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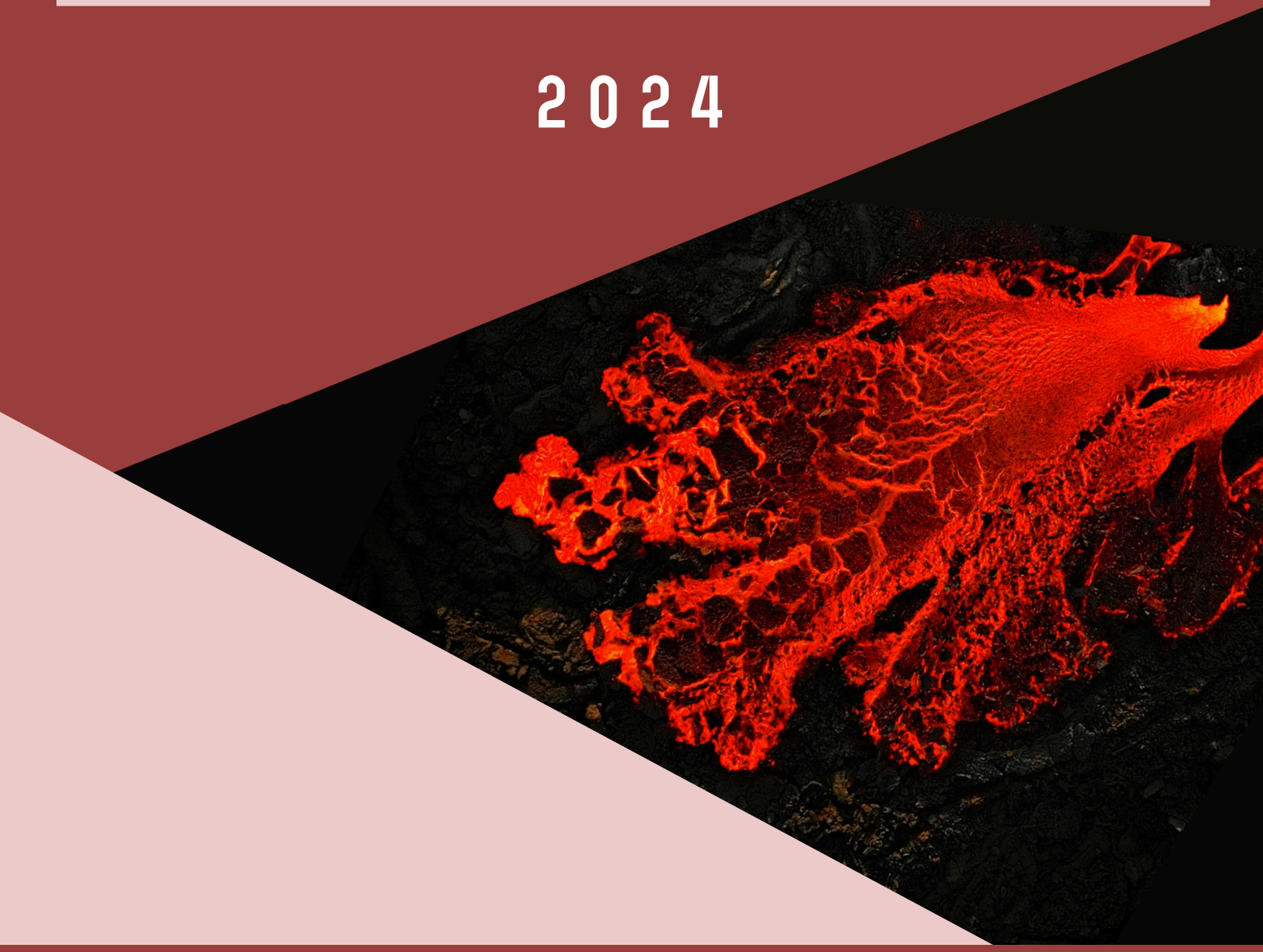
STUDENT GEOLOGICAL CONFERENCE

2024



MASARYKOVA UNIVERZITA

Studentská geologická konference 2024

Student Geological Conference 2024

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Sborník abstraktů

Book of Abstracts

Zuzana Bartošová, Sára Kozáková, Kateřina Musilová,
Lucie Stejskalová & Jakub Vácha (eds)

Masarykova univerzita
Přírodovědecká fakulta, Ústav geologických věd
Brno 2024

Studentská geologická konference 2024 proběhla pod záštitou Přírodovědecké fakulty Masarykovy univerzity dne 29. 5. 2024. Pořadatelem byl Ústav geologických věd ve spolupráci s Českou geologickou společností.

The Student Geological Conference 2024 was held under the auspices of the Faculty of Science of Masaryk University on 29 May 2024. The conference was organised by the Department of Geological Sciences in cooperation with the Czech Geological Society.

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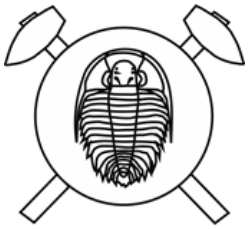

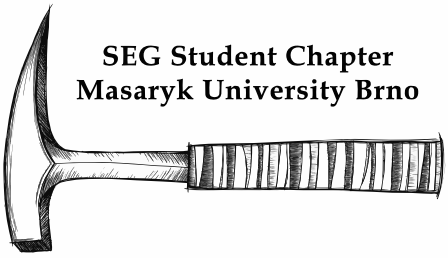

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Obsah

Intelligent Machine Learning for Automated Petrophysical Characterization of Complex Reservoirs

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Accurate characterization of complex lithologies like shaly sands is crucial for hydrocarbon exploration, but manual interpretation of well logs is time-consuming and subjective. We present a novel automated workflow that leverages machine learning to robustly delineate reservoir units and predict their petrophysical, geometrical, and zone parameters from well log data.

Our approach synergistically combines the Most Frequent Value (MFV; Steiner, 1988; 1991) clustering algorithm and an inversion scheme (Fig. 1). The MFV method applies robust statistical principles to detect layer boundaries without prior information. Its key advantage over traditional k-means is immunity to non-Gaussian noise common in well logs (Fig. 2). The unsupervised clustering results initialize layer models for a subsequent interval inversion that optimizes parameters like porosity, permeability, water saturation, shale volumes, and cementation exponents to match the measured curves (Szabó *et al.*, 2021).

We validate our integrated clustering-inversion workflow on synthetic cases with varying lithologies as well as field datasets from Hungary and Egypt. In the Baktalórátháza-1 well, our algorithm automatically delineates a shaly sand sequence comprising Pleistocene sands overlying Pannonian shales. For a Jurassic reservoir, we predict porosity-permeability relationships consistent with sedimentological environments and core data. Our noise-robust probabilistic framework enhances formation evaluation, eliminates subjective inputs, and enables high-fidelity characterization of complex reservoirs.

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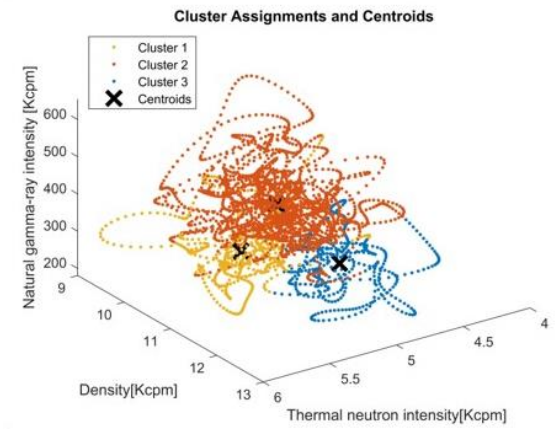

Figure 1: 3D Cross plot shows the clustering results.

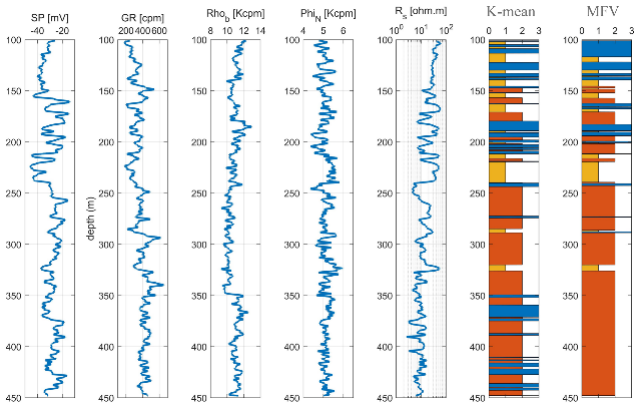

Figure 2: The resulted clusters from both the k-means and MFV clustering methods.

Unveiling Metamorphic Conditions: Chemical Analysis of Minerals in Granitic and Gneissic Rocks of Umra-Mubarak-Abu Karahish Area

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This study thoroughly investigates the mineralogical intricacies of granitic and gneissic rocks from the Umra-Mubarak-Abu Karahish region. Utilizing electron microprobe analyses related EDX and WDX techniques, we unravel a rich diversity in their mineral compositions, indicative of the complex metamorphic processes shaping their evolutionary regime.

In our approach, we leverage our extensive experience with the Najd Fault System in the Eastern Desert of Egypt and other shear zones in the region to conduct an integrated study. Our primary focus is on the Mubarak post-accretionary belt, Abu Karahish and El Umra complexes, where we aim to relate their evolutionary trajectory to existing knowledge of basement complexes in the region. Specifically, we seek to determine the temperature, pressure and times of peak metamorphism, discerning between hypotheses regarding exhumation mechanisms.

The amphibole chemistry reveals a predominance of calcic compositions, suggesting a wide temperature range from approximately 570 °C to 780 °C. Biotite analysis uncovers a nuanced metamorphic history with temperatures varying between 370 °C and 690 °C, implying multiple metamorphic phases. Chlorite geothermometry depicts fluctuating thermal conditions, reflecting a variable thermal history. Plagioclase chemistry exhibits compositional variations consistent with metamorphic conditions.

Our findings highlight a pressure-temperature path characterized by moderate to high-pressure conditions (6 to 8.5 kbar) and a temperature spectrum spanning from relatively low to high, illuminating a complex metamorphic evolution. Through this study, we aim to contribute significantly to unravelling the tectonic evolution of the Umra-Mubarak-Abu Karahish area, offering valuable insights into the intricate processes shaping its geological history as a part of the Central Eastern Desert.

Geochemický rozbor U-Mo ložiska Kurišková, Slovensko

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Ložisko Kurišková s U-Mo mineralizáciou sa nachádza v petrovohorskom súvrství krompašskej skupiny (severné gemerikum) približne 7 km SZ od Košíc. Horniny vulkanicko-sedimentárneho komplexu sú z obdobia permu a predstavujú primárny výskyt uránovej mineralizácie na území Slovenska (Szabó *et al.*, 2014). Zistené hlavné rudonosné minerály na ložisku sú uraninit a coffinit, zriedkavejšie ortobrannerit, molybdenit, apatit a powellit (Kohút *et al.*, 2013).

Analýzy vzoriek vo forme vrtného jadra a 2 leštených výbrusov boli robené pomocou elektrónovej mikrosondy, XRF spektrometrie, LA-ICP-MS a optickej mikroskopie. Získané dáta poskytli geochemický prehľad o študovanej lokalite a v najbližšej dobe prebehne porovnanie s ložiskami Mo-U mineralizácie v kaldere Streltsovka v Rusku.

Pomocou elektrónovej mikrosondy bol vo výbrusoch zistený uraninit (priemer 84,3 hm.% UO_2), coffinit, apatit, chlorit, kalcit a kremeň. Pozorované bolo aj množstvo Ti-oxidov vo forme branneritu, ktorý vznikol ako početné pseudomorfózy po Ti mineráloch na základe ich reakcie s uránovými fluidami a REE. Skúmanie migračných ciest (Obr. 1) a prípadné nahromadenie U minerálov a iných prvkov bude predmetom ďalšieho výskumu. XRF skenovanie vrtného jadra prebehlo na 3 profiloch, simultánne bolo meraných 37 prvkov. Najväčšie koncentrácie U (14 000 ppm) a ΣREE (2 500 ppm) boli analyzované v oblasti hematitizovanej žilky. Vyhodnotením analýz bola potvrdená korelácia medzi prvkami Mg, Al, Si, Fe, Ti, Cr a taktiež medzi Ca, Mn, Sr. S rastúcim obsahom U, rástol aj obsah REE.

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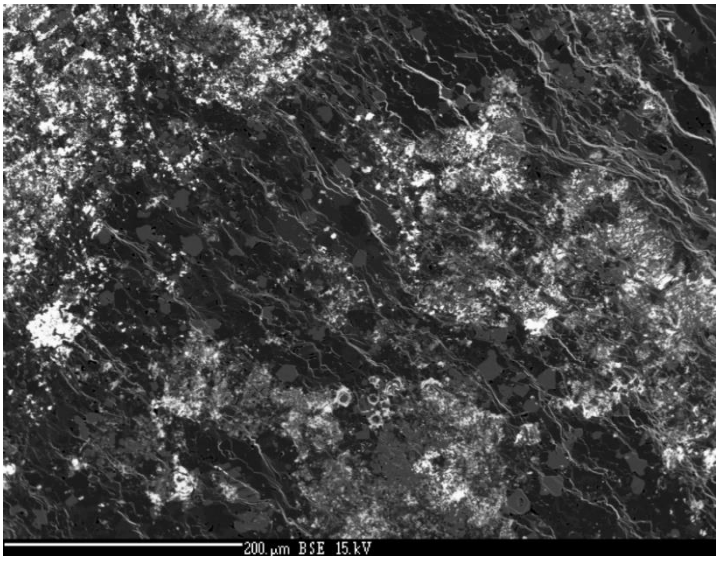

Obrázek 1: BSE snímka migračných ciest na výbruse z ložiska Kurišková (Slovensko).

Depositional conditions of the Callovian and lowermost Oxfordian deposits in the Kraków region against the background of the formation of the Atlantic Ocean

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On the Callovian-Oxfordian boundary were climatic fluctuations recorded throughout Europe. The research aims to analyse the factors influencing the conditions of deposition of sediments of the Callovian-Oxfordian succession from the Kraków region. The Callovian-Oxfordian deposits are a transgressive sequence with a transition from siliciclastic formations deposited in the environment of the shallow clastic shelf (Herveyi zone) through carbonate formations of the sublittoral zone with a nodular layer (Koenigi, Calloviense zones) and stromatolites (Lamberti zone?) passing into marls representing the uppermost Callovian (?) – Oxfordian lowest (Mariae zone; Giżejewska & Wieczorek, 1976; Matyszkiewicz *et al.*, 2015). Sedimentation environments change from the upper shoreface through the lower shoreface to the upper offshore and inner shelf.

The succession is characterized by significant lateral and vertical facies variability, as well as the presence of many stratigraphic gaps. The accumulations of fauna, a large amount of ferruginous ooids and glauconite grains as well as redeposited lithoclasts testify to an extremely slow rate of sedimentation. In addition, submarine erosion or corrosion surfaces most likely record a widespread crisis of carbonate production or a change in its nature. Precipitation of calcium carbonate was difficult and even dissolving was possible. There have also been changes in global temperature and sea level fluctuations (Giżejewska & Wieczorek, 1976; Dromart *et al.*, 2003a; 2003b; Pellenard *et al.*, 2014). In the studied interval, global climatic and environmental perturbations took place, caused by increased hydrothermal activity of the seabed, opening new oceanic connections, creating a new network of currents during the breakup of Gondwana and the formation of the Atlantic Ocean (Wierzbowski *et al.*, 2009). The episode of glaciation at the Callovian-Oxfordian transition is indicated, among others, by high $\delta^{18}O$ values (Dromart *et al.*, 2003a; 2003b). The cooling was sudden on a geological scale and lasted about 0.8 million years. It most likely resulted from negative feedback from previous warming (Dromart *et al.*, 2003a; 2003b).

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Study of Nb-Ta-Sn bearing facies from the Viitaniemi pegmatite, Finland

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Many elements like niobium, tantalum, or tin are needed in civilization development (electronics etc.) and could be listed as the critical elements. Nowadays, looking for new sources of these elements is one of the main goals for exploration companies. Pegmatites, which are a coarse-grained magmatic rock could be a host for numerous critical elements. Due to the variation in the occurrence of critical elements in individual pegmatites, there was a need to classify them. They were divided into three families: LCT, NYF and a combination of both (Černý & Ercit, 2005).

The aim of this work is to investigate Nb-Ta-Sn bearing facies from the Viitaniemi pegmatite – world class known pegmatite, which exhibit unique mineral association (Lahti, 1989; Kluza *et al.*, 2022). The studied pegmatite is located in the Eräjärvi area, in southern Finland. The pegmatite is an LCT-type pegmatite occurring in the form of a dyke with a thickness up to 10 meters and a length of several hundred meters. The magma intruded within schists that were metamorphosed and folded during the Svecofennian orogeny, approximately 1.8 billion years ago. Unique mineral association is characterized by a numerous sulfides, oxides, as well as phosphates. Moreover, it's a type locality for two phosphates Viitaniemiite and Väyrynenite, both are well known around the world.

During fieldwork, aimed at analysing facies within Viitaniemi pegmatite, representative samples with cassiterite and minor CGM were collected (cassiterite served as a marker due to it is distinctive characteristics). Transmitted-light and reflected-light microscopy were used to petrological analyses. Chemical analyses were conducted by electron microprobe at AGH University of Krakow. In analysed samples, cassiterites, columbite group minerals (tantalite, columbite) and wodginite were observed.

The observed minerals, based on their chemical composition, can be divided into: Mn-columbites, Mn-tantalites and Fe-tantalites. The columbite group minerals present are both euhedral and anhedral, which may indicate their different genesis. Moreover, in some crystals of CGM zonation can be observed. Cassiterites revealed a significant enrichment of tantalum (up to 8.16 wt.% Ta_2O_5) and niobium (up to 2.15 wt.% Nb_2O_5). Moreover, cassiterites from the Viitaniemi pegmatite displayed compositional variations depending on the pegmatite zone (determined based on the hosting mineral). The inner quartz zone showed a weaker tantalum enrichment compared to the outer blocky zone of the pegmatite.

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Exploring molybdenite-hosted rhenium occurrence in the Recsk Deep-level ore deposit, Hungary: Geochemical investigations and 3D modelling

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The Recsk Deeps is a substantial base and precious metal mineralization ore complex with diverse mineralization stages that show significant potential mineral resources, particularly in copper and gold, as well as in the exploration of molybdenite, which is rich in rhenium. Szebényi & Földessy (2010) previously presented data about Recsk's copper-molybdenite ore concentrates rich in rhenium, formed in the sub-volcanic depth ranges of medium and low temperatures. Miklovicz (2017), using available geophysical data in his model, concluded that the intrusion's source could be a batholith, with its top positioned approximately 2.5 km deep, providing conditions conducive to potential mineralization at this depth, primarily in the form of skarn mineralization, characterized by a high Mo/Cu ratio. Our initial study aimed to assess molybdenite-bearing samples and validate the existence of rhenium in the Recsk Deeps, during which petrographic and ore microscopic analyses were performed, as well as EPMA-EDX and LIBS. Until now, there have been no detectable rhenium mineral phases in0 the molybdenite-bearing samples. According to analogous examples, the amount of rhenium found in molybdenites typically exhibits significant variability and may be influenced by various factors, including metal sources, magma fractionation, and distinct generations of molybdenite (Voudouris *et al.*, 2013; MacFall *et al.*, 2019), which might indicate rhenium introduction at different formation stages. Szebényi (2020) reported significant rhenium content in skarn molybdenite ores after conducting LA-ICPMS, revealing elevated levels that averaged 750 ppm, accounting for a cumulative content of 10500 ppm. These mineralizations are thought to originate from a common mineralizing system but occur at different vertical levels. Complementing this study, the 3D geological model assesses the presence and distribution of molybdenum content, revealing its distinct concentration patterns in the porphyry and skarn formations at different depths, further contributing to the foundational understanding of mineral occurrences in this geological context.

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Preparation of the Mapping Geological Hazards in the Khevsureti Region in Georgia

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The paper describes the preparations of the "Georgia 2024" project supported by the Czech Challange Fund 2023, which focuses on the elimination of the risk associated with geological hazards, which are particularly threatened by the high-mountain regions of Georgia. The frequency of destructive events is increasing as the intensity of climate change increases.

CGS cooperates with the Georgian National Environmental Agency (NEA), which is responsible for monitoring, assessing and mapping geological risks in Georgia. Our long-term goal is to increase the capacities of NEA experts through the implementation of new tools and the transfer of experience. The key milestones of the project are the visit of NEA experts to the Czech Republic, where they will participate in workshops and field training. Other milestones include three field expeditions to Georgia, where we organize workshops and field mapping work to map geological hazards along the main and only access road to the Khevsureti region in the Georgian Caucasus. The difficult-to-access and landslide-prone area is heavily deforested and thus suitable for deploying our new analytical tool for detecting changes in the landscape by comparing satellite images. This procedure was used in a case study of the detection of landscape changes induced by the Kaikoura earthquake in New Zealand in 2016 (Jelének *et al.*, 2021). The detected change in the nature of the landscape can be caused by the activation of a Landslide, Debris flow, but also by deforestation, construction or mining. This tool has a wider environmental use. And for us, the analysis is a very good preparation for the field verification of the detected phenomena. We use the freely available Sentinel-2 data and the Copernicus DEM digital terrain model for the possibility of replication in other areas of Georgia and other countries. Geological hazard maps of the Khevsureti area are also one of the main outputs of the project. A robust GIS project was created as a basis for the creation of maps that will be fully digital and linked to databases of individual geological hazards such as Landslides, Debris flow, Erosion, Source of Rock fall, Avalanche area and others. These maps will be freely available and can thus have a long-term positive effect on the development of the area by streamlining the planning of new infrastructure. It is easier for communities living in remote areas like Khevsureti to obtain permits and funds to upgrade infrastructure when there is a natural hazard map for the area.

The project is a continuation of the previous cooperation from 2014–2017 and 2021, the result of which is, among other things, an article about the immediate threat of hydroelectric power plants in Kazbegi, Georgia, due to frequent Debris flows (Dostalík, 2024).

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SUPERVISED BAYESIAN CLASSIFICATION FOR 3D RESERVOIR CHARACTERIZATION: A GAS SAND CASE STUDY, PANNONIAN BASIN

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Precise 3D mapping of hydrocarbon-bearing sand reservoirs is often hampered by limited well data. This study presents a workflow for 3D gas sand prediction and differentiating it from non-gas formations utilizing supervised bayesian classification on 3D pre-stack seismic data. The proposed methodology begins with defining gas sand signatures through well-log analysis and petrophysical relationships. These signatures are then used to train the Bayesian classifier, incorporating prior knowledge of regional geology. The trained model is applied to seismically-derived attribute volumes, generating 3D probability maps of gas sand occurrence. The workflow started by deriving lithology classifications from well-log crossplots. A cross plot of Lambda-Rho ($\lambda\rho$) and Mu-Rho ($\mu\rho$) was used to identify gas sand zones from non-gas sand zones and to determine the a priori proportions of the lithology and the probability density function calculation for each lithology type. Then, we applied these probability distributions and a priori proportions to the 3D seismic volumes of the Lambda-Rho and Mu-Rho volumes to create a lithology volume and probability volumes for the gas sand distribution. The Lambda-Rho ($\lambda\rho$) and Mu-Rho ($\mu\rho$) volumes were obtained by simultaneous pre-stack inversion. A confusion matrix is used to check the accuracy of lithology classification and the assumption that classes are independent. The matrix shows how accurate the classification is; diagonal elements show correct classifications; and off-diagonal elements show how many times the classification was wrong or confused with other lithology classes. In this study, gas sand was classified with 100% accuracy and exhibited no misclassification as non-gas sand. The results of this study provide a precise 3D distribution of gas sand in the study area beyond well control, demonstrating the efficacy of the proposed workflow in enhancing the understanding of subsurface characteristics for petroleum exploration and development.

Hodnocení stability skalních stěn na vybraných lokalitách v okolí Chocně

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Byla hodnocena stabilita celkem 4 skalních útvarů přibližně 1 km východně od města Choceň v údolí Tiché Orlice na lokalitách v bývalém lomu u střelnice, v přírodní rezervaci Hemže-Mýtkov (skalní výchoz a skalní věž) a v oblasti Hrádníky.

Všechny skalní útvary jsou tvořeny písčitými slínovci (opukou) České křídové pánve s typickým kvádrovitým rozpadem a lavicovitým charakterem vrstevnatosti. Skalní útvary vystupují po stranách strmého údolí vyhloubeného v období glaciálů erozní činností řeky. Na vybraných lokalitách se vyskytují projevy skalního řícení nebo opadávání úlomků, které může ohrozit návštěvníky těchto míst.

K hodnocení byla vybrána metoda RMR (Rock Mass Rating; Bieniawski, 1989) a její nástavba pro skalní stěny a umělé zářezy, SMR (Slope Mass Rating; Romana, 1993). V terénu byla provedena měření pevnosti Schmidtovým kladívkem a měření orientace diskontinuit geologickým kompasem typu Freiberg. Dále byly v terénu posouzeny dílčí parametry RMR a SMR.

Jednotlivé útvary spadají do třídy SMR podle nejhoršího výsledku pro jednotlivé systémy nebo diskontinuity. Všechny lokality, mimo Hemže-Mýtkov – skalní věž, která spadá do IV. třídy SMR s označením nestabilní, spadají do III. třídy SMR s označením částečně stabilní. U všech lokalit dochází v různé míře k opadávání bloků, odvalovému řícení a jsou zde vyvinuty planární poruchy. Hlavní příčinou horšího ohodnocení Hemže-Mýtkov – skalní věž byl stav puklin a jejich výplně, ostatní parametry RMR byly na všech lokalitách velmi podobné.

Sanace byla navržena pro skalní stěnu v bývalém lomu u střelnice, kde by bylo vhodné stěnu očistit od nestabilních bloků a následně zabezpečit geosítěmi nebo geomřížemi proti dalšímu opadávání úlomků. Sanace by bylo vhodné provést i u skalní věže v přírodní rezervaci Hemže-Mýtkov, bylo by vhodné zde zabezpečit prostor, kam dopadají úlomky a bloky. U skalního hřbetu v Hrádníkách by bylo vhodné zabezpečit části skalního hřbetu proti opadávání úlomků nebo vybudovat příkop u paty svahu.

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MINERALOGY AND GEOCHEMISTRY OF THE URANIUM AND RARE EARTH ELEMENTS MINERALIZATION IN RIRANG AREA, KALAN, WEST KALIMANTAN

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The Rirang River in Kalan, Indonesia exhibits significant potential for uranium (U) and rare earth elements (REE) resources (Syaeful *et al.*, 2014; Ngadenin *et al.*, 2017), but research on this mineralization in Indonesia is scarce. To address this gap, mineralogical and geochemical studies were conducted on two rock samples and seven ore samples using petrographic, XRF, ICP-MS, and micro-XRF methods. The U and REE mineralization is hosted within metapelite and metasiltstone intercalations units, characterized by clay minerals, hydrothermal alteration products, and low-grade metamorphic index minerals (Farrenzo *et al.*, 2023). Geochemical studies using chondrite-normalized REE and trace element normalization suggest the mineralization is related to Na-rich magma from the Sukadana Granite Intrusion (Cuney & Kyser, 2008). This magmatic process accelerated fractional crystallization and precipitates tourmaline and monazite ores that host REE-bearing minerals such as, monazite, xenotime, and loparite. The post-magmatism period is characterized by U mineralization with minerals like brannerite, uranophane, swamboite, and trace elements, enriched due to hydrothermal alteration processes (Pirajno, 2009; Bruneton & Cuney, 2016). This study elucidates the paragenesis of REE and U-bearing minerals in the Rirang River, Kalan, which also yield other economically valuable metals.

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Revize paleontologických nálezů lokality Úsobrno

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Lokalita Úsobrno je nejvýše položenou lokalitou s výskytem spodnobadenských sedimentů na Moravě (490–500 m n. m.). První průzkumy lokality, které provedl Reuss a Procházka, nebyly nikdy zpracovány. První zpracování provedl až Vašíček (1941), který zde popsal bohatou fosilní faunu, převážně měkkýšů a korálů. Revizní paleontologický průzkum lokality bohužel nepřinesl nové objevy, a proto byl zpracován materiál ze sbírek ÚGV PřF MU.

Celkem se podařilo determinovat 573 jedinců, z toho byla třída Gastropoda zastoupena 39 druhy, třída Bivalvia 5 druhy, třída Scaphopoda 2 druhy a třída Anthozoa 12 druhy. Nově bylo na lokalitě popsáno 51 druhů, např. *Nassarius badensis, Nassarius spectabilis, Aspa marginata* a *Glans rudista*.

Většina studovaných schránek byla dobře zachována, u větších jedinců byly poškozeny vrcholy a ústí. Fragmenty odlomených částí byly v materiálu také zastoupeny. Na některých schránkách byly nalezeny známky abraze a predační stopy *Oichnus* sp., způsobené pravděpodobně naticidními nebo muricidní plži (Mikuláš & Pek, 2000). Na lokalitě byl determinován druh *Euspira helicina*, který tento ichnorod způsobuje.

Na základě nálezů některých druhů měkkýšů a korálů lze usuzovat, že moře bylo teplé, pravděpodobně s teplotou nad 20 °C a dobře prokysličené. Nálezy druhů *Glans rudista* a *Glycymeris* sp., kteří žijí na jemnozrnném substrátu (Dulai, 1996), nebo rod *Conus* (Chira & Voia, 2001) svědčí o výskytu měkkého substrátu, ale v okolí se vyskytovaly i oblasti s pevným substrátem tvořeným kameny, skalami případně úlomky fauny, které sloužili jako podklad hermatypním a ahermatypním korálům. Většina determinovaných druhů žije spíše v infralitorálu, ale nálezy některých měkkýšů, například rodu *Ranella*, případně ahermatypních korálů dokládají větší hloubku. Vzhledem k nálezům fauny z různých hloubkových úrovní mohlo na lokalitě docházet k mísení mělkovodní a hlubokovodní fauny.

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Mineralogicko-petrografická charakteristika chondritu H5 S4 W2

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V roku 2019 bol poľským zberateľom T. Jakubowksim v Maroku zakúpený exemplár meteoritu o váhe 431 g. Cieľom práce bolo mineralogicko-petrografické zaradenie meteoritu do správnej skupiny a následné určenie stupňa šokovej metamorfózy a zvetrania.

V meteorite sa vyskytovalo niekoľko typov chondrúl, napríklad “barred olivine”, “radial pyroxene”, “cryptocrystalline”, “granular olivine”, o veľkosti okolo 300 μm. Priemerné chemické zloženie minerálov v meteorite bolo: *olivín* $Fo_{82,3}Fa_{17,2}Te_{0,5}$; *pyroxén* $En_{82,1}Fs_{16,5}Wo_{1,4}$; *plagioklas* $Ab_{81,7}An_{13,0}Or_{5,3}$; *kamacit* 92,7 hm.% Fe, 6,9 hm.% Ni a 0,5 hm.% Co a *taenit* 73,0 hm.% Fe, 26,6 hm.% Ni a 0,3 hm.% Co; *troilit* $Fe_{1,01}S_1$; prítomný bol tiež *chromit*, *magnetit*, *merrillit* a *hydroxylapatit*.

Prítomnosť chondrúl s ostrými hranicami a prítomnosť kryštálov plagioklasu nepresahujúcich 50 μm uložených v rekryštalizovanej jemnozrnnej matrix tvorenej olivínom a ortopyroxénom o veľkosti do 300 μm zaraďuje študovaný meteorit do petrologického typu 5 (Van Schmus & Wood, 1967). Šoková metamorfóza bola stanovená ako S4 na základe prítomnosti planárnych fraktúr a mozaikovania v olivíne, undulózneho zhášania plagioklasu a neprítomnosti maskelynitu (Stöffler *et al.*, 1991).

Stupeň zvetrania W2 bol určený podľa pomerne rozsiahlej limonitizácie minerálov s obsahom železa (Wlotzka, 1993).

Meteorit bol klasifikovaný ako H5 obyčajný chondrit, S4, W2.

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Quaternary tectonic activity imprinted on the river terrace in Brno

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A new outcrop of the Upper Pleistocene river terrace has been exposed in the central part of Brno City. A complex of sedimentary sequences has been uncovered, composed of river sandy gravel, grave sand, and silt covered by loess. Relatively fine sand about 2 m thick with silty intercalations forms the lower portion of the outcrop, while dominating coarse gravel layers above a light bordering sequence are on top of it. The loess is positioned within a small tectonic trough of meter-scale dimensions. As we assumed that this pattern relates to a young fault tectonics, the outcrop was further examined by a complex of methods.

Firstly, the outcrop was divided into a 1×1 m grid for better visualization in the photogrammetric mosaic. Further analyses of the outcrop revealed that the horst-and-graben structures were formed and bordered by several generations of faults. The faults are characterized by both dextral and sinistral components. The left-lateral faults revealed an offset of approximately 270 mm towards the east. The dextral normal fault offset the strata for about 150 mm roughly toward the ESE direction. Individual strata visually wedge against each other progressively from NW to SE. In addition to young faulting activity, water escape structures were observed. These structures were formed either concurrently with the faulting or later, but not before the faults emerged. Their genesis might be associated with seismic activity. In these areas, calcite bleaching occurred, highlighting tectonic ruptures.

As the upper layer of loess is following the tectonic disruption of the strata below, it can be suggested that the terrace was "tectonically active" after the deposition of loess. The age of the lower sandy sequence is approximately 21.2 ± 1.3 ka, while the age of the upper gravel is approximately 11.77 ± 0.78 ka according to OSL dating. The sagged loess revealed about the same age of about 11.99 ± 0.67 ka and the whole tectonic deformation is postdated by the not deformed uppermost colluvium of 4.12 ± 0.25 ka. Between the colluvium and the gravel, there are distinct lobes and wedges on top of some faults. Originally, they were interpreted as colluvial fault-scarp wedges, but their relatively old age of 115.3 ± 0.71 ka and 111.4 ± 0.89 ka, respectively, which was dated on very fine quartz grains of 0.15–0.20 mm, indicates rather their transport from the basal sequences of the terrace along the faults in form of sand bowls.

The research was supported by the grant project "*Coseismic Landslides in Mountain Ranges of Active and Stabilized Accretionary Wedges*" funded by the Grant Agency of the Czech Republic (GC22-24206J) and the Taiwanese Ministry of Science and Technology (NTSC 111-2923-M-008-006-MY3).

Petrophysical Flow units of the Nubia Sandstone: A Case Study from Gebel Abu Hasswa, South Western Sinai, Egypt

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The Nubia Sandstone formation in Southwestern Sinai, Egypt, is a vital geological unit with significant hydrocarbon and groundwater potential. In this comprehensive study, we present a detailed petrophysical assessment of the Nubia Sandstone at the Gebel Abu Hasswa area, covering an approximately 15 square kilometre region. Through an integrated approach, we have examined the lithostratigraphic changes, mineralogical composition, and storage capacity parameters of the Palaeozoic rock formations in the study area (Ahmed, 2014).

Eleven thin sections were prepared and examined by a polarizing microscope, while Scanning Electron Microscope (SEM) used to show and obtain information about petrology, geology, and pore-geometry. However, X-ray diffraction (XRD) analysis reveals that the Nubia Sandstone is predominantly composed of quartz, with varying amounts of calcite, hematite, and kaolinite.

The petrophysical measurements, including bulk and grain density, porosity, and permeability, were conducted on carefully prepared samples. The results indicate that the porosity of the Nubia Sandstone ranges from 2.69 % to 29.6 %, while the permeability varies from 0.0013 to 4027.66 mD. The strong correlations between these parameters and rock lithology highlight the heterogeneous nature of the formation (El-Sayed, 1995).

Furthermore, we have investigated the electrical properties of the Nubia Sandstone, focusing on the formation resistivity factor and its relationship with porosity, permeability, and bulk density (Elsayed, 2000). The application of the Electrical Flow Unit (EFU) concept provides valuable insights into the rock's heterogeneity and flow characteristics.

Acoustic properties, including compressional and shear wave velocities, were also analysed to establish their connections with the petrophysical parameters. The study samples exhibit a wide range of velocity values, reflecting the lithological and textural variations within the Nubia Sandstone.

This comprehensive petrophysical assessment of the Nubia Sandstone at Gebel Abu Hasswa contributes to a better understanding of the storage capacity, fluid flow, and heterogeneity of this important geological formation. The insights gained from this work can inform future hydrocarbon exploration and groundwater management strategies in the region.

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Genesis of spherules in Permian rhyolites from the Zamtyn Nuruu area

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Dikes of peralkaline rhyolite cut across Permian and older rock beds in the Zamtyn Nuruu area of western Mongolia. During mapping expeditions conducted by the Czech Geological Survey between the years 2005 and 2007, it was discovered that these dikes contain high-temperature crystallization domains, including spherulites. Spherulites have been known to form in silica-rich glassy volcanic bodies like rhyolitic dikes since the 19th century (Breitkreuz, 2013).

Studied spherulites and host rhyolites were characterized from thin section samples with polarized light microscopy and electron microprobe. Both spherulites and the host rock were composed mainly of quartz and feldspar. Feldspar was identified based on Greenwood & Earnshaw (1998). Sampled plagioclase was identified as albite ($Ab_{93–100}Or_{0–7}$). All of K-feldspar had the composition of orthoclase ($Ab_{2–50}Or_{95–98}$). Pyroxene grains were identified as aegirine ($Aeg_{61–94}Jd_{5–39}$), amphiboles as ferro-eckermannite (Na 1.78–1.94 apfu). Classification used for pyroxene and amphibole was Morimoto (1988) and Hawthorne *et al.* (2012) respectively.

The spherulites crystalized from supercooled rhyolitic melt, often around subautomorphic crystals of quartz, feldspar or around vesicles, and grew as fibrous crystals of quartz or feldspar from the centre outward at the same rate in all directions. Crystals of amphibole or pyroxene formed concurrently were incorporated into the structure. The spherulites ranged in diameter from a few mm to about 3 cm and were subdivided into three types based on observed textures and mineral composition: Type one contained a crystallization centre and was composed of intergrown fibrous crystals of quartz and feldspar and included amphibole and pyroxene crystals. Larger samples of the type one spherulites were distinguished by visible zoning. The second type contained no visible crystallization centre and was mainly composed of albite and included pyroxene, amphibole, or hematite crystals. Type three also did not contain a visible crystallization centre was composed entirely of albite.

The rock exhibited signs of later hydrothermal alteration. Primary magmatic minerals were replaced by albite ± chlorite ± quartz pseudomorphs, chalcedony, limonite, kaolinite, smectite and muscovite.

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Hodnotenie svahových pohybov na základe digitálneho modelu reliéfu

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S geodynamickými javmi sa môžeme najčastejšie stretnúť v inžinierskom alebo stavebnom odvetví, pri určovaní stability a pevnosti svahov. Cieľom tohto štúdia bolo zhodnotenie svahových pohybov na základe digitálneho modelu reliéfu, zmapovanie a zaradenie zosuvov podľa upravenej klasifikácie Němčoka (1974) a následné vytvorenie informačnej karty, ktorá obsahuje prehľad informácií o jednotlivých svahových pohyboch a ich lokalitách. Karta zahrňuje fotografiu svahu, opis povrchu lokality, miestnu geológiu a katastrálne údaje. K vyhľadaniu týchto geodynamických javov boli v programe ArcGis a na online stránkach zbgis.skgeodesy.sk použité mapy digitálneho modelu reliéfu (ZBGIS, 2024). Ku tvorbe DMR máp sa využíva technológia LIDAR (Light Detection and Ranging) na zaznamenávanie a vykresľovanie povrchu vo vysokom detaile. Výstup práce predstavuje informačnú kartu, ktorá môže v budúcnosti pomôcť pri vyhľadávaní informácií a inžiniersko-geologických prácach na vybraných lokalitách.

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Genesis of the dolomites from the Selac, Kosovo; Fluid inclusions and stable isotopes studies

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Dolomite – a complex carbonate mineral, can be primary in various environments (including hydrothermal), as well as a secondary phase formed by dolomitization process of pre-existing carbonate rocks (Mehmood *et al.*, 2018). Any alteration of dolomites can be classified as a dedolomitization (Fairbridge, 1987). Boni *et al.* (2011) concluded that dolomite rich in Fe is more susceptible to dedolomitizations. The aim of this work is to propose origin using fluid inclusion studies as well C and O stable isotopes analyses of dolomites enriched in zinc from listvenites from the Selac, located in the northern Kosovo. Lithologies in the Selac area are represented mainly by Triassic mafic rocks and serpentinites followed by Oligocene-Miocene volcanic and pyroclastic rocks. On the contacts between serpentinites and volcanic rocks, as well as in tectonic zones listvenite rocks are observed (silicified in distal parts and carbonatized close to the tectonic zone. Listvenites as well as breccias in tectonic zones host hydrothermal mineralization (Mederski *et al.*, 2021). Dolomite as a main rock-forming mineral occurs in listvenites, breccias and veins in main tectonic zones (Kluza *et al.*, 2023).

In the studied area, zinc enriched dolomites are associated with Ni-arsenides, sulfarsenides, and rare Ni-Zn-Mg arsenates and silicates in bonanza type mineralization (Mederski *et al.*, 2021; Kluza *et al.*, 2023). Representative samples were collected from outcrops arounds the Selac village. EPMA and microscopy were used in the original study, which documented the presence of zinc in the dolomites and identified the typical textures. Microthermometry analyses on primary fluid inclusions within dolomite crystals were conducted at AGH University of Krakow, while C and O stable isotopes analyses in dolomites were conducted at Slovak Academy of Science in Banská Bystrica. Dolomite occurs as the anhedral and subhedral crystals with size from a few μm up to a few mm. Dolomite crystals exhibit occurrence of large number of inclusions, primary as well as secondary ones. Microthermometry analyses gave homogenization temperatures in range of 105.9 °C up to 240.2 °C for dolomite formation in Selac, which reflects the low temperature epithermal environment. However, isotopes ratios of investigated dolomites vary between +0.66 ‰ and +2.01 ‰ VPDB for carbon, and between -20.72 ‰ and -14.18 ‰ VPDB for oxygen and reflect hydrothermal origin of zinc-enriched dolomite, rather than supergene genesis.

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Seismic and field traces of the Kroměříž fault

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Western Carpathian flysch zone is in the central Moravia covered by the Pliocene graben of SE-NW direction. The southern fault of the graben is named the Kroměříž fault.

We used 33 seismic profiles, and 6 boreholes were utilized. Specifically, these include 2D reflection seismic profiles and seismically surveyed boreholes with a depth of at least 1 km for the study of the Kroměříž Fault. This data was processed using Petrel software, which allows for interpretation in 3D.

Through this method, three stratigraphic boundaries were identified: the Brunovistulian, Miocene, and accretionary wedge. By identifying these boundaries, it was possible to place the interpreted faults within a temporal framework. Based on this data, it was found that the Kroměříž Fault is a structure with a northeast-southwest orientation. This fault dips towards the east to northeast and affects both Brunovistulian and Miocene layers, as well as the accretionary wedge. Specifically, these layers are downthrown along the Kroměříž Fault, creating a graben structure. The degree of subsidence varies among different layers, with the greatest offset observed in the base of the Brunovistulian, averaging a subsidence of 400 m with a maximum value of up to 990 m. The smallest offset occurs in the sediments of the accretionary wedge.

The heterogeneous subsidence along the Kroměříž Fault indicates that it is a syn-sedimentary fault, rather than one that occurred after the sedimentation of all layers. The onset of subsidence can be attributed to the Miocene, while the final phase of the Kroměříž Fault can be traced to the Pliocene based on borehole data. Based on 3D modelling of the Brunovistulian, it was found that the Kroměříž Fault is part of a larger system of subsidence faults and cannot be unequivocally delineated in the model.

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The mechanism of soil formation on different rock types in the Moravian Karst

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Soil is one of the most important components of terrestrial ecosystems and human environment and plays a crucial role in the nutrient cycles. Soils developed on parent material, which character and chemical composition significantly affect the soil properties. Soils generally consist of weathered rock, organic matter, water, air and living organisms. During weathering and soil formation, some primary rock-forming minerals (feldspars, micas) are progressively replaced by newly formed clay minerals, Fe and Al oxy-hydroxides. The formation of the secondary minerals is except the climate characteristic controlled especially by the soil parent material – the parent rock that soil develops from in situ or material that has been deposited by wind, water, or ice.

This work was motivated by the assumption that the chemical composition of soil is dominantly controlled by source rock type. However, our results indicate that soil can be a mixture of multiple parent rocks. Petrography and geochemical data indicate variable input of aeolian material (loess) in all studied weathering profiles. In this study, we characterize soils and saprolites formed at the expense of sedimentary or granitic protolith. Based on field description, particle size distribution, mineralogy, and geochemistry, we track the mixing of parental rocks and aeolian silt in the substrates of soils. The soils that developed on the contrast rocks from the three geological formations are fairly homogeneous in their pedological properties. However, their geochemical and mineralogical features are significantly distinct in the deepest part of the weathering profiles (saprolite). According to the WRB classification (IUSS Working Group WRB, 2007), the predominant soil types are cambisols and rendzinas. All soils have predominantly silty clay and silty-clayey loam texture, with a great variability in pH (from pH 3.14 to 6.65) and base saturation. The similarities degree of soil development in the upper part studied profiles can be explained by the mixing loess and saprolite parental rocks. The upper horizons of all the investigated weathering profiles contain 48 to 61 wt.% of SiO_2, 7 to 11 wt.% Al_2O_3 and 1 to 3 wt.% K_2O. All studied upper soil horizons have similar mineral compositions with slight differences in ratios between the main mineral phases. Quartz predominates in all of them, followed by muscovite-celadonite, illite-aluminoceladonite, chlorite, and kaolinite. Some K-feldspar, Na-plagioclase, and Fe and Al oxy-hydroxides are also present in small quantities. The results show that the contributions of loess can widely affect the process of pedogenesis in the Moravian Karst.

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Quantitative determination of iron oxidation state in tourmaline-supergroup minerals using electron microprobe

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The flank method, pioneered by Höfer *et al.* (1994), Höfer (2002) and Höfer & Brey (2007), serves as an analytical tool developed for quantitative determination of the Fe oxidation state in solid phases using electron probe microanalyzer. It combines the peak shift and differences in the Fe *L*α and Fe *L*β intensities as functions of the Fe content and $Fe^{3+}/\sum Fe_{tot}$ value. This method is based on the measurement of the X-ray intensities at specific spectral positions (Fe*L*α a Fe*L*β flank) using a TAP monochromator, where the largest differences between emission X-ray spectra of Fe^{2+} and Fe^{3+} phases occur. The relationships among the ratio of X-ray intensity collected at the flank position, known $Fe^{3+}/\sum Fe$ and FeO_{tot} content were used to derive an equation for subsequent calculating $Fe^{3+}/\sum Fe$ in unknown samples. The methodology was developed for quantitative determination of the Fe oxidation state in minerals of tourmaline supergroup using the electron probe microanalyzer. The calibration of the flank method is based on measurement of Fe*L*α/Fe*L*β flank X-ray intensities ratio on natural tourmaline standards with low Fe^{3+} content and on their annealed (at 700 °C) and fully oxidized equivalents. The standards were chosen to cover the range from ~8 to ~20 wt.% FeO_{tot}. The content of Fe^{3+} in standards were determined by Mössbauer Spectroscopy and revealed ≤6.5 rel.% of Fe^{3+} in natural standards and 100 rel.% of Fe^{3+} in annealed ones. An accelerating voltage of 15 kV, beam current of 50 nA and 22×30 μm area were selected as optimal analytical conditions. The equation for $Fe^{3+}/\sum Fe$ calculation was derived from the parameters defining the calibration space for the tourmalines. The accuracy of the calibration and the derived equation for $Fe^{3+}/\sum Fe$ was evaluated on the series of natural tourmalines of known and variable Fe^{3+} content. The measurement was tested on two spectrometers with TAP crystals in parallel, and the results were comparable. The $Fe^{3+}/\sum Fe$ values determined by flank method were in good agreement with data obtained from Mössbauer spectroscopy. The analytical error was estimated to ~10 rel.% for tourmalines of ~8 wt.% FeO_{tot}, and ~5 rel.% for tourmalines of ~20 wt.% FeO_{tot}. The lower the FeO_{tot} in tourmalines the higher was standard deviation of calculated $Fe^{3+}/\sum Fe$. The developed methodology is applicable for tourmalines >5 wt.% FeO_{tot}.

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Infiltration uranium mineralisation of the Smrčiny (Fichtelgebirge) granite as a source of radioactive springs

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The Smrčiny (Fichtelgebirge) granite is characterized by a remarkably distant reach of per-descensum processes (infiltrating meteoric waters), with supergene uranium mineralisation found even at levels of 200 m below ground at the Rudolfstein deposit (Dill *et al.*, 2010), and also a presence of spring waters with very high ^{222}Rn activities. Turnová (2019) described numerous highly radioactive springs in the area between towns Skalná, Plesná and Bad Brambach associated mainly with strongly weathered muscovitic variety of the granite (type $G1S_m$ by Hejtman (1984)). The Wettinquelle spring located in Bad Brambach reaches ^{222}Rn activity even of 25 kBq/l.

In 2018 during the search for radioactive springs, an occurrence of metatorbernite was found in a railway cut close to Bad Brambach. This contribution focuses on prospection and mineralogical characterisation of more supergene uranium mineral occurrences in the area studied by Turnová (2019) and discussing from the results of structural measurements and geophysical data if the uranium minerals originated from waters infiltrating the weathered granite could be the source of high contents of radionuclides in the spring waters.

Four occurrences of supergene uranium minerals were described in railway cuts on 9 km long section of railway between stations Bad Brambach and Vojtanov. The previously found metatorbernite creates thin "veins" and clusters of idiomorphic crystals growing onto granite surface. Second occurrence of torbernite is characterized by hypidiomorphic crystals reaching 5 mm size growing freely in filling of a fissure. These crystals show transformations from translucent torbernite into opaque metatorbernite and intergrowths with fluorescent green-yellow metaautunite. Last two occurrences have a form of small pockets located near ground level with clusters of small yellow metaautunite crystals growing onto grains of strongly weathered granite. On 5 railway cuts and 2 natural outcrops, directions of 567 tectonic structures were measured, of which 36 showed increased radioactivity. Analysis of 16 samples from fissure fillings with presence of hydrous Fe oxides revealed increased amounts of U (21–6982 ppm) and Ra (35–8000 ppm). The most prominent directions of structures with increased radioactivity are NW-SE, NNE-SSW and ENE-WSW. Very similar directions were obtained by evaluating geophysical (VLF) data measured on Břetislav and Pod Skalou spring sites. We cannot definitely decide whether the source of radioactivity in waters below ground is of supergene origin, but the correlation of fissure directions, high amounts of radionuclides in fillings of fissures and deep reach of supergene processes in the area speaks in favor.

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Quantification of Mn^{3+}/Mn^{4+} using the titration method in supergene Mn oxides from Štiavnica stratovulcano, Slovakia

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Manganese occurs in natural compounds in oxidation states +2, +3 and +4, most often associated with iron. The preferred oxidation state is Mn^{4+} (d3) with the lowest stabilization energy, which is further enhanced in octahedral positions and preferred over Mn^{2+} (d5). The position Mn in the MnO_6 octahedron is dominantly occupied by the Mn^{4+} cation, but it can be substituted by Mn^{3+} or vacant (Post *et al.*, 2020). Manganese as a biogenic element participates in the process of biomineralization, and it can be oxidized by bacteria and fungi in both oxic and anoxic environments to form manganese oxides - MnO_x (Tebo *et al.*, 2005). Biotically produced oxides are characterized by a characteristic amorphous or weakly crystalline form, structurally they belong to the group of layered manganese oxides (birnessite, buserite, vernadite), in the octahedral position of MnO_6 they mostly contain Mn^{4+} and a minority of Mn^{3+} (Villalobos *et al.*, 2003). The formed layered oxides can recrystallise into oxides with a tunnel structure (Feng *et al.*, 2010). Due to the occurrence of Mn in manganese oxide compounds in the two oxidation states Mn^{3+}/Mn^{4+} and their different ratio in minerals formed biotically and abiotically, it is important to know their content as accurately as possible. In this work, we optimized the titration method based on the standard bismuthic acid method according to E. Bloom (1978) and quantified Mn^{3+}/Mn^{4+} in six secondary MnO_x samples. The results of the determination of Mn^{3+} and Mn^{4+} (Tab. 1) are verified by the experimental XANES method.

	TER-5	Sch-4	Bib-11	Sch-51	FER-01	TER-0423
Mn_{tot} %	49.48	49.06	50.61	58.98	41.02	56.26
Mn (III)%	16.73	11.5	18.99	11.65	4.03	4.19
Mn (IV)%	32.74	37.56	31.62	47.33	36.99	51.89
Mn_{abs} (III)%	33.81	23.44	37.52223	19.75246	9.824476	7.447564877
Mn_{abs} (IV)%	66.17	76.56	62.47777	80.24754	90.17552	92.232492
AOS	3.6611	3.7656	3.624778	3.802475	3.901755	3.912726626

Table 1: Determination of total Mn, Mn^{3+} a Mn^{4+} using titration method, expressed in wt.%.

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Albian–Cenomanian coral-bearing limestones from SE India: insight into the carbonate platform from the Cretaceous Southern Hemisphere

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Our knowledge of Cretaceous carbonate platforms has long centred on the Northern Hemisphere. Yet, the exploration of Mid to Upper Cretaceous limestones in Tamil Nadu, Southeast India offers insight into Southern Hemisphere carbonate platforms. The genesis of the Cauvery Basin traces back to the Late Jurassic–Early Cretaceous, emerging after the fragmentation of the Gondwana supercontinent.

In this study, microfacies analysis focused on the Albian–Cenomanian limestones of the Dalmiapuram Formation within the Uttatur Group, extracted from quarries near Dalmiapuram in Kovandankurichchi. Previous research within the Dalmiapuram Formation has revealed evidence of Oceanic Anoxic Events (OAE) 1c and 1d (Madhavaraju *et al.*, 2021). These limestones predominantly comprise bioclastic and bioclastic-lithoclastic packstone-wackestones containing quartz. Fragments of colonial corals, bivalves, and echinoderms constitute the most prevalent bioclasts, followed by bryozoans, worms, gastropods, sponges, and benthic foraminifera, albeit in lesser abundance. Contrary to previous reports my investigation did not confirm previous reports of limestones determined as the coral-algal or coralline limestones. Instead, corals represent level-bottom assemblages, with algae being scarce.

The studied coral-bearing limestones were deposited on a carbonate platform with moderate energy and moderate sedimentation rate. Relatively high biodiversity, the presence of colonial corals and micritization of bioclasts indicate a photic zone, normal salinity, and good oxygenation. Numerous microsolenids, opportunistic corals adapted to heterotrophic feeding, and normal bivalve fragments suggest higher nutrient level possibly related with terrigenous sedimentary input.

Cretaceous deposits in SE India contain numerous macrofossils which were studied by Ferdinand Stoliczka (1838–1874), a Moravian (born in Kroměříž) geologist and palaeontologist working in India. Results were published in *Palaeontologia Indica* (1864–1873; four volumes, nearly 1500 pages, 178 plates) and concerned with various fossil groups: cephalopods, gastropods, bivalves, brachiopods, echinoderms, corals (see Singh *et al.*, 2023) and other groups.

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Srovnání zastoupení dřevin v pylových spektrech a vzorcích uhlíků na lokalitě Pohansko

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Táto práca sa zaoberá zhrnutím palynologických a makrozbytkových výskumov drevín z veľkomoravského hradiska Pohansko. Vypracovaná bola súhrnná tabuľka taxónov drevín ako z makrozbytkovej analýzy (uhlíky, semená), tak z peľových analýz. Grafické porovnanie peľových a makrozbytkových analýz bolo spracované v podobe diagramov v programe POLPAL (Walanus & Nalepka, 1994). Z diagramov bolo možné pozorovať rozdiely v zachovávaní jednotlivých taxónov drevín v peľových spektrách a asociáciách uhlíkov v jednotlivých stratigrafických úrovniach lokality. Tieto zistené rozdiely boli diskutované na základe tafonomických a paleoekologických aspektov (Doláková *et al.*, 2020; Dresler *et al.*, 2022). Najväčšie rozdiely v zachovávaní bolo možné pozorovať pri pionierskych drevinách (*Pinus, Betula*), drevinách s mäkkým drevom (*Tilia, Alnus, Salix*) a úžitkových druhoch (Pomoideae, *Juglans, Prunus, Vitis*). Pionierske dreviny produkujú obrovské množstvá ľahkých peľových zŕn, ktoré sú vetrom unášané na veľké vzdialenosti. Táto skutočnosť môže vplývať na výsledky z diagramu, ktoré môžu byť nadhodnotené. Ich podiel v palynospektrách je vždy vyšší než u makrozbytkov. Lipa (*Tilia*) sa v diagramoch zachovávala najmä v podobe peľových spektier. Nízke zastúpenie v asociáciách uhlíkov mohlo byť spôsobené jej nepoužívaním ako stavebného a palivového materiálu a rovnako náchylnosťou jej dreva na napádanie hmyzími škodcami a zaparením vplyvom vlhkosti. Ako primárny zdroj stavebného a palivového materiálu bolo využívané drevo duba (*Quercus*). Ten v asociáciách uhlíkov jednoznačne dominoval. Naopak bolo možné vidieť jeho postupný pokles v peľových spektrách práve vplyvom odlesňovania a odstraňovania z porastov. Malé ale pravidelné zastúpenie smreka (*Picea*) v peľových spektrách pravdepodobne poukazovalo na ojedinelý výskyt tejto dreviny na vhodných stanovištiach aj v nížinách.

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Magnesium phosphates from serpentine-magnesite deposits, Modum, Norway

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In the southeast of Norway, not far from famous cobalt mines of Skutterud, several serpentine-magnesite deposits can be found. They form bodies of steeply dipping elongated lenses up to 100 m long and 20 m wide and are composed of alternating layers of ophimagnesite (mixture of serpentine and magnesite) and serpentinite. Two of these deposits at Tingelstadtjern and Overntjern yield particularly unique assemblage of Mg phosphate minerals, which were described from these deposits: althausite (Raade & Tysseland, 1975), its lower temperature polymorph holtedahlite (Raade & Mladeck, 1979), raadeite (Chopin *et al.*, 2001), phosphate-carbonate heneuite (Raade *et al.*, 1986), and phosphate/magnesium analogue of elllenbergerite – phosphoellenbergerite (Raade *et al.*, 1997). This research focuses mainly on a detailed study of these minerals along with other closely related minerals.

Most chemical measurements were done with the use of electron microprobe, LA-ICP-MS was used for trace elements, such as REE, Sc, As, and other.

The most common Mg phosphate in both localities is althausite. Study of textural relationships indicates that althausite and heneuite are of primary origin. The other phosphates formed later and usually partially overprint althausite. At the Overntjern deposit, althausite occurs in association with collinsite and F-rich hydroxylapatite. An unknown Mg-Ca-P phase was discovered as well in association with althausite, with dominant element ratios of 1 Mg : 4 Ca : 3 P. Further research of this phase is required, and it has potential to be a new mineral. Althausite also exhibits elevated concentrations of As, causing its zonation in BSEI. At the Tingelstadtjern deposit, althausite is less abundant and its associated minerals are holtedahlite, raadeite, heneuite and has lower As content and lacks zonation.

Variability of fluorine content in althausite was observed, with lower contents at Overntjern and twice as much at Tingelstadtjern. It is thought that the low fluorine concentration in the original magma led to the formation of althausite instead of wagnerite. Wagnerite is relatively common Mg phosphate rich in fluorine, that is found in similar geological setting in the south of Norway.

Increased concentrations of rare earth elements were measured in various apatites, monazite, and xenotime. The elevated thorium content in primary monazite enabled the determination of the age of mineralization through chemical dating, yielding a Mesoproterozoic age of 1051 ± 26 Ma.

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Tectonics of the Lower Paleozoic sedimentary rocks between Vápenný Podol and Heřmanův Městec

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The rocks of the Seník Formation (Cambrian) and the Míčov Formation (Ordovician) within the Chrudim Paleozoic between villages Vápenný Podol and Heřmanův Městec exhibit both ductile and brittle deformation. The deformation phases responsible for their present appearance primarily occurred during the Variscan orogeny. Magnitudes of deformation were estimated on selected fossil samples, several deformational phases were interpreted, and the orientation of principal normal stresses of brittle fractures was determined from collected structural data.

Deformation of fossils was determined based on changes in angles and length ratios. Breddin's diagram was utilized to quantify this deformation using shear angle. The magnitude of fossil deformation in the Seník Formation near Heřmanův Městec was small. Exact deformation values could not be obtained due to the unclear orientation of the principal normal stress σ1. However, the shear angle was small on all analyzed fossils, with an ellipticity not exceeding 1.4. These resulting deformation values are applicable only to the Palác locality near Heřmanův Městec, where a localized antiform mega-fold exists, representing the only area in the Seník Formation where trilobite fossils have been found. The direction of lineation that corresponds to the stretching direction cannot be visually determined at this locality. Based on these observations, it is assumed that the rocks around the Palác locality near Heřmanův Městec underwent less deformation than other outcrops of the Seník Formation, where potential fossil remains would likely have been destroyed due to greater deformation.

In the graphitic shales of the Míčov Formation, two-fold systems (older and younger) were identified. The original orientations of structural elements of the older folds were reoriented during younger deformational phases. This can be observed from the geometry of the dataset's grouping of lineations in the Lambert azimuthal equal-area projection. They exhibited a circular distribution around linear elements corresponding to the π-pole of schistosity. The schistosity was folded by folds with a WNW-ESE direction, representing the youngest plastic deformation processes. Based on the vergence of folds, it can also be assumed that in younger deformation phases, there was likely thrusting of southern block over the northern one, causing a general convergence of graphitic shales towards the south.

The orientation of principal normal stresses was determined using paleostress analysis in the MARK2010 program. In the rocks of the Seník Formation, the results indicated normal fault tectonics. Extension was oriented approximately horizontally in the S-N direction, and the stress σ_2 was in the E-W direction. In the Míčov Formation, the direction of movement on the fault could not be determined, so the only correct solution was for the principal normal stress σ_2, which is steeply inclined towards the southwest.

Abandoned Mines Survey Using Non-Destructive Methods

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Abandoned mine workings are a specific type of geohazard that can have a negative impact on the stability of the surface (see e.g. Brook & Nobes, 2014). In order to ensure safe constructional, agricultural, and other land use, it is important to precisely determine the spatial dimensions and the overall stability of old mines. This study sums up the results of a field survey carried out in Mikulčice-Těšice (Hodonín district) in 2023 which was done as part of a research for Bachelor's thesis of the corresponding author (Vaněček, 2023). The results of the ground-penetrating radar (GPR) survey were correlated with a digital elevation model of the area in order to compare the impact of the abandoned mine workings on the current surface. This comparison allowed to assess the current stability of the surveyed area and to identify potential risks. The results of this study prove GPR to be an effective method in abandoned mine exploration as it can not only identify the mineworkings, but also evaluate the subsurface stability and point at possible geohazards.

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Geochemická charakteristika menilitového souvrství na území České republiky

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Cílem této studie bylo charakterizovat geochemii jednotlivých členů menilitového souvrství v České republice. Menilitové souvrství je charakterizováno jako mocný a litologicky bohatý vrstevní sled, dosahující rozsahu několika desítek metrů. Tento vrstevní sled zahrnuje rozmanité typy hornin, včetně jílovců, prachovců, pískovců, slínovců, vápenců a rohovců. Podle charakteristického sledu změn v horninovém a fosilním záznamu je souvrství rozděleno do čtyř formálních členů. Tento sled změn naznačuje změny v paleoprostředí během období oligocénu. Menilitová formace je zmapována pouze na několika málo lokalitách v oblasti České republiky a tvořena různými typy hornin, které poskytují důležité informace o geologické historii oblasti.

Studie se zaměřila na sběr a analýzu dat pro posouzení geochemických charakteristik této formace. Metodika studie zahrnovala sedimentologické a geochemické metody, které umožnily detailní posouzení jednotlivých členů menilitové formace. Na základě získaných dat byl možno zhodnotit využití prvkových proxy parametrů pro rekonstrukci depozičního prostředí menilitového souvrství.

Předkládaná studie vycházela také z předchozích studií, zejména Píchy *et al.* (2006), Stráníka (1981) a Švábenické *et al.* (2007), které poskytují důležité informace o geologických charakteristikách menilitového souvrství. Kromě toho byly zohledněny i poznatky z disertační práce Jirmana (2020) zabývající se potenciálem zdrojových hornin a termickou zralostí menilitové formace v České republice.

Získané výsledky poskytují ucelený obraz o geochemických vlastnostech formace a jejím významu v regionální geologii.

Výsledky této studie jsou významným příspěvkem k poznání geologického vývoje menilitové formace v České republice a mohou být využity pro další výzkum v oblasti geologie a paleontologie.

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Foundation in specific geological conditions

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Problems with foundation conditions in construction are becoming more and more frequent at present. The main reasons are the rising price of building land and the shortage of land. The price of building land in the Czech Republic has risen by 200 % in the last 15 years, whereby by 130 % in the last 5 years (Odds CZ, 2024). We are therefore in a situation where buildings are being built in inappropriate places or where historically they have never been built. These are places with massive layers of building rubble, undermined areas or areas of former watercourses. It is therefore necessary to seek solutions for these non-standard conditions in cooperation between geologists and civil engineers.

In addition to the situation directly on the construction site, the geotechnical conditions are defined by the standard (ČSN EN 1997–1, 2006). Based on the combination of the complexity of the building construction and the complexity of the foundation conditions, 3 geotechnical categories are distinguished. Subsequently, according to the geotechnical category, the level of engineering-geological survey is defined and the foundation construction is designed.

For non-standard foundation conditions, a detailed or supplemental engineering geologic survey must be designed. For areas with massive layers of building rubble, the use of a static penetration test where the penetration tip is pushed at a constant speed of 20-25 mm/s into the soil and the resistance at the tip is recorded has proven to be effective. The dynamic penetration test (result is the number of blows required to achieve penetration) has proven successful for former watercourse areas (Dušek, 2021; ČSN EN ISO 22476–2, 2005; ČSN EN ISO 22476–12, 2009). Different geophysical methods are suitable for underground areas, e.g. electrical resistivity tomography (ERT), shallow reference seismic (MRS) or GPR.

The design of the foundation solution is then based on the identified parameters and economic optimization. Replacement of existing soil with higher quality soil, combination of standard solutions (e.g. grid of reinforced concrete strips in combination with piles) or non-standard solutions (foundation of the building on a floating reinforced concrete slab - a "pillow" made of EPS, slag, fly ash or liapor).

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