enriched type has green-grey CL colour, whereas the Na-depleted one shows both green-grey and brown CL colours. The CL emissions of green-grey and brown luminescent scapolite consists of broad band with the maximum emission line at 500 nm attributed to the presence of S_2^- in the structure of scapolite (Gorobets and Rogojine 2002). Simultaneously, two scapolite types exhibit high CO_2 contents (av. 4.60 wt. %) coupled with relatively low amounts of SO_3 (av. 0.04) wt. %. The accessory minerals of the scapolite-rich gabbro are represented by vesuvianite, vuagnatite, pyrite, rutile, titanite, and wollastonite. Additionally, abundant prehnite is disseminated through cleavage planes of scapolite, while numerous calcite occurs as inclusions in plagioclase at the contact with scapolite. On the basis of textural relationships between particular phases (i.e. sharp and planar interface between plagioclase and scapolite, no relics of feldspars in scapolite as well as rounded margins at pyroxene-scapolite interface) we infer that scapolite is of primary (igneous), intercumulus origin and hence crystallized directly from CO_2 -rich magma (cf. Smith et al., 2008). The La/Yb (ca. 16.60 and Dy/Yb (ca. 1.99), obtained from bulk-rock chemistry, suggest the parental magmas were derived from partial melting of spinel-peridotite facies (see: Jung et al., 2006). Moreover, the depletions in Nb, Ta, and Ti coupled with enrichments in LREE and some of the LILE elements are typical of subduction-related settings. According to the specific relationships between Sr/Nd and Th/Yb ratios, these signatures could be further ascribed to the contribution of metasomatizing fluids that originated from sediment melting rather than dehydration of subducting slab (Woodhead et al., 1998).

Keywords: meionite, gabbro, interstitial, magmatic origin

Mineralogical Characteristics of the IOCG Sin Quyen Deposit, North Vietnam

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abstract

Iron Oxide Copper Gold (IOCG) are most attractive for mining industry looking for multi commodities deposit. The most important commodity in numerous deposits are copper very often associated with gold. The first element from this classification is less important, as a commodity, however it plays important role in accumulation of Cu, Au and sometimes also U and REE. Magnetite concentrate are characterized with the high Fe content and relatively high concentration of sulphur. Results of both field and laboratory investigation of samples collected from Sin Quyen deposit are presented in this work. The Sin Quyen deposit is located within the altered amphibolite and biotite gneiss in the metamorphosed sedimentary rocks of the Proterozoic Sin Quyen Formation, which fills the wide zone of the Red River regional fault. In the deposit there are numerous of ore bodies forming lenses which are forming orebody several tens of meters in width and a few hundred meters length. Orebody is trending the NW-SE direction (Ishihara et al. 2011). The deposit can be divided into two zones downer and upper, the downer consists of least-altered rocks and ores, the upper of weathered rocks. Over 50 samples were collected from the deposit and from the waste.

Following minerals have been identified during ore microscope study: magnetite, ilmenite, pyrite, pyrrhotite, chalcopyrite, sphalerite, marcasite, tennantite, cubanite, arsenopyrite, galena, native bismuth, bismuthinite, and electrum and native gold. Small inclusions of gold (up to a few microns in size) occur in massive pyrite and chalcopyrite micro veins cut older pyrite. In the deposit uraninite crystals have also been identified. In the copper as well as in magnetite-sulphide ores the minerals from allanite group have also been recognized. Thiosulphate replacing pyrrhotite and Fe-oxides have also been found in the dry waste samples. Thiosulphates are a result of pyrrhotite oxidation, and finally are responsible also for uraninite dissolution making low pH of water in the tailing. Microscope investigation and WDS analyses let to recognize two different minerals from the allanite group. The first is allanite with low total REE contents ranging between of 14 - 19wt% and the second with higher concentrations ranging from 20% to 27 wt %. Raman spectra as well as optical properties and chemical variation documented differences between both groups of allanites, and position OH in their structure.

Electron microprobe „chemical” dating of the uraninite based on WDS quantitative measurements, yield an age of 500±33 Ma (n = 35) for the paragenetically early urani-

nite and an age of 73 ± 15 Ma ($n = 6$) for the younger ones. The minerals of older age, which are interpreted as the primary ore mineralization stage, correspond with the ages of a range of deposits along the East Gondwana margin.

Following condition of WDS measurements were implemented: accelerating voltage of 15 kV, a probe current of 40 nA, with a focused electron beam diameter of 3 μm ; counting times peak/background (in sec.) were as follows: Si 10/5, Al 10/5, S 20/10, REE 45/15, P 20/10, Ti 20/10, Ca 20/10, V 10/5, Fe 20/10 and As 20/10. For better statistic of measurement and decreasing of detection limit following condition peak/background (in sec.) were used: U 120/60, Pb 180/90, Th 120/60. Original Jeol ZAF procedures were used for a final correction of all measured elements. Monazite crystal TS-Mnz (894.8 ± 5.3 Ma) was used as a reference material for microprobe standardization.

Conclusions

Based on mineralogical observation in the deposit the major Cu and Fe minerals are chalcopyrite, magnetite, pyrite, pyrrhotite, Au and Ag minerals are electrum and the allanite is a REE bearing minerals. Two different minerals from the allanite group have also been documented and contain different amounts of major ions like Ca, Al, Ce and La. The S natural contamination in the Fe concentrat disclassifies Fe ores as economic ones. Three stages of ore mineralization have been documented in the deposit, timing of two major stages was confirmed by absolute age determination using U–Pb–Th quantitative measurement. The skarn-metasomatic stage was developed in age range of 575–430 Ma, and the younger in the age range of 82–42 Ma.

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2. Jadwiga Pieczonka, ChauNguyen Dinh, Adam Piestrzyński, Phon Le Khanh (2019) Timing of ore mineralization using U–Pb dating in IOCG Sin Quyen deposit, North Vietnam. *Quarterly Geology* (in press)

Keywords: IOCG Sin Quyen deposit, major and minor minerals, REE minerals

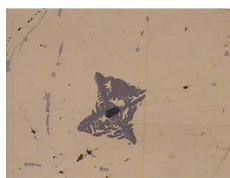


Fig. 1 Sphenalite star inclusion (grey) in chalcopyrite. Reflected light

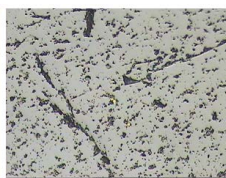


Fig. 2 Gold inclusions (Yellow) in pyrite. Reflected light

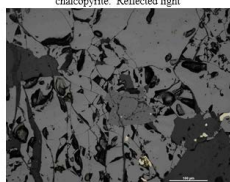


Fig. 3 Uraninite crystal in magnetite. Reflected light



Fig. 4 BSE image of uraninite with points of absolute age calculation.



Relation Between some Selected Major and Trace Elements in the IOCG Sin Quyen Deposit, North Vietnam

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abstract

In the paper the results of the chemical analyze and optical observation together with electron microprobe analyze for the samples collected from the IOCG Sin Quyen deposit are presented. Based on the obtained results the correlations between selected major and trace elements are considered. The positive correlations between chalcophile elements: Cu, Ag, Au, Pb, Bi, Te, Zn, Cd; siderophile elements: Co, Ni, Fe; and lithophile elements: Th, REE were observed. In the studied deposit the correlations between natural radionuclides and some elements of the above mentioned groups such as U-Cu, U-Ag, U-Au, U-Pb, U-Bi, U-Te, U-Zn, U-Cd, and Th-REE were also noted. The correlations together with optical and electron microprobe results were very useful in the geochemistry study of the elements in the IOCG deposit. The obtained geochemical regulars can be used for the other similar deposits, which are occurring in the Indochina block.

Keywords: correlation, major and minor elements, geochemistry, IOCG Sin Quyen deposit, North Vietnam



Metacarbonate Formations in Kontum Massif (Vietnam) and their Relation to Mineral Resources

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abstract

In Vietnam, Kontum Massif locates on the southern part of Truong Son Paleozoic Orogenic Zone and the northern side of Da Lat Mesozoic Magmatic Zone. Here the carbonate and metacarbonate formations occur with small volumes, reported in the Kan Nac (NA-PPkn) Complex, Ngoc Linh Complex (PP-MPnl), Kham Duc Complex (MPkd), Phong Hanh (PZ1)ph and Ngu Hanh Son (C-Pnhs) formations. They systematically distribute and are in the relationship to the history of geological development in Southeast Asia, associated with many industrial materials and geological heritages.

The Archean metacarbonate rocks of the Kan Nac Complex (NA-PPkn) consist of small blocks in Kon Roi, Xa Nam, and Kroong areas. The beds and metacarbonate lenses including marble, olivine marble, diopside marble, calcite-bearing silicate rocks have strongly been deformed, accompanied by gneiss, crystalline schist, two pyroxene gneiss. The rocks have typical mineralogical associations: Cal + Fo ± Phg (1); Cal + Fo ± Spi (2); and Cal + Di ± Phg (3), belonging to the granulite facies of temperatures of 880-900°C, pressure of 940 -950 Mpa, corresponding to a depth of 28 to 30km. Special structures have been discovered in exposed bodies of metacarbonate in Kroong and Xa Nam areas, in the geological cross-section of Song Ba (Gia Lai province). These structures are very similar to those of described stromatolite in the world (Green River Formation in the south of the Greater Green River Catchment-Wyoming, United States; stromatolite in Kona Formation, Peninsula-Michigan, Early Proterozoic stromatolite in the Tree River -Port Epworth, Nunavut, Canada).

The Paleoproterozoic metacarbonates of Ngoc Linh Complex (PP-MPnl) with a very small volume of distribution, including lenses and pods of white marble, diopside marble, plagioclase - diopside marble. The rocks have typical mineralogical associations: Cal + Di (1) and Cal + Di + Plg60 (2), metamorphically graded at amphibolite facies.

The Neoproterozoic metacarbonates of Kham Duc Complex (MPkd) are in the form of layers and lenses intercalated with two-micas quartz schist and two-micas gneiss, mica quartzite, metamorphosed at the epidote-amphibolite to the greenschist facies. Petrographic composition includes tremolite-bearing marble, dolomitic marble. Dolomitic marble block occurred in Sa Nghia area (Kon Tum province) in a lens-shape of up to 400m thick, extending over 1000m, strongly affected by metasomatic activities. Metasomatic activity of high-temperature stage created a zoning metacarbonate body,

including: wollastonite mono-mineral zone (3), olivine calcite zone, olivine – pyroxene-calcite zone, olivine – phlogopite- dolomite zone (2)) and tremolite-dolomite marble zone (1). The low temperature hydrothermal metasomatic stage has chrysotile, lizardite, dolomite, calcite, prenite etc. that replaced the products of the previous stages (olivine, diopside etc.). The Sa Nghia metacarbonates and serpentinites having beautiful colors and good mechanic characters can be used as ornamental and decorative stones.

Early Paleozoic metacarbonates of Phong Hanh Formation (PZ1ph) distribute in Phong Hanh (Phu Yen province), Chu Se (Gia Lai province), Dac Uy and Dak Rolong (Kon Tum province). Petrographic composition comprises of marble and dolomitic marble, tremolite marble, low-grade metamorphism at level of greenschist facies. Dolomitic marble bodies in Kon Queng area (Gia Lai Province), Phong Hanh (Phu Yen province) accompanied with industrial-scale magnesite ore bodies, originated from low-temperature hydrothermal metasomatism.

Thanh My metacarbonate block (Quang Nam province) has a large size, including blue-grey marble, striped marble, which can be compared with the marble of the Ngu Hanh Son formation (C-Pnhs) containing *Petagonocyclincus* sp. relics of Carboniferous-Permian age. At the boundary contacted to the granitoid of Late Paleozoic age, Thanh My marbles have locally been thermal-contact metamorphosed, creating narrow-scale zones of silicate-calc hornfels and silicate-carbonate hornfels of thickness of 0.1-0.2 m to 1.0-2.0m. The rocks have typical associations: Cal + Wo + Q (1); Cal + Di + Wol + Phl + Q (2); Cal + Di + Wol + Q ± Phl (3); Cal + Di + Wol (4); Cal + Oli + Di ± Wol (5), metamorphically graded at hornblend hornfel facies of metamorphosed temperature of 650 to 6500°C, pressure of 2-3 kbars. Thanh My blue-grey stripped marbles (Quang Nam province) has a good quality, currently being exploited as cement materials. The marble block of Ngu Hanh Son (Da Nang province) is related to beautiful cave systems and landscapes, attracting many foreign and domestic tourists.

Keywords: metacarbonate, marble, Kon Tum massif



The Causes of the Instability of the Hau Riverbank in An Giang Province, Vietnam

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abstract

In recent years, the landslides and erosions of the Hau riverbank in An Giang province, Vietnam occur more frequently and significantly in both magnitude and scale. This paper presented the research results on the causes of the instability of this riverbank segment. The result of stability analysis showed that the instability in the research area is mainly related to the soft ground structure of the riverbank and riverbed, the geometry of riverbed, hydrodynamic flow, and human activities. In particular, in some areas where distribute the sand lenses in the soft ground structure and have the high speed flow then the landslides and erosions occur substantially and cause the serious instability of the riverbank.

Keywords: landslides and erosions of riverbank; stability of riverbank; the Hau river; soft ground structure

Study on Saltwater Origin and Mechanism in Aquifers of Danang Area and Solution for Sustainable Groundwater Development

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abstract

This research project applies a combination of methods to study the source and mode of salinity propagation, thereby determining the thresholds for exploitation to prevent salinity intrusion in coastal aquifers in Danang area, centre of Vietnam in the context of climate change and sea level rise. The methods selected in this project focus on: (i) make full use of existing hydrological and hydrogeological data and documents, especially previous analysis on isotopic water samples to determine the age and source of groundwater (ii) Hydrographic - groundwater flow digital model to determine the amount of groundwater recharge (an important factor that affects the distribution of freshwater lenses) and the mechanism, mode of propagation and distribution of salinity intrusion under the impact of climate change & sea level rise. Numerical models were used in the research to best simulate complex hydrogeological conditions in Danang area and affect by tidal in Han, Cu De river and sea water level. The results of identifying origin and mechanism of salinity propagation and salinity intrusion simulation by models will be the basis for the research to determine the sustainable exploitation thresholds for prevention of salinity penetration in coastal aquifers in the context of climate change and sea level rise in Danang area.

Keywords: Saltwater intrusion, Danang-Vietnam, Numerical modeling, Sustainable groundwater development



Methods of Adjusting Geophysical Parameters in the Calculation of Numerical Simulation of an Oil and Gas Reservoir to Obtain Reliable Simulation Results

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abstract

The method of numerical simulation is widely used today to manage the flow obtained from an oil/gas reservoir. However, the geophysical data provided for the simulation program is unreliable, so the numerical simulation results in large errors compared to reality. The paper presents a method for correcting geophysical data in numerical simulation to obtain reliable simulation results.

Keywords: FD - Finite difference, NS-Numerical Simulation

Pure SiO₂ Extraction through Aluminosilicates Synthesis from Incinerated Solid Wastes

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abstract

In this study, pure SiO₂ solution extraction from incinerated solid wastes following after aluminosilicate synthesis is presented. The optimum conditions for obtaining both the pure SiO₂ solution and the substantial amounts of unique residue material should be 200°C of reaction temperature, 1:30 of sample: NaOH, 2M NaOH, and enough reaction time over 24 hours. The optimization of the pure SiO₂ extraction proposes an effective way for recycling the abundant incinerated solid waste as well as other waste ashes.

Keywords: solid wastes, coal fly ash, synthesis, SiO₂ solution extraction



Improve the Effectiveness of Seismic Research in Petroleum Exploration in Vietnam

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abstract

Vietnam is located in Southeast Asia, with diverse and very complex geological conditions. Over the years, geophysical methods have been effectively applied to solve many different geological tasks both on land and at sea such as geological structure, petroleum and mineral exploration, research hydrogeology, engineering geology, environmental geology, etc. In this report, we present some achievements on seismic exploration in marine geology, petroleum exploration not only usually structural traps but also reservoirs fractured granite basement, non-structural traps (stratigraphic and complex traps) in sedimentary basins, for the first time gas-hydrate exploration in deep sea areas. The development of seismic methods such as seismic 3D, 4C, HRS has been concerned. Advanced seismic processing and interpretation system has been used as special filters (T-P, Radon, SRMA), Pre Stack Migration (PSTM, PSDM), Seismic Inversion (SI), Amplitude Versus Offset Analysis (AVO), Control Beam Migration (CBM), Artificial Neural Network (ANN), Seismic Sequence Stratigraphy analysis, Seismic Attribute Analysis etc. The achieved results allow to improve exploration efficiency and increase oil and gas production.

Keywords: petroleum exploration, seismic data, seismic inversion, seismic sequence stratigraphy, AVO, seismic attribute analysis





Geodesy and Mining Surveying

Application of Information Technology to Improve the Management of Mineral Resources in Quang Ninh Province, Vietnam

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abstract

The current mining operation of mineral resources in Quang Ninh province - Vietnam is increasingly complicated. Correspondingly, the management of the mine sites becomes more difficult. Records and documents of minerals and mine sites are archived in different forms. Database systems are stored dispersedly and insufficiently; in many cases lack accuracy, topicality and have not been linked to each other systematically. These lead to many difficulties in accessing and extracting information for the implementation of management as well as for investors and people with related interest. In this paper an advanced software has been developed for the management of mineral resources and has been applied for Quang Ninh province. The software has improved the supervision and administration of the mining operation in the province.

Keywords: software, mineral resources, management



Use of Unmanned Aerial Vehicles for Monitoring the Air Quality of Open-pit Coal Mines

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abstract

Recently remarkable advancement of unmanned aerial vehicles (UAVs) has been observed and their applications can be noticed in many fields such as agriculture, industry, and environmental management. However, in the mining industry, the application of the UAV technology remains potential. This paper presents a low-cost unmanned aerial vehicle technology-based system for the air quality monitoring at open-pit mine sites in Vietnam. The system includes monitoring sensors mounted on a low-cost rotary-wing type UAV. The system collects a variety of data, mainly images, airborne pollutant concentrations and psychometric properties of the air. To evaluate the performance of a proposed system, field tests were carried out at the Coc Sau coal mine. Based on the images transmitted to the ground monitoring station, large-scale 3D topographic maps were successfully modeled. At the same time, sensors mounted on the UAV system were able to monitor the levels of environmental variables associated with the air quality within the pit such as temperature, dust, CO, CO₂, and NO_x concentrations. This study proved the applicability of low-cost UAVs for the air quality monitoring at large and deep coal pits with relatively high accuracy.

Keywords: air quality monitoring system, open-pit coal mines, UAV



Comparison of the Resampling Methods for Gridded DEM Downscaling

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abstract

In this paper, a comparison and evaluation of three resampling methods for gridded DEM is implemented. The evaluation was based on the results of bilinear resampling, bi-cubic and Kriging resampling methods for an experiment using both degraded and sampled datasets at 20 m and 60 m spatial resolutions. The evaluation of the algorithms was accomplished comprehensively with visual and quantitative assessments. The visual assessment process was based on direct comparison of the same topographic features in different downscaled images, scatterplots and profiles. The quantitative assessment was based on the most commonly used parameters for DEM accuracy assessment such as root mean square errors (RMSEs), linear regression parameters m and b , and correlation coefficient R . Both visual and quantitative assessment revealed greater accuracy of the Kriging over the other two conventional methods.



Applying Light-weight UAV in Mapping Quarries

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abstract

In Vietnam, there are a huge number of quarries that are exploited and mainly provide materials to the construction sector of the country. However, most of the quarries are operating without topographic plans due to a lack of surveying activities. This paper introduces an approach of using low-cost UAVs to produce digital surface models which in turn are used to draw topographic maps of quarries in Vietnam. For assessments of accuracy, safety, and working efficiency, four quarries different in terrain conditions, namely Luong Son, Long Son, Nui Nho, and Nui Dai were selected as the study areas. Ground control points were established in each area by using GNSS/RTK for camera calibration and accuracy assessment. The accuracy of DSM was assessed using the root-mean-square error (RMSE) in X, Y, Z, XY, and XYZ components. Capturing images from each site were processed by using Agisoft®PhotoScan Professional 1.5.2. The results showed that all the DSM models of the four areas have high accuracy, RMSE on the checked GCPs ranges from 1.0 to 9.0 cm, from 1.2 to 5.0 cm, from 4.4 to 13.4 cm, from 1.6 to 10.3 cm, and from 4.9 to 16.9 cm for X, Y, Z, XY, XYZ components, respectively. We concluded that the low-cost UAV based mapping technology can guarantee the accuracy of DSMs, the safety of UAV flying, and the efficiency of surveying working simultaneously when using in quarries.



Accuracy Evaluation of Trimble RTX Technology and the Integration of GNSS Precision Positioning in Real Time with Geodetic Surveys for Archaeological Purposes

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abstract

This paper concerns the results of accuracy evaluation of RTX technology and description of integration of the data obtained with the Spectra Precision SP60 GNSS receiver in the geodetic works supporting archaeological researches. There were two polish expeditions called "Wyprawa BaARI" conducted in past two years. The main aims of them were to popularize and protect the archaeological remains of Paphos Archaeological Park in Cyprus and at two archaeological sites in Jordan (Dajanyia and Tuwaneh). Modern geodetic surveys technologies were used to help in this.

Real-Time eXtended (RTX) technology is a combination of RTN and PPP technologies. The manufacturer ensures that this innovative technology provides accuracy of 2 cm horizontal, 5 cm vertical (RMS). What is very important - RTX technology enables to determine coordinates of points in the real-time using only one GNSS receiver (no base is required) and without the connection to the network of ground permanent stations. The core of the technique is based on a worldwide network of over one hundred tracking stations. The precise satellite data in the CMRx format can be obtained by the user in two ways: through a satellite link (the receiver need to be equipped with L-Band antenna) or via the internet.

The repeatability and global accuracy of the RTX methodology were assessed. It can be say that the tested method meets the accuracy requirements sets by the manufacturer and satisfies archaeologists. Analyses confirmed that the maximum differences between determined coordinates with RTX technology are within the limits of the error at Cyprus in 2017 - 4 cm and in Jordan in 2018 - 2 cm horizontally. RTX technology was also used to support modern surveys methods: Terrestrial Laser Scanning, close range photogrammetry or making virtual tours.

Keywords: RTX, Global Navigation Satellite System, data processing, statistical analysis, real-time systems



Application of Artificial Neural Networks in Flash Flood Forecasting Model in Northwest Vietnam

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abstract

In recent years, flash floods in northwestern Vietnam have become more serious, causing huge losses to the socio-economy and people's lives. It is necessary to build the flash flood partitioning maps of high-precision to enhance people's resilience and response to climate change, ensure stable long-term life of the community in flash flood areas.

The application of geographic information systems (GIS), remote sensing (RS) and especially the application of artificial intelligence (AI) have given useful tools to solve complex problems of flash flood models.

The paper presents methods of using Sentinel remote sensing data to detect flash flood and combining with other database maps, thereby modeling flash flood forecasting on the basis of artificial neural networks application for mountainous areas of northwestern Vietnam.

Keywords: flash flood, northwestern Vietnam, Artificial Intelligence (AI)



Research on Technical Solution to Develop Monitoring System for Displacement and Deformation of High Rise Building in Real Time using GNSS/CORS Technology

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abstract

This article presents a technical solution for monitoring for displacement and deformation in real-time based on GNSS / CORS technology. The components and principles of operation of the monitoring system for displacement and deformation have been designed and establish. The continuously operation reference station (CORS) was used to correct position for monitoring station in the RTCM format. A device for receiving and transmitting data from the monitoring station to the server has been designed and developed. NMEA messages have been decoded and filtered through three steps using home-made software that improves the accuracy of the monitoring results. The results show that the developed equipment system can monitor horizontally displacement to 3 mm and vertical displacement to 5 mm.

Keywords: continuously monitoring, displacement; deformation, global navigation satellite system, continuously operating reference station GNSS, real time



Identification of Areas Susceptible to Mass Movements in the Area of the Skawa River Dam (Poland)

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abstract

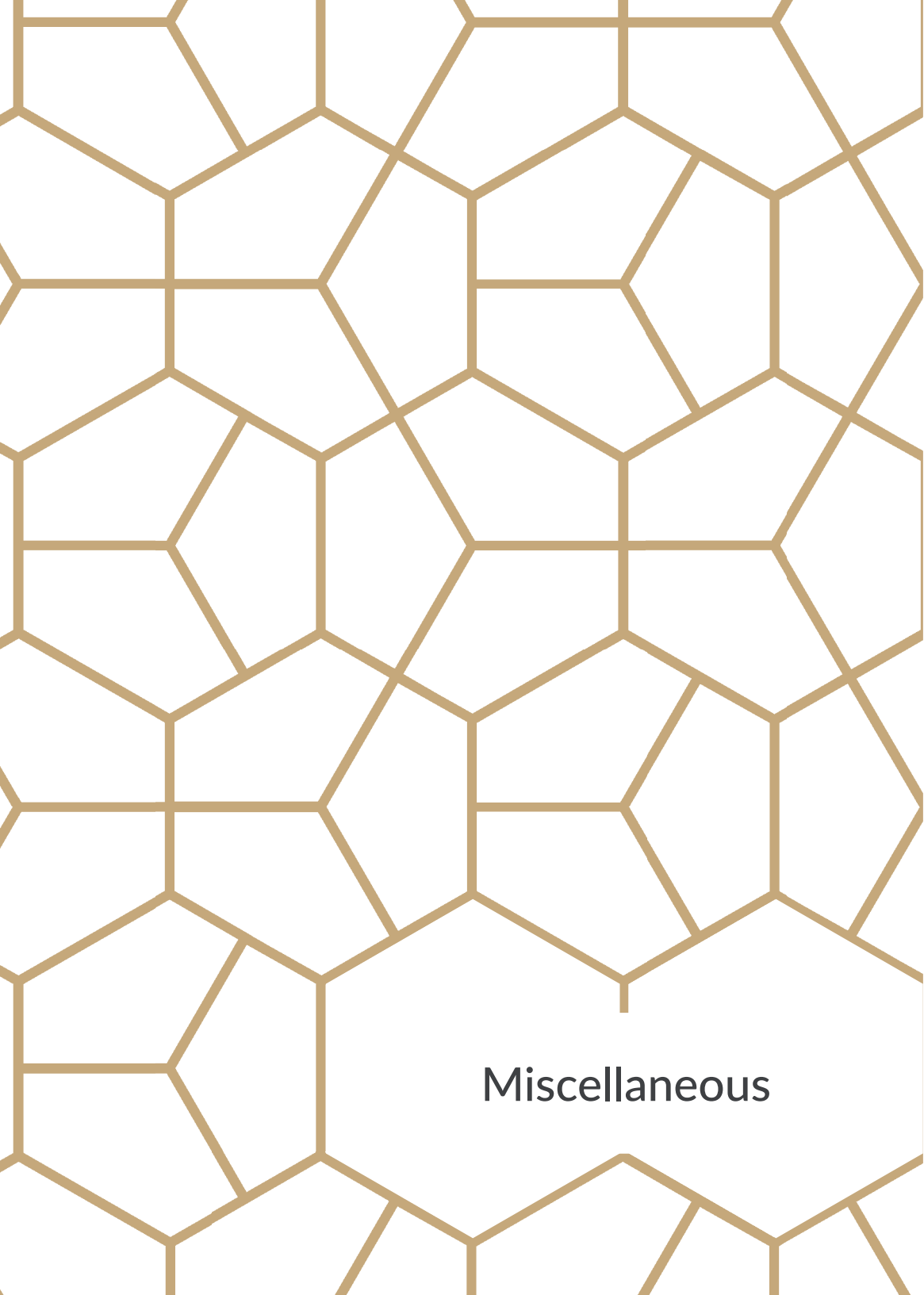
As a result of the launch of the Świnna Poręba reservoir on the Skawa River (Poland), there has been a change in the level of the water table flowing by nearly 30 meters. Until now, the exposed slopes of the valley have been flooded into the so-called normal level of damming (305.5) meters above sea level. In the future, at the stage of reservoir operation, the water level may fluctuate within 23.5 meters (in the range from the minimum to the maximum level of damming).

In the area of the reservoir, 26 landslides have been documented, which were completely or partially flooded when the normal damming level was established. This is an extremely unfavorable situation, because water is one of the basic factors stimulating mass movements. Therefore, in the discussed case the processes of gravitational ground movement downhill due to the failure of the ground in lower elevation areas, but also increased processes related to loss of hill stability due to river erosion in the „increased” riverbed profile.

For the analysis of landslide risk, a list of parameters that influence the possibility of activating landslide processes is used. One of these parameters is the proximity of running water. In the presented case, the results of the performed geological tests were presented, which allowed to make a landslide map for a given region, which is a basic element of the risk management process.

Keywords: river valley, landslide, dam





Miscellaneous

Application of Uncertainty Analysis Based on Monte Carlo (MC) Simulation for Life Cycle Inventory (LCI)

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abstract

The use of Monte Carlo (MC) simulation was presented in order to assess uncertainty in life cycle inventory (LCI) studies. The MC method is found as an important tool in environmental science and can be considered the most effective quantification approach for uncertainties. Uncertainty of data can be expressed through a definition of probability distribution of that data (e.g. through standard deviation or variance). The presented case in this study is based on the example of the emission of SO₂, generated during energy production in Integrated Steel Power Plant (ISPP) in Kraków, Poland. MC simulation using software Crystal Ball® (CB), software, associated with Microsoft® Excel, was used for the uncertainties analysis. The MC approach for assessing parameter uncertainty is described. Analysed parameter (SO₂) performed in MC simulation were assigned with lognormal distribution. Finally, the results obtained using MC simulation, after 10,000 runs, more reliable than the deterministic approach, is presented in form of the frequency charts and summary statistics. Thanks to uncertainty analysis, a final result is obtained in the form of value range. The results of this study will encourage other researchers to consider this approach in their projects, and the results of this study will encourage other LCA researchers to consider the uncertainty in their projects and bring closer to industrial application.

Keywords: Poland, Integrated Steel Power Plant, Monte Carlo simulation, Crystal Ball, frequency charts, summary statistics.



Estimation of Target Hazard Quotient (THQ) for Heavy Metals by Consumption of Fish From Quang Binh, Vietnam

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abstract

Three fish species (*Gerres filamentosus*, *Mugil cephalus*, and *Sillago sihama*) were randomly collected in commercial catches at local markets in Quang Binh from July to September 2018. The dorsal muscle was dissected and analyzed for their Lead (Pb), Cadmium (Cd) and Zinc (Zn) contents by the flame atomic absorption spectrometer by PerkinElmer AAnalyst 800. The mean concentration of Cd, Pb, and Zn in muscles of *Gerres filamentosus* were 0.011; 0.125 and 1.917, respectively ($\mu\text{g}\cdot\text{g}^{-1}$ d.w). Content in muscles of *Mugil cephalus* were 0.032; 0.124 and 1.308, respectively ($\mu\text{g}\cdot\text{g}^{-1}$ d.w). Content in muscles of *Sillago sihama* were 0.014; 0.121 and 1.251, respectively ($\mu\text{g}\cdot\text{g}^{-1}$ d.w). A health risk analysis based on target hazard quotient (THQ) estimated for consumptions. THQ values over 1 were not observed through the consumption of fish. Total THQ values of heavy metals in *Gerres filamentosus*, *Mugil cephalus*, and *Sillago sihama* were 0.134; 0.187 and 0.134, respectively.

Keywords: fish, heavy metals, health risk, target hazard quotient (THQ), Vietnam

Application of 1-methyl 3-teradecyl Imidazolium Impregnated Solid Carriers in Sorption of Platinum from Chloride Solution

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abstract

Ionic liquid (IL) 1-methyl 3-teradecyl imidazolium ($[C_{14}MIM]Cl$) were successfully synthesized and characterized by Fourier transform infrared (FT-IR) and nuclear magnetic resonance (NMR) spectra. Synthesis reactions were carried out using conventional heating with high yields (over 85%). Synthesized IL were used as green solvents to extract platinum in chloride solution with high extraction percent (over 90%). Sorbents in nature of supported ionic liquid phases (SILPs) were prepared by impregnating IL on some solid carriers such as silica gel, amberlite XAD-7, and XAD-4 ion exchange resins. Platinum was recovered using these sorbents with the yields over 90%, however, the amounts of used ionic liquid is much less than that of ionic liquids used in extraction method and the process can easily be transferred to heterogeneous phase. The platinum sorption is affected surface characterization and structure solid carriers, the ionic liquid loading (% pore volume), and IL/Pt molar ratio. Sorption isotherms were investigated with different ionic liquid loadings and IL/Pt molar ratios. From the stoichiometric ratio obtained at saturation of the SILPs the sorption mechanism and similar reactive extraction mechanism involved a ion exchange with ion pair formation between hexachloroplatinate species $PtCl_6^{2-}$ and imidazolium groups ($[C_{14}MIM]^+$) was proposed.

Keywords: imidazolium ionic liquid, extraction, sorption, recovery of platinum, sorption isotherms, supported ionic liquid phase



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