ASSOCIATION OF HUNGARIAN GEOPHYSICISTS
MAGYAR GEOFIZIKUSOK EGYESÜLETE

HUNGARIAN GEOLOGICAL SOCIETY
MAGYARHONI FÖLDTANI TÁRSULAT

LIV.
MEETING OF YOUNG GEOSCIENTISTS
IFJÚ SZAKEMBEREK ANKÉTJA

5 – 6 APRIL 2024
2024. ÁPRILIS 5. – 6.

EGER

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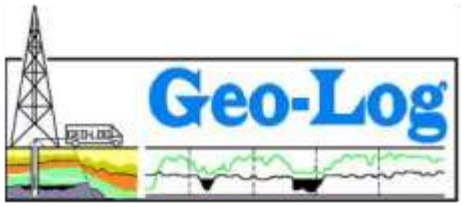
EUROPEN ASSOCIATION OF
GEOSCIENTISTS & ENGINEERS



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Kutatóintézet

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INVITATION

to the **54th** Meeting of Young Geoscientists

5 – 6 April 2024

Eger
Hotel Szent István

Useful information:

Accommodation and meals are available only for pre-registered participants.
The presentations are open and public.
Official languages of the conference are English and Hungarian.

Registration desk open: from 8:00 am, 5th April 2024 onwards

Organisers

MAGYAR GEOFIZIKUSOK EGYESÜLETE
1145 Budapest, Columbus utca 17-23.
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MAGYARHONI FÖLDTANI TÁRSULAT
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MEGHÍVÓ

az **54.** Ifjú Szakemberek Ankétjára

2024. Április 5 – 6.

Eger
Hotel Szent István

Tudnivalók:

Szállást és étkezést csak az előre regisztrált résztvevőknek tudunk biztosítani.
Az ankét programja szabadon látogatható.
A konferencia hivatalos nyelve angol és magyar.

Regisztrálás: 2024. Április 5. 8:00-tól folyamatosan

Rendező Bizottság

ISBN 978-963-8161-23-9

PROGRAMME

5 APRIL 2024, FRIDAY

09^{00} - 09^{10}	OPENING
09^{10} - 10^{30}	1^{ST} SESSION
10^{05} - 12^{20}	2^{ND} SESSION
12^{40} - 13^{17}	POSTER SESSION – SHORT ORAL SUMMARIES
13^{20} - 14^{20}	LUNCH
14^{20} - 15^{55}	3^{RD} SESSION
16^{10} - 17^{45}	4^{TH} SESSION
17^{50} - 19^{00}	POSTER SESSION – DISCUSSION
19^{00}	DINNER

6 APRIL 2024, SATURDAY

- 10^{00}	CHECK-OUT FROM THE ROOMS *Please leave your room after breakfast, until 10 o'clock. The baggages can be stored in a luggage room.*
07^{30} - 09^{00}	BREAKFAST
09^{00} - 10^{35}	5^{TH} SESSION
10^{50} - 12^{10}	6^{TH} SESSION
12^{10} - 13^{30}	LUNCH
13^{30}	AWARD GIVING AND CLOSING CEREMONY

FRIDAY

09^{00} OPENING

09^{10}- 10^{35} 1ST SESSION

09^{10} *Importance of thermal dispersion in p orous medium based on synthetic numerical simulations*

T **Bence Molnár**[1,2], Attila Galsa[1,3]

[1]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary, [2]MS Energy Solutions Ltd., Eger, Hungary, [3]HUN-REN Institute of Earth Physics and Space Science, Sopron, Hungary

09^{25} *Exploring Iron Ore and Barite Deposits through Multiscale Analysis: A Case Study in Wadi Halfa, North Sudan*

A **Abazar M A Daoud**[1,2], Mutwakil Nafi[3], and Péter Rózsa[1]

1Department of Mineralogy and Geology, University of Debrecen, 4032 Egyetem Tér 1. Hungary, 2Engineering Geology Department, Faculty of Earth Sciences, Red Sea University, Sudan, 3Indimi Faculty of Minerals and Petroleum, International University of Africa, Khartoum, Sudan

09^{40} *Possible historical cartographical magnetic north datas from the late 18th Century*

T **Benedek Koszta**

ELTE, Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary

09^{55} *Evaluating landslide hazard in newly developed hilly terrain near Cairo: comparing statistical and machine learning approaches*

A **Mohamed M. Abdelkader**[1,2], Árpád Csámer[1,3]

[1]University of Debrecen, Department of Mineralogy and Geology, 4032 Debrecen, [2]Ain Shams University, Faculty of Science, Geology Department, Cairo, Egypt, [3]University of Debrecen, Cosmochemistry and Cosmic Methods Research Group, 4032 Debrecen

10^{10} DISCUSSION

10^{30}- 10^{45} BREAK

10^{45}- 12^{20} 2ND SESSION

10[45] *Calculating the potential value of given sea segments based on mareograph data*

T **Kamilla Cziráki**[1]

[1]ELTE, Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary

11[00] *Unveiling Uranium Mineralizations in El-Erediya Area, Central Eastern Desert, Egypt: Leveraging the Strength of Field investigation and petrographic study*

A **Aya S. Shereif**[1,2], Abdelhalim S. Mahmoud[3], Mohamed A. Abdelkader[4,5], Árpád Csámer[1,6]

[1]University of Debrecen, Department of Mineralogy and Geology, 4032 Debrecen, [2]Department of Geology, Tanta University, 31527 Tanta, Egypt, [3]Fayoum University, Department of Geology, 63514 Al-Fayoum, Egypt, [4]Akita University Department of Earth Resource Science, 010-8502 Akita City, Japan, [5]Menoufia University, Faculty of Science, Department of Geology, Shebin El-Kom, Egypt, [6]University of Debrecen, Cosmochemistry and Cosmic Methods Research Group, 4032 Debrecen

11[15] *Gold Potentiality Mapping Utilizing Remote Sensing and Airborne Geophysical Data*

A **Ali Shebl**[1,2], Árpád Csámer[1,3]

[1]University of Debrecen, Department of Mineralogy and Geology, 4032 Debrecen, [2]Tanta University, Department of Geology, 31527 Tanta, Egypt, [3]University of Debrecen, Cosmochemistry and Cosmic Methods Research Group, 4032 Debrecen

11[30] *Exploring the inner structure of the Esztramos Mountain using muographic measurements*

A **Bence Rábóczki**[1,2], Gergely Surányi[1], Gergő Hamar[1], László Balázs[1,2]

1HUN-REN Wigner RCP, High-Energy Physics Department
2ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary

11[45] *Numerical study of a dewatering process in a remediation area in Western Hungary*

A **Jónás Révész**[1], Márk Szijártó[1,2], János Stickel[3]

[1]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary, [2]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geology, József and Erzsébet Tóth Endowed Hydrogeology Chair, [3]ELGOSCAR-2000 Environmental Technologies
and Water Management Ltd.

12^{00} DISCUSSION

12^{20}- 12^{35} BREAK

12^{35}- 13^{22} POSTER SESSION – short oral summaries

12^{35} *Nitrate and phosphate removal from shrimp farm effluent using Scenedesmus algae/TiO2 combination adsorbent*

P **Árpád Csámer**[1], Seyed Kamaloddin Hosseini[1], Saeedeh Rastgar[2]

[1]University of Debrecen, Department of Mineralogy and Geology, 4032 Debrecen, [2]Gorgan University of Agricultural Sciences and Natural Resources, Faculty of Fisheries and Environmental Sciences, Department of Environmental Sciences, Gorgan 49189-43464, Iran

12^{38} *Modelling study on hydrogen reservoir monitoringby nuclear borehole geophysics*

P **József Gábor Szűcs**[1], Attila Galsa[1,2], László Balázs[3]

[1]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, [2]HUN-REN Institute of Earth Physics and Space Science, [3]HUN-REN Wigner Research Centre for Physics Department of High Energy Experimental Particle and Heavy Ion Physics

12^{41} *Comparative Analysis of Geophysical and Hydrogeological Well Parameter Calculations*

P **Julianna Mekker**[1,2], Zoltán Püspöki, PhD[1], Péter Szűcs, DSc[2]

[1]Supervisory Authority for Regulatory Affairs, [2]University of Miskolc, Institute of Water Resources and Environmental Management

12^{44} *About the nomenclature of quartz varieties and types*

P **Diána Skita**[1], Péter Rózsa[1]

[1]University of Debrecen, Department of Mineralogy and Geology, 4032 Debrecen

12^{47} *Preliminary results of the newest 2D land seismic measurements in the Bóly-basin, South Hungary*

P **Tivadar Szabó**[1], Áhim Mátis[2], László Bereczki[1], Márton Bauer[1]

[1]Supervisory Authority for Regulatory Affairs Hungary (SARA), [2]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science

12[50] *Identifying linear features of Tsagaan-uul area, Southern Mongolia employing different DEMs*

P **Munkhsuren Badrakh**[1,2], Gáspár Albert[2]

[1]ELTE Eötvös Loránd University, Doctoral School of Earth Sciences, Budapest, Hungary, [2]ELTE Eötvös Loránd University, Institute of Cartography and Geoinformatics, Budapest, Hungary

12[53] *Geophysical investigations in the Mecsekalja Tectonic Belt*

P **Tamás Lukács**

Supervisory Authority for Regulatory Affairs

12[56] *Framboidal pyrite size distribution – a tool for reconstructing depositional conditions*

P **Bálint Bodor**[1], Sándor Körmös[2], Gábor Steinbach[3], Félix Schubert[1]

[1]Department of Mineralogy, Geochemistry and Petrology University of Szeged, Egyetem u. 2, H-6722 Szeged, Hungary, [2]MOL Plc. Dombóvári út 28, H-1117 Budapest, Hungary, [3]XHN-REN Biological Research Centre, Szeged, Temesvári krt. 62, H-6726 Szeged, Hungary

12[59] *Geophysical Investigation of Near-Surface Aquifers Near Pilisszentkereszt*

P **András Cégény**[1], Balázs Takács[2], dr. Nóra Edit Gál[1], László Bereczki[1], dr. Márk Szijártó[3,4], dr. Ferenc Visnovitz[3]

[1]Supervisory Authority for Regulatory Affairs, [2]Central Rail and Track Inspection Ltd, [3]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary, [4]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geology, József and Erzsébet Tóth Endowed Hydrogeology Chair

13[02] *Geothermal potential of the Danube Basin*

P **Kitti Váradi**[1,2], Márk Szijártó[1], László Bereczki[3]

[1]Department of Geophysics and Space Science, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University, Budapest, Hungary, [2]Bayer Construct Plc., Sóskút, Hungary, [3]Supervisory Authority for Regulatory Affairs, Department of Mineral Resources Research and Geophysics, Budapest, Hungary

13[05] *Comparison of SARA's 2023 four seismic projects by acquisition and data analysis parameters*

P **Márton Kemény,** Róbert Csabafi, Tivadar Szabó, László Bereczki, Márton Bauer, István Török, Tamás Lukács, Gábor Markos, Ernő Takács

Supervisory Authority for Regulatory Affairs

13^{08} *The effects on the structural hydroxyl content of the clinopyroxenes from the Laleaua Albă magmatic complex (Gutâi Mts, Eastern Carpathians).*

P **Ákos Kővágó[1,2,3]**, Marinel Kovacs[4], Csaba Szabó[2,3], István János Kovács[2,3]

[1]Doctorate School of Earth Sciences, Eötvös Loránd University, Hungary, Budapest, [2]Lithosphere Fluid Research Lab (LRG), Eötvös Loránd University, Hungary, Budapest, [3]ELKH Institute of Earth Physics and Space Science, Hungary, [4]Technical University of Cluj-Napoca, North University Centre of Baia Mare, Romania, Baia Mare

13^{11} *Data processing and interpretation of a magnetotelluric key section*

P **Renáta Szebenyi**, János Kiss

Supervisory Authority for Regulatory Affairs

13^{14} *Examination of saturation models by comparing petrophysical data and core data*

P **Zsuzsanna Winkler**

MOL Hungarian Oil and Gas Plc., Hungary, E&P Subsurface Field Development team

13^{17}- 14^{25} LUNCH

14^{20}- 15^{55} 3RD SESSION

14^{20} *Signs of the Dinosaur hybridisation*

T **János Magyar**

Institute of Geography and Earth Sciences, Department of Palaeontology, Eötvös Loránd University, Pázmány Péter sétány 1/C, Budapest 1117, Hungary

14^{35} *Supervised bayesian classification for 3D reservoir characterization: a gas sand case study, pannonian basin*

A **Mohamed .Elbalawy[1,2]**, Mohamed Balash[1,3], Ernő Takács[1,4], Felicitász Velledits[1]

[1]University of Miskolc, Hungary. Faculty of Earth and Environmental Sciences and Engineering, Institute of Exploration Geosciences, [2]Ain Shams University, Egypt. Faculty of Science, Geophysics Department, [3]South Valley University, Faculty of Sciences, Geology Department, [4]Geological Directorate, Supervisory Authority for Regulated Services, Hungary

14[50] *Complex geological studies on the combustion metamorphic units of the Novohrad-Nógrád Geopark*

T **Laura Horváth**[1], Tamás Gábor Weiszburg[1], Péter Prakfalvi[2], Máté Biró[1]

1Department of Mineralogy, Eötvös Loránd University, H-1119 Budapest, Pázmány Péter sétány 1/a, Hungary, 2Novohrad-Nógrád UNESCO Global Geopark

15[05] *Application of natural radionuclides in the hydrogeological characterization of karst system supplying the Lake Hévíz*

A **Saeed Bidar Kahnamuei**[1], Katalin Hegedűs-Csondor[1], Petra Baják[1], Ákos Horváth[2], Dénes Szieberth[3], György Czuppon[4], Márta Vargha[5], Bálint Izsák[5] György Németh[6], György Tóth[7] and Anita Erőss[1]

[1]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences Department of Geology, József and Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary, [2]ELTE Eötvös Loránd University, Institute of Atomic Physics and Astronomy, Department of Atomic Physics, Budapest, Hungary, [3]Budapest University of Technology and Economics, Department of Inorganic and Analytical Chemistry, Budapest, Hungary, [4]HUN-REN Research Center for Astronomy and Earth Sciences, Institute for Geological and Geochemical Research, Budapest Hungary, [5]National Center for Public Health and Pharmacy, Department of Public Health Laboratories and Methodology, Budapest, Hungary, [6]St. Andrew Hospital for Rheumatology and Medicinal Spa of Hévíz, [7]Supervisory Authority for Regulators Affairs

15[20] *Efficiency comparison of deep borehole heat exchangers using Python-driven finite element models*

T **József Pap**

University of Miskolc, Research Institute of Applied Earth Sciences Miskolc, Hungary

15[35] DISCUSSION

15[55]- 16[10] BREAK

16[10]- 17[45] 4[TH] SESSION

16[10] *Mineral chemistry of sphalerite from VMS deposits of the Neotethyan realm*

T **Botond Géza Gereczi**, Gabriella B. Kiss

Eötvös Loránd University, Department of Mineralogy, Budapest, Hungary

16[25] *Archaeometric study of late Sarmatian ceramics from Tázlár-Templomhegy settlement*

A **Bozsik Vivien**[1], Fintor Krisztián[1], Gulyás Sándor[2], Kristály Ferenc[3], Kreiter Attila[4], Walter Dorottya[5]

[1]Department of Mineralogy, Geochemistry and Petrology, University of Szeged, Hungary, [2]Department of Geology and Paleontology, University of Szeged, Hungary, [3]Department of Applied Mineralogy, University of Miskolc, Hungary, [4]Hungarian National Museum, National Institute of Archaeology, 1113, Budapest, Hungary, [5]Doctoral School of History, Doctoral Program on Medieval Archeology, University of Szeged, Hungary;

16[40] *Impact of pore water content on stress sensitivity*

A **Hadeer Hassan**

University of Miskolc, Faculty of Environmental and Earth sciences and Engineering Department of Geophysics, 3515 Miskolc, Hungary

16[55] *Muography in geophysics: model validation and optimization*

T **Abigél Boglárka Stefán**[1], Gergő Hamar[2], László Balázs[1,2]

[1]Eötvös Loránd University, Department of Geophysics and Space Science, [2]Wigner Research Centre for Physics, The Innovative Gasoues Detector R&D Group, High-Energy Geophysics Research Group

17[10] *Mapping of peatlands change by remotelysensed data in Sumatra, Indonesia*

T **Agustiyara**, Balázs Székely

Eötvös Loránd University, Department of Geophysics and Space Science, Institute of Geography and Earth Sciences, Doctoral School of Environmental Science, Budapest, Hungary

17[25] DISCUSSION

17[45]- 19[00] POSTER SESSION – discussion

19[00] DINNER

SATURDAY

09^{00}- 10^{35} 5^{TH} SESSION

09^{00} *Enhancing road infrastructure management through ground-penetrating radar (GPR) inspections: a case of study miskolc university campus*

A **Edoson Manuel Ernesto**[1], Endre Nádasi[2]
[1,2]Miskolc University, Department of Geophysics, Faculty of Earth and Environmental Science and Engineering, Miskolc, Hungary

09^{15} *Rare elements and its mineralogy in rock bodies from NE Hungary*

A **Csilla Balassa**, Norbert Németh, Ferenc Kristály
University of Miskolc, Institute of Exploration Geosciences, Miskolc, Hungary

09^{30} *Unveiling hidden histories: evaluating the performance of non-traditional geoelectric arrays in archaeological investigations at Szendrő, Hungary*

A **Marcell Kárpi**[1], Dr. Krisztián Mátyás Baracza[2], Dr. Sándor Szalai[3]
[1,2]University of Miskolc, Research Institute of Applied Earth Sciences, [3]Institute of Earth Physics and Space Science (ELKH-EPSS), Sopron, Hungary

09^{45} *Orbital forcing of the Pliocene/Pleistocene succession from Eastern Hungary*

A **Ahmed Abdeldaim**[1.2], Velledits Felicitász[1]
[1]University of Miskolc, Faculty of Earth and environmental science and engineering, Miskolc, Hungary, [2]South Valley University, Faculty of Science, Geology Department, Qena, Egypt

10^{00} *The Effectiveness and Environmental Impact of Rooftop Rainwater Harvesting by Shallow Well Infiltration*

A **Zsóka Szabó**[1,2], Péter Szabó[3], Endre Csiszár[4], Daniele Pedretti[5], Marco Masetti[5], György Falus[1], László Palcsu[6], Judit Mádl-Szőnyi[2]
[1]Supervisory Authority for Regulatory Affairs, Geological Survey, Budapest, Hungary, [2]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geology, József & Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary, [3]ELTE Eötvös Loránd University, Doctoral School of Environmental Sciences, Budapest, Hungary, [4]BÁCSVÍZ Water and Sewer Services Ltd., Kecskemét, Hungary, [5]Università degli Studi di

Milano, Dipartimento di Scienze della Terra 'A. Desio', Milano, Italy, [6]Hertelendi Laboratory of Environmental Studies (HEKAL), Institute for NuclearResearch – Isotoptech Ltd., Debrecen, Hungary

10^{15} DISCUSSION

10^{35}- 10^{50} BREAK

10^{50}- 12^{10} 6TH SESSION

10^{50} *3D modeling approach for geological insights in molybdenite-hosted rhenium occurrence study in the Recsk deep-level ore deposit*

A **Evane César João da Cunha**
University of Miskolc, Faculty of Earth and Environmental Sciences and Engineering, Institute of Geosciences and Exploration, Miskolc, Hungary

11^{05} *Petrographic reambulation of the Pusztaföldvár Basement High, SE Hungary – consequences on spatial correlation*

T **Péter Ábel Polyák[1]**, Tivadar M. Tóth[1]
[1]University of Szeged, Faculty of Science and Informatics, Department of Mineralogy, Geochemistry and Petrology, Szeged, Hungary

11^{20} *Historical reconstruction of the 18–19th century mineral collection of the Pannonhalma Archabbey, NW Hungary*

T **Szücs Levente Csaba[1,2]**, Bodorkós Zsolt[3], Bubik Veronika[4], Felkerné Kóthay Klára[2,5], Gherdán Tamás[2], Harman-Tóth Erzsébet[2,5], Papp Gábor[1], Szente István[6], Tanai Péter[7], Weiszburg Tamás[2]
[1]Magyar Természettudományi Múzeum, Budapest 1083, Ludovika tér 2-6, [2]ELTE TTK Ásványtani Tanszék, Budapest 1117, Pázmány P. stny. 1/c, [3]Open Eye Geology Bt., 8992 Boncodfölde, Ady u. 14, [4]Budapesti Metropolitan Egyetem, Szakirányú Továbbképzési, [5]ELTE Természetrajzi Múzeum, Budapest 1117, Pázmány P. stny. 1/c, [6]ELTE Tatai Geológus Kert, Budapest 1117, Pázmány P. stny. 1/c, [7]Pannonhalmi Főapátság, Múzeuma, 9090 Pannonhalma, Vár 1

11^{35} *Application of satellite gravity data for surface and subsurface structural mapping in vicinity of Merwi Dam, Northern Sudan*

A **Ali Ahmed Mohieldain Ali**
Exploration Geosciences Institute, University of Miskolc.

11^{50} DISCUSSION

12^{10}- 13^{30} LUNCH

13^{30} AWARD GIVING AND CLOSING CEREMONY

ABSTRACTS

1ST SESSION

Importance of thermal dispersion in porous medium based on synthetic numerical simulations

Bence Molnár[1,2], Attila Galsa[1,3]

[1]ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Geophysics and Space Science, Budapest, Hungary, [2]MS Energy Solutions Ltd., Eger, Hungary, [3]HUN-REN Institute of Earth Physics and Space Science, Sopron, Hungary

Theoretical

Thermal dispersion is often an ignored parameter in heat transport numerical simulations because its value and necessity are controversial. Nevertheless, the use of thermal dispersivity can facilitate the accurate heat transport modeling of heterogeneous porous media that is often complicated due to computational reasons and/or lack of data about aquifer heterogeneities. However, the issue is open: what is the ideal value of thermal dispersivity?

In this study, comprehensive numerical simulations were developed to elucidate the relationship between aquifer heterogeneity and thermal dispersivity. A simplified finite element model was built in COMSOL Multiphysics software package to simulate the spreading of injected cold (50°C) thermal plume in a closed hot (~120°C) heterogeneous aquifer, where this aquifer was bedded by two homogeneous aquicludes. Lognormally-distributed, stochastic heterogeneous permeability distributions were created in SGeMS geostatistics software using unconditional Sequential Gaussian Simulation (SGS). The permeability fields were characterized by three quantities: the same mean (10^{-12} m^2), the same variance (one order of magnitude), and the different correlation lengths (R=5, 10, 20, 50 m). 10–10 realizations were calculated for each value of R. In addition to heterogeneous model calculations with different correlation lengths, homogeneous model simulations with different dispersivity values were carried out as well, to reveal relationship between the scale of heterogeneity and thermal dispersivity. Detailed sensitivity analysis was completed to investigate, how the value of thermal dispersivity

(α_L) is affected by (1) the scale of heterogeneity (R), (2) the model length (L), (3) and the Darcy flux (q_{in}). The results of simulation were quantified by the control parameters (e.g. breakthrough time curves (BTCs), and time of 10% cooling). The numerical models were solved both in the absence and in the presence of thermal conduction to separate its effect and understand the interaction in the heat transport processes.

It was established that the cold water reaches faster the outflow side of the model through the high-conducting channels, so the thermal breakthrough time decreases in heterogeneous medium, which indicates that the permeability heterogeneity in porous medium induces heat dispersion. Results show, properly-tuned α_L allows homogeneous models to fit well the BTCs from the heterogeneous simulations. The defined control parameters based on the difference of heterogeneous and homogeneous BTCs are in the range of 0.5–11%. Increase in both heterogeneity scale and model length implies higher thermal dispersivity, but the scale of heterogeneity is the dominant factor. However, in practice and in literature only the observation scale is emphasized. For instance, the heterogeneity scale of R=10 m corresponds to a longitudinal thermal dispersivity of α_L=7.55 m, while at R=20 m it can be approximated to α_L=15.34 m within the applied model configuration. The modified Péclet number reveals that the thermal conduction weakens, yet does not remove, the effect of heterogeneity or thermal dispersivity. It is concluded that a well-tuned effective thermal dispersivity in heat transport models is relevant for accurate predictions of e.g. BTCs in heterogeneous systems, which is important results for modelling of lifetime of geothermal system (e.g. well doublet).

Exploring Iron Ore and Barite Deposits through Multiscale Analysis: A Case Study in Wadi Halfa, North Sudan

Abazar M A Daoud[1,2], Mutwakil Nafi[3], and Péter Rózsa[1]

[1]Department of Mineralogy and Geology, University of Debrecen, 4032 Egyetem Tér 1. Hungary, [2]Engineering Geology Department, Faculty of Earth Sciences, Red Sea University, Sudan, [3]Indimi Faculty of Minerals and Petroleum, International University of Africa, Khartoum, Sudan

Applied

Within the framework of modern mineral exploration, particularly in conflict-susceptible regions, rapid and cost-effective remote sensing has become an available tool for geologists. This paper focuses on the examination of clastic sediments around the region of Wadi Halfa North Sudan, employing an innovative approach that integrates remote sensing, field observations, and petrographical analysis to identify iron ore and barite deposits.

Utilization of image processing techniques such as band ratios (BR), false color composites (FCC) were applied for the detection of hydroxyl-bearing minerals, ferric, and ferrous iron oxides (B6/B7), (B4/B2), (B5/B6) and barite (B7/B6) respectively; four types of iron ore and barite with different distinct layers were detected and identified.

Petrographical and chemical analysis of rock samples validate the remote sensing findings, indicating significant concentrations of iron ore (46.01% for Fe+2) and barite (63.9% for Ba+), respectively.

The final geological map generated by composed bands R(B6/B7), G(B4/B3), and B(B5/B7), R(B6/B7), G(B4/B2), B(B4/B11) in Landsat 8 OLI and Sentinel S2 respectively reveals major geological variations between lithological units of different ages with new finding of another resources of iron ores around the study area.

Results obtained from the combination of remote sensing and field observations provide valuable information for future exploration and assessment of these critical mineral resources, which are of significant economic importance for Sudan and the region and can be applied for similar areas in other arid semi-arid regions.

Possible historical cartographical magnetic north datas from the late 18th Century

Benedek Koszta
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Theoretical

On some maps of the first military survey of the Habsburg Empire, the upper direction of the sections does not face the cartographic north, but makes an angle of about 15° with it. This may be due to the fact that the sections were subsequently rotated to the magnetic north of the time. Basically, neither their projection nor their projection origin is known yet.

In my research, I am dealing with maps of Inner Austria, the Principality of Transylvania, Croatia and Galicia (nowadays Poland and Ukraine), and I am trying to determine their projection origin. For this purpose, it is assumed, based on the archival documentation of the survey, that these are Cassini projection maps. My hypothesis is that they are Graz, Cluj Napoca or Alba Julia and Lviv. Furthermore, I suppose that Croatia has the same starting point with Inner Austria, because of the same angle of rotation. I also consider the position of Vienna in each case, since it was the main centre of the survey.

The angle of rotation was taken in part from the gufm1 historical magnetic model back to 1590 for the assumed starting points and year of mapping. In addition, as a theoretical case, I calculated the rotation angle of the map sections using coordinate geometry. I then calculated the longitude of the projection starting point for each case using univariate minimization. Since the method is invariant to latitude, it can only be determined from archival data.

Based on these, the starting point for Inner Austria from the rotation of the map was Vienna, which is not excluded by the archival sources, and since the baseline through Graz also started from there, it is partly logical. The map rotation for Galicia and Transylvania also confirmed the starting point of the hypothesis. Since both Alba Julia and Cluj Napoca lie at about the same longitude, the method cannot make a difference there; and the archival data did not provide enough evidence. In comparison, the magnetic declination rotations yielded

differences of about 1°, which may be due to an error in the magnetic model.

On this basis, I have given the assumed projections of the three maps with projection starting points, and developed a method for determining the projection starting points of the other rotated grid maps. The results suggest that there is a very high probability that the section network was rotated in the magnetic north direction, and thus provide a way to refine the magnetic declination data at that time.

With this method I managed to give new indirekt magnetic declinations data from Central-East Europe, which can help to improve the historical magnetic field models. The main reason for this is that we don't have any measurement from that region.

Furthermore the difference beetwen the angle of the section north and the declination data from gufm1 always 0.8-1°. Maybe there are systematical data error at that region.

Evaluating landslide hazard in newly developed hilly terrain near Cairo: comparing statistical and machine learning approaches

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Applied

Rapid urban expansion around Cairo has induced development projects in nearby hilly regions. However, this growth often neglects the geological hazards, like landslides, raising significant geo-environmental risks to the sustainability and safety of these new settlements. This study analyzes and compares landslide susceptibility in the area near the new capital of Egypt using three models: the Statistical Index (SI), Logistic Regression (LG), and Random Forest (RF). A landslide inventory (183 landslide and 183 non-landslide locations) was used to train and test the models. Fourteen factors influencing landslide probability (topography, hydrology, geology, and human activity) were considered, which confirmed their uniqueness through multicollinearity analysis. The Area Under the Curve (AUC) values for training data were 0.884, 0.872, and 0.945 and testing data were 0.891, 0.859, and 0.959 for SI, LG, and RF models, respectively. This indicates that the RF model produces the

most accurate landslide susceptibility map. Furthermore, almost 25.41-30.25% of the study area falls within high or very high-risk zones, highlighting the need for protective management and mitigation strategies. This study's findings provide valuable insights for policymakers and land-use planners for minimizing future landslide risks in the developing regions around Cairo.

2ND SESSION

Calculating the potential value of given sea segments based on mareograph data

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Theoretical

The theoretical shape of the Earth has been defined since the 19th Century as a distinct potential surface of the gravity field that best fits the sea level at rest. This field is described as a sum of spherical function series whose coefficients are calculated from gravity measurements. Sea levels have been measured in harbours since the 18th century using mareographs, and are now often supplemented with data from nearby GNSS stations.

In my work, I developed a program to determine the potential value for a given height from mareograph data. This allows us to use the data available from the stations to determine what this value was in an earlier period as well. Furthermore, if more than one dataset is available for a particular sea segment, the average value for that sea over a certain period can be given.

I tested the method in the Japanese Sea, where I had data from 9 different stations. These were averaged every 5 years and the resulting data were used to calculate the potential values, as well as the average value for the sea segment for the latest period 2016-2020. In the future, I plan to use this method to perform such calculations for more sites, which would also provide information on the effects of tectonics and global sea level change.

Unveiling Uranium Mineralizations in El-Erediya Area, Central Eastern Desert, Egypt: Leveraging the Strength of Field investigation and petrographic study

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Applied

Abstract- The granite pluton of El-Erediya stands out as a highly promising geological locale, boasting a rich array of mineralizations, including but not limited to gold, sulfides, and iron. Its geological and economic significance has not gone unnoticed, drawing substantial attention, and becoming the subject of extensive studies, particularly in the context of uranium mineralizations. This heightened interest has spurred an intensive exploration effort within the region, manifesting in the creation of numerous exploratory mining tunnels concentrated primarily in the southern sector of the El-Erediya pluton. To pinpoint and gain access to a diverse array of mineralizations, we undertook meticulous fieldwork, thoroughly exploring the geological features of the region as well as conducting exhaustive petrographic studies and studying samples under Environmental Scanning Electron Microscope (ESEM).

Conducting field investigations is crucial for obtaining direct data from geological formations, including representative samples from granitic units and mineralized zones. Field observations uncovered that the El-Erediya granite pluton showcases pink to reddish-pink hues, featuring oval shapes and NW-directed elongation. This intrusion is a medium to coarse-grained, equigranular hypidiomorphic texture. The granite pluton is bordered by a NNW-SSE fault to the east and an additional NW-SE fault to the west, with mafic dikes aligned along the same trends. Additionally, mineralization-bearing Shear Zones are located in the southern part of the region.

The petrographic investigation determined that the pluton in the El-Erediya area consists of monzogranite and syenogranite. The mineral

composition of both includes quartz, alkali feldspar, sodic plagioclase, and essential mafic minerals such as biotite and muscovite. Additionally, fluorite, rutile, magnetite, tantalum-bearing minerals, zircon, and iron oxides, occurring as hematite and limonite clots, are identified as accessory minerals. Notably, secondary uranium mineralizations manifest in the thin sections, characterized by a distinct canary yellow color such as uranophane, and beta-uranophane. Kasolite, betafite and autunite are prevalent also. Furthermore, radioactive elements bearing rare metals like columbite and cassiterite also make an appearance in the studied samples.

ESEM when coupled with Energy Dispersive X-ray Spectroscopy (EDX), provides valuable insights into the chemical composition and distribution of elements in a sample. SEM here played a pivotal role in confirming the presence of radioactive mineralizations in El-Erediya samples such as uraninite, urano-thorite, and thorite.

The global trend is now focused on exploring economically promising areas. Consequently, the El-Erediya area, identified as a promising zone with radioactive mineralization, requires in-depth study and further attention. Given its significant economic importance to sustainable development.

Gold Potentiality Mapping Utilizing Remote Sensing and Airborne Geophysical Data

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Applied

Integrated datasets show significant potential for enhancing the accuracy of lithological mapping, a critical aspect in identifying mineral-rich areas. In this study, Sentinel 2, ASTER, ALI, Landsat 8, and ALOS PALSAR DEM were employed to refine lithological mapping and delineate hydrothermal alteration patterns within Egypt's East Barramiya area. Geologically, the study area is covered by ophiolitic components mainly represented by ophiolitic serpentinites and their related rocks, including talc-carbonates and quartz-carbonate dykes. Serpentinites form mostly conspicuous mountainous rocks and are widely distributed within the study area, however, smaller size

blocks could be found. These blocks are mainly distributed within highly tectonized volcaniclastic metasediments as a mélange matrix, which covers a considered areal extent at the southern part of the study area. Besides these ophiolitic segments, island arc metavolcanics constitute a considered part of the study area mainly at the southwestern corner. Based on previous studies and our field observations, these metavolcanics mainly comprise andesite and andesitic meta-tuffs. Intrusive rocks are mainly represented by metagabbro-diorite and syn-orogenic granitic rocks. Band ratios, directed principal component analysis, and constrained energy minimization techniques were highly effective in highlighting alteration patterns from the utilized datasets, closely aligning with the geological structures and distribution of mineralized zones. Our results indicate a correlation between alteration zones and areas with changes in magnetic and radiometric properties, characterized by high magnetic values and elevated K/eTh ratios. Additionally, the hydrothermal alteration patterns predominantly feature OH-bearing minerals and iron oxides. Verification of these results, derived from remote sensing and airborne geophysical indicators, was conducted through extensive fieldwork, petrographic investigations, and SEM-EDX images. These findings have the potential to enhance the identification of alteration zones for future feasibility studies and resource exploitation projects.

Exploring the inner structure of the Esztramos Mountain using muographic measurements

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Applied

Muography is a rapidly developing geophysical research method, that utilises high energy cosmic muon particles to explore the inner structure of large objects, such as volcanoes, pyramids or mountains. Cosmic muons originate from upper atmosphere and have a known, steady, angle dependent flux on the surface. Muons are absorbed as they pass through matter, depending on the density of the material along their trajectories. By comparing the expected and the measured

muon flux and using geoinformatic models of the observed area it is possibble to calculate the density distribution inside the aforementioned structures. The Esztramos Mountain, located in the northeast of Hungary is a suitable candidate for such a project. The mountain is a member of the Aggtelek Karst and mainly consists of limestone, with traces of iron ore. Due to this the mountain was a subject to multiple mining operations between the early 19th century up until the late 20th. During these operations many caves were discovered, such as the Földvári Aladár Cave and the Rákóczi Cave. It is suggested, that more caves lie inside the parts of the mountain that were untouched by miners. Our group at the HUN-REN Wigner RCP focuses on muographic imaging including research, hardware development and geophysical applications. The presentation describes the priciples of muography, demonstrates it's usability in the Esztramos area and highlights recent results in discovering unkown cavities therein.

Numerical study of a dewatering process in a remediation area in Western Hungary

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Applied

Nowadays, groundwater contamination is a huge problem and its magnitude is continuously increasing. Even countries as fortunate as Hungary in terms of drinking water supply are not immune to the consequence of accidents and poorly managed projects. If the problems are getting recognized 'early' remediation methods can be effective in a short time. In case of the 'classical' methodology, the contaminant is removed from the soil by operating production and pumping wells up to a legally regulated threshold. In addition to the 'classical' method, some bacteria are used to decompose the hydrocarbon molecules in the periodically unsaturated zone. However, this procedure requires dewatering, which in some areas cannot be observed due to different types of structures and artificial barriers.

Three-dimensional numerical modelling seems effectively support in planning the whole remediation or the dewatering process and was set up in agreement with an area under remediation operated by ELGOSCAR-2000 Ltd in Western Hungary with the goal of getting rid of hydrocarbon contamination spread through the site originating from the corrosion of fuel tanks.

First the hydraulic effect of an individual pumping well was investigated in a 2D axisymmetric and a 3D model scenario using the software named COMSOL Multiphysics with the version 5.3a. The results were verified with the Dupuit equation. If we compare the simple solutions of the two-dimensional and three-dimensional models, we find a marginal error of 1-2%. However, given the three-dimensional nature of the real-life problem, and considering that the results of the three-dimensional benchmark tests are closer to the actual outcomes, it was decided that the problem requires three-dimensional simulations. The time-dependent nature of the problem was further investigated by comparing the horizontal component of Darcy velocity at the boundaries of the model under stationary, and time-dependent conditions. It was observed that the time-dependent solution converges to the stationary solution after approximately two years of pumping. According to this we can state that this kind of geological problems requires a time-dependent simulation.

The three-dimensional model spans dimensions of 85 meters in the *x*-direction, 105 meters in the *y*-direction, and 6.5 meters in the *z*-direction within our local, Cartesian coordinate system. This whole domain is partitioned horizontally into three layers. The uppermost 2-meter-thick layer comprises mainly sandy material with a hydraulic conductivity of 10^{-3} m/s. The lowest layer spanning 1 meter contains mainly clayey aquitard, characterized by a hydraulic conductivity of 10^{-10} m/s. Our particular focus is on the 3-meter-thick 'bedded', periodically unsaturated layer, which has the most important role in the groundwater dynamics, given the placement of the groundwater level. The 3D spatial distribution of the hydraulic conductivity of the 'bedded' layer in the range from $1 \cdot 10^{-4}$ to $6 \cdot 10^{-4}$ m/s.

In the three-dimensional model, we are able to scrutinize various boundary conditions such as no-flow, hydraulic pressure on the sides. Additionally, we can assess the impact of single or multiple wells on groundwater table. For instance, employing a separated well with a

yield of 2 m^3/h, our analysis indicates a drawdown effect within an approximate radius of 10 meters, with a minimum reduction in groundwater level of at least 10 cm. Furthermore, natural conditions including the annual fluctuation of the groundwater was also taken into consideration raging from a minimum depth 3.9 meters to a maximum depth of 5.98 meters.

In general, based on the outcomes of the numerical simulations we can state that the numerical modelling serves as a valuable tool for planning of the whole remediation and dewatering process. It helps significantly to minimize both the energy consumption and the associated costs as well. Moreover, it offers a fast way to predict the potential errors, and to find a long-lasting way to save one of our most precious natural resources: potable water.

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POSTER SESSION

Nitrate and phosphate removal from shrimp farm effluent using Scenedesmus algae/TiO_2 combination adsorbent

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Poster

Introduction: Due to the presence of a wide range of pollutants with varying concentrations, shrimp farm effluents are one of the major sources of pollution in the aquatic environment. Shrimp farm effluent management is essential due to the large annual volume of effluent discharged into the environment. On the other hand, due to the presence of different concentrations of nitrate and phosphate in shrimp farm effluents and the fact that the content of nitrate and phosphate leads to the phenomenon of eutrophication, it is necessary to use

effective methods to remove these types of pollutants. It is felt. In the first stage, this research aims to modify and combine the organic adsorbent with titanium dioxide to produce a nanocomposite, and then remove the indicator compounds of shrimp culture through the nanocomposite.

Materials and Methods: First, the nanocomposite was prepared by incorporating TiO_2 into the algae structure. Then, the structural, physical, and chemical characteristics of the produced products were investigated using X-ray diffractometer (XRD), Fourier transform infrared spectroscopy (FT-IR), and scanning electron microscope (FESEM) techniques. The results of the analyses demonstrated the stabilization of titanium dioxide in algae. Synthetic nanocomposites were then used to remove nitrate and phosphate compounds. The effect of various parameters such as pH, temperature, nanocomposite concentration, and reaction time on the purification process was also investigated to determine the optimum conditions for removing the desired pollutants with high efficiency. The experiments were analyzed using a one-way ANOVA test.

Results: The results obtained from factorial design and ANOVA analysis showed that nanocomposite concentration and pH were the most important parameters affecting the removal efficiency of nitrate and phosphate compounds, respectively. The maximum removal percentage of nitrate compounds was 91%, and that of phosphate was 96% under optimal conditions (pH 6.5, nanocomposite concentration 2.5 mg/liter, temperature 35°C, and reaction time 67.5 minutes).

Conclusion: This issue is very foremost in the discussion of industrial wastewater treatment on an industrial scale. The result of this research showed that the synthetic composite had a very good ability to remove nitrate and phosphate compounds from shrimp farms.

Modelling study on hydrogen reservoir monitoring by nuclear borehole geophysics

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Poster

In the face of constant struggles to fight climate change, hydrogen storage has enormous potential as a long-term energy storage strategy. The recent recovering of natural hydrogen reservoirs in France makes this field even more perspective and important. In order to fully exploit these potentials, a well-established monitoring apparatus is necessary. A crucial part of this complex system can be borehole geophysics measurements. These methods need to have deep penetration even in cased hole scenarios, and preferably should be insensitive to reservoir water salinity. Nuclear borehole geophysics measurements fit these criteria. Neutron-gamma tools could be exceptionally useful, since hydrogen is a highly efficient neutron moderator, and as such, even small changes in its content can be well detected. We carried out numerical modelling of this measurement using the newest version (6.1) of the Monte Carlo N Particle (MCNP) code, which is the implementation of the Monte Carlo Method for particle transport simulation. Our former simulations indicated that carbon dioxide saturation can be monitored indirectly owing to the change in hydrogen content. We found that the characteristic silicon, and iron peak on the gamma spectrum is very sensitive to the hydrogen content in the vicinity of the tool. The reason for that is the coupling between the neutron and gamma flux. Our new results suggest, that this phenomenon can be utilized for the evaluation of hydrogen reservoirs as well. In our study we investigate the use of the silicon peak, since the iron content around the tool depends strongly on the borehole completion (e.g. diameter, pipe thickness). A ratio is introduced which is sensitive to hydrogen content, calculated from the gamma counts around the silicon peak using 2 scintillation detectors of the sonde. This approach is based on the work by Trcka et al. (2006), who used the whole gamma spectrum. Although using only the part of the spectrum around silicon confines the method to

relatively pure sandstone reservoirs, model results indicate that significant sensitivity increase is achievable this way. We present the characteristic and sensitivity of this ratio at different energy windows, reservoir porosities, hydrogen saturations and sandstone purities.

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Comparative Analysis of Geophysical and Hydrogeological Well Parameter Calculations

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Poster

Determination of hydrogeological parameters of the lithological facies is key for understanding the geological environment. Data regarding lithological facies parameters comes from several sources such as geophysical well logging, well pump tests, and laboratory analysis. These datasets reflect the perspectives of professionals from various backgrounds, calculating the same well parameters using their study field aspects.

Geophysical logging measurements aim to comprehend the well surrounding geological settings and its structure. Utilizing diverse techniques, these measurements provide data for each lithological unit along the borehole, including aquifers. Interpretation of these logs requires specialized knowledge of the logging technologies and the data analysis.

The traditional hydraulic parameter calculations are relied on pumping tests, which provide information solely about the screened aquifer formations. Professionals preferred to use the well-known pumping test data calculating parameters with the commonly used Theis, Dupuit-Thiem, and Jacob methods[1][2].

Comparative analysis of hydrogeological parameters derived from different methodologies offers insights into their applicability. This study covers various traditional hydrogeological and geophysical methods to determine transmissivity and hydraulic conductivity values in drinking water wells. The selected water wells include diverse

geological facies, which offer an ideal base to see the methodological boundaries[4]. This way the geophysical well logs could be used as complementary information alongside the pumping tests for hydrogeological parameter calculations[3].

Through these comparisons, we gain a comprehensive understanding of hydrogeological parameter calculations, suitable for drinking water wells in the Jászság basin.

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About the nomenclature of quartz varieties and types

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Poster

SiO_2 varieties have been known and used by mankind since prehistoric times in some form (e.g., primitive man-made arrowheads). They began to represent a market value in ancient times, and nowadays they are an integral part of the life of ordinary people, both as investment assets worth serious sums and as useful, esoteric objects or jewels. For these reasons, quartz and its varieties were often given different names depending on the field of expertise (e.g., onyx-nicolo-chalcedony).

Mineralogical and gemological classification and nomenclature of quartz varieties are not completely compatible with each other either. The mineralogical side has almost oversimplified the issue of nomenclature, while gemmology has out of the frying pan into the fire and uses a multitude of unnecessary fanciful names. The origins of several of the latter can be traced back to long ago times, so they typically do not have a scientific approach, and they are not uniform and consistent in themselves.

In order to get closer to clarifying the topic, thanks to the development of technology, researchers now have a very diverse set of instruments at their disposal, with which non-destructive measurements (also) can be carried out, however, some issues remain. First, a stable financial background is required to perform geochemical, structural, etc., analyses in large numbers, second, different quartz varieties would have to be procured from many parts of the world to clarify every detail, which means a very serious financial burden. In addition, instrumental tests also cost a lot.

For this reason, at this stage of the research, we use not only our analytical results but also literary data. The unified classification and nomenclature that we are going to present now include grouping from the mineralogical side based on internal structures and appearance, and simplified classification based on colour and pattern from the gemological side. It should be noted, however, that as the research progresses (based on literature data and instrumental analyses), this classification may change somewhat, but it does not fundamentally affect the main groups.

Preliminary results of the newest 2D land seismic measurements in the Bóly-basin, South Hungary

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Poster

The Bóly-basin lies on the boundary of Tolna, Baranya and Somogy Counties in South Hungary, bounded by Mecsek Mountains from the north and the Villány Mountains from the south. The pre-Cenozoic basement of the basin is mainly formed by the nappes of Villány-unit [1].

From a geological and geophysical view, the Bóly-basin is under-investigated. The first information about the geometry of the pre-Cenozoic basement originates from 1952, when gravitational measurements were carried out in the area. The results indicated the presence of a trench structure under the basin, with an axle of approximately east-west direction, but the information was incomplete to draw the conclusion about the genesis and the exact depth of the

trench. In 1962 seismic refraction surveys were carried out in the area, which helped to define a 1500 m depth of the pre-Cenozoic basement in the middle of the basin, but drilling data was not available to take control of the results. The first boreholes in the area were deepened in 1973 for water research purposes, additional wells were drilled in the 2000's, but all of them is located on the edge of the trench described by the results of the 1952 gravity survey. The deepest borehole is the Bóly-B-14, which explored a Cretaceous strata column with ~1000 m thickness and reached the Jurassic carbonates in a depth of 1630 m. The first reflection seismic sections were measured in 1979 in the area (XMV-1 and XMV-2). The XMV-2 seismic line is crossing the Bóly-basin at the middle of the trench. However, the poor resolution of the stack section and the lack of available borehole data in the vicinity of the seismic line make the interpretation of the seismic section difficult.

To improve the data density in the area, in September of 2023, the Supervisory Authority of Regulatory Affairs carried out three high-resolution 2D seismic reflection surveys in the Bóly-basin The survey tracks were designed to fit the available borehole data and connect them to the XMV-2 seismic line. Our measurements resulted a complex, network-like dataset, which allows us to carry out a complex geological and structural interpretation to get a more accurate knowledge about the geometry of the trench and the genesis of the Bóly-basin. The dataset also helps us to make improvements to the pre-Cenozoic geological map of Hungary.

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Identifying linear features of Tsagaan-uul area, Southern Mongolia employing different DEMs

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Applied

Lineaments represent linear to curvilinear features on the earth's surface. Mapping them plays a crucial role in structural geology, geomorphology, hydrology and related disciplines. This study aimed to investigate the use of digital elevation models (DEMs), including SRTM DEM, ALOS PALSAR, and ASTER GDEM data, for the automatic extraction of lineaments in the Tsagaan-uul area of 274 square kilometers in southern Mongolia. After geometric correction, multiple shaded relief maps with various illumination azimuths and altitudes were produced from the DEMs and used to analyze the lineaments, and then compared with existing lines on the geological map, such as faults, veins and lithological boundaries. Lineament density maps were produced using computer interpretation with PCI Geomatica software, and the total number and length of lines were examined for each relief-shading map. As a result, compared to the other two DEMs, the 12.5 m resolution ALOS PALSAR produced a larger number of lineaments, approximately 3 times more than ASTER GDEM and 6 times more than SRTM, with average line length varying from 125 m to 1.5 km. The length of lineaments obtained from lower resolution ASTER GDEM and SRTM data was larger, varied between 0.3 km and 4.5 km. These results can be explained by the fact that most of the parameters of the LINE module algorithm used in this study are specified in number of pixels. The lineament density analysis revealed that the Neoproterozoic Tsagaan uul Formation, which stretches from west to east in the southern part of the area and is dominated by metamorphic limestone and quartzite, has a much denser lineament network than other parts, which are mainly composed of gneiss, granite gneiss, limestone, siltstone and andesite in the central part; granite, rhyolite, and andesite in the north. This area is also bounded by faults on the geology map from adjacent formations. A relatively higher but varying fracture density was also detected in the Carbonian Baruun tsohio formation, which seems homogeneous on the geological map, but otherwise consists of andesite, rhyolite and sandstone. Moreover, density maps extracted from shaded relief with an altitude of 30 degrees were much denser than those from 45 degrees, indicating that the illumination altitude influenced the density of lines. Based on the orientation analysis, the dominant direction of the linear features showed three main directions on the rose diagram for all DEMs: NW-SE, NE-SW, and N-S,

depending largely on the azimuth angles. This partly corresponded to the WNW-ESE directions of veins, NW-SE and NE-SW directions of faults on the geologic map. The present study confirmed that DEM-based lineament analysis complements and refines the results of other mapping methods based on remotely sensed data, and demonstrated that the resolution of the DEM model and the angle of illumination play important roles in the process.

Geophysical investigations in the Mecsekalja Tectonic Belt

Tamás Lukács
Supervisory Authority for Regulatory Affairs
Poster

During 2023, various geophysical measurements were conducted in the vicinity of the Mecsekalja Tectonic Belt (MTB), focusing mainly on the Valley of Goldgrund, near the small settlement, Ófalu. The first campaign was carried out in March, mainly for testing, establishing parameters and settings on known surfacial geological objects in order to plan later measurements. In november, according to the agreement between the Eötvös Loránd University (ELU) and the Supervisory Authority for Regulatory Affairs (SARA), with the supervision of the SARA's experts, the students of ELU planned and conducted the second measurement campaign, utilizing a wide range of geophysical techniques in multiple locations.

The Mecsekalja Tectonic Belt is a highly metamorphosed, inhomogenouos, appr. 1.5 – 2 km wide zone with WSW-ENE bearing. It is a dislocation belt confining the Mecsek Mountains from the south. It is known for its various and highly changeable geological features and objects.

We used Electrical Resistivity Tomography, Induced Polarization, Seismic Tomography, Magnetic susceptibility and Magnetometry methods in order to investigate and help the better understanding of the MTB.

Framboidal pyrite size distribution – a tool for reconstructing depositional conditions

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Poster

Framboidal pyrite is the most common form of sedimentary pyrite (MACLEAN ET AL. 2008). The framboidal texture is not unique to pyrite, it can also be observed in other sulphide minerals. Its name derives from the French word "framboise", meaning raspberry, referring to its specific appearance. A framboid is defined as a spherical or spheroidal microcrystalline aggregate not exceeding 100 μm in size. It occurs in an oxygen-deficient or low-oxygen environment, in the top few to 10 meters of sediment, or in the water column (RICKARD 1970). Bacterial activity plays an important role in its formation. The precursor iron sulphides being formed by the reaction of sulphate reduced by bacteria, with iron ions and iron oxyhydroxide dissolved in water. The importance of studying pyrite framboids lies in the fact that *diagenetic* framboids formed in the sediment and *syngenetic* framboids formed in the water column can be distinguished by statistical analysis of their diameter size distribution (WILKIN ET AL. 1996). This separation allows the oxidation conditions in the sedimentation environment to be determined.

In our research, we examined calcareous marl samples from the Late Ladinian-Early Carnian Kantavár Formation. Polished sections, cut perpendicular to the beddings were examined using a BX-41 optical microscope and backscattered electron micrographs were taken using a Hitachi S-4700 field-emission electron microscope. Image analysis was achieved to determine the representative area, including pyrite framboids and to calculate the size distribution. The images were processed by ImageJ (SCHNEIDER 2012) 1.54d code. Bulk pulverized samples were used to determine the total sulphur and total organic carbon contents using an Elementar vario Macro Cube elemental analyzer and a Rock-Eval 6 instrument.

The sedimentation of the Kantavár Formation is characterized by brackish lagoon environment. (GÖTZ 2003), which is suitable for the formation of pyrite. The marine, brackish character can be confirmed

by correlating the TOC and sulphur content of the samples and by examining the fossil content by optical microscopy. Pyrite grains were selected on the SEM images based on the higher pixel values. Framboidal and euhedral pyrite grains appeared simultaneously in the samples, and the crystals were separated by sphericity. Sphericity is a value between 0 and 1, which is calculated from the following equation: $circularity= 4pi(area/perimeter^2)$. That represents how close an object is to a mathematically perfect sphere, that value 1 stands for. Literature lacks data quantifying the sphericity of framboids, therefore, initially, the spherical shape was determined on artificial objects and then the size distributions of the 0.7, 0.8 and 0.9 sphericity-values were calculated along with statistics. Since the polished sections represent 2D intersects of the framboids, during calculations a stereological correction was applied to mimic a 3D spheroid. RICKARD (2019) presented that the average diameter of a population in 2D falls short of the original one in 3D. In general, a correction was applied to assess the initial size distribution.

The size distributions of framboid populations with different minimum sphericity thresholds all show low scattering with few outliers. In addition, the arithmetic mean diameter of the different populations is between 2.5 and 3.5 μm. These results suggest an oxygen-deficient environment based on the recent framboid size distribution data reported in the literature (SKEI 1988, WIGNALL&NEWTON 1998). The oxygen-deficient nature of the deposition environment is complemented by the brackish character reconstructed by the correlation of TOC and sulphur content. The new results of our research confirm the previously known picture of the Kantavár Formation and provide more accurate information about its oxygenation conditions.

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Geophysical Investigation of Near-Surface Aquifers Near Pilisszentkereszt

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Poster

The main objective of this research was to explore the geological environment of individual springs and wells located near Pilisszentkereszt. Electric resistivity tomography (ERT) and vertical electrical sounding measurements were conducted for this purpose. The locations for these measurements were designated based on field observations and preliminary data.

Substantial information was obtained regarding the geological factors influencing the surface outflow of each spring. ERT profiles measured in the area of interest revealed that the springs examined there (Golyvas Spring, Nameless III Spring), and the Klastrom Well, are situated on the eastern side of the Pilis, formed under similar lithological conditions. The emergence of water to the surface is attributed to a low-resistance clay layer of the Hárshegy Formation, which, due to its low hydraulic conductivity, impedes most precipitation from seeping into deeper layers. Consequently, this reservoir layer, primarily composed of debris from the main block of the mountain, is tapped by several springs in the Pilisszentkereszt

area, resulting in variable discharge due to water retention scarcity and numerous tapping points.

Unlike the springs and wells near the Csév basin, where the inclination of tapping points is indicative of tectonic activity, our data suggest that the extrusion of these springs is not tectonically driven; rather, the reservoir primarily consists of block debris. Descending to the nearby valley to the east, the data indicates that this layer gradually disappears due to topographic reasons, with the underlying, likely Oligocene, clay layer forcing fluid emergence. This layer also contributes diffusely to the discharge of examined watercourses, as evidenced by the slightly higher dissolved magnesium content compared to springs and wells near Piliscsév. While this layer is consistently present in the area, uncertainties remain regarding the quality of the aquifer water stored below the surface debris in the underlying sandstone layer.

The available methods did not yield substantial information about structural details or the depth of the Triassic Dachstein Limestone Formation, which forms the bedrock of the block. Some events observed on the ERT profile measured near the Klastrom well suggest neotectonic activity impacting the quaternary debris, although these events appear inconsistent with respect to other profiles and the recent stress field. Therefore, additional detailed information from the bedrock is necessary to confirm or refute their existence. Future investigations employing different methods with higher penetration depth and expanding the area of interest could be prospective research goals to gain a more accurate understanding of the hydrogeological conditions of the basin.

Geothermal potential of the Danube Basin

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Poster

Given the geopolitical and economic context of our daily lives, the role of renewable energy sources and their conscious use is becoming an increasingly important issue. Fortunately, due to the geology of the

Pannonian Basin, Hungary offers excellent opportunities for the use of deep and shallow geothermal energy. At present, more than 90% of Hungary's energy consumption for district heating is based on natural gas [1], but within 10 years up to 1-1.5 billion m^3 of natural gas per year could be replaced by a greater use of geothermal energy. Unlike most other renewable energy sources, geothermal energy can be harnessed 24 hours a day, all year round. However, a major drawback of this energy source is that it has to be used or converted on a near-local basis, so a study of geothermal conditions is justified and necessary. Furthermore, a new legislative environment that will enter into force on 1 March 2023 has made geothermal investments easier, faster, and more affordable, creating a "geothermal boom" in the energy sector.

In our research, we tried to examine the geothermal conditions of the entire Danube Basin as a case study. We collected and summarized temperature and water yield data of the study area, established a geothermal database, and prepared a seismic interpretation of the area from a hydrostratigraphic point of view. On this basis, the geothermal reservoirs in the area were delineated and their typical expected hydrogeological properties were determined. The district heating needs of certain areas of the Danube Basin, which can be met by geothermal energy, are also discussed, as well as proposals for the use of the different types of geothermal reservoirs. In this way, the results of our research can serve as a guide for industry players in the exploitation of the geothermal potential of the Danube Basin.

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Comparison of SARA's 2023 four seismic projects by acquisition and data analysis parameters

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Supervisory Authority for Regulatory Affairs

Poster

A total of four reflection seismic acquisition projects were carried out by the Supervisory Authority for Regulatory Affairs in Hungary during the year 2023, namely at Mályi (near Miskolc), Dombóvár, Mohács-Bóly, and Budapest. It was intended to map deep geological structures to identify aquifers and structures that might contain significant thermal water resources. One of the projects involved wireless nodes for 3D seismic acquisition, while the other three involved 2D seismic surveys. A seismic cube of 4500x4500 meters was acquired in Mályi, two in Dombóvár (Domb-1: 12 km, Domb-2: 16,5 km), another two near Bóly and Mohács (Boly-1: 9,5 km, Boly-2: 15 km), and one in Budapest (13 km). In collaboration with our colleagues, we processed the data following acquisition. It was concluded at the Dombóvár 2D-s that the time-variant bandpass filter proved to be the most effective method of noise filtering, and that our stacks and migrated sections provided us with valuable information regarding the geology of the region. The Budapest section had a pioneering concept about acquisition in urbanized areas, in spite of the significant noise we complemented the data-sparse area with this line in the Rákos-patak valley. Because of the increased linear noise level we needed to use unconventional F-K filtering and select the parameters of conventional data processing algorithms very carefully. Our processing was affirmed to be valuable by having a sight on our urban stack and migrated section. In Boly, we implemented the acquisition with three types of acquisition parameters. At Boly-3 we used 20 m distance between geophone groups, 20 m distance between sources and 10 m group width, at Boly-2: 25 m distance between geophone groups, 25 m distance between sources and 20 m group width and at Boly-1: 10 m distance between sources and 20 m between single geophones. The latest is the pattern which we use generally during our acquisition projects, in Dombovar and Budapest also. We used these different parameters to conclude which is the best one to use in our later projects.

The effects on the structural hydroxyl content of the clinopyroxenes from the Laleaua Albă magmatic complex (Gutâi Mts, Eastern Carpathians).

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Poster

The Laleaua Albă magmatic complex (Gutâi Mts, Eastern Carpathians) represents one of the last volcanic phases in the Gutâi Mts. (8.5 - 8.0 Ma, Kovacs, 2002) and consists of two small-sized composite magmatic dykes. The studied samples are from an old quarry revealing one of the two dykes showing a cross-section through the composite dyke consisting of two distinct igneous rocks: a light color dacitic core with a tulip-like shape surrounded by a dark grey color andesitic envelope. The dacite has macroporphyritic texture, with large crystals of sanidine, large-sized plagioclase and quartz, biotite, amphibole, and clinopyroxene (Kovacs, Fülöp, 2010, Kovacs et al., 2010a). The andesite has aphanitic to porphyritic texture and contains seldom small-sized plagioclase, quartz, biotite, amphibole, and clinopyroxene. Abundant mafic microgranular enclaves (MME, amphibole + clinopyroxene MME/type 1, and clinopyroxene + amphibole MME/type 2) of very different sizes (up to 90 cm), mainly occur in the dacite. Clinopyroxenes (diopside and augite) are very similar in the three rock types representing xenocrysts in dacites and andesites, and phenocrysts in the MME, based on the calculated pressure (6-9 kbar) they were crystallized in a deep magmatic reservoir (23-33 km) from a mafic melt (Kovacs et al., 2021).

Clinopyroxenes from the dacite and MME were analyzed with Fourier Transform Infrared spectrometry (FTIR) to acquire their structural hydroxyl (OH) contents and to uncover the magmatic 'water' content in the mafic melt in equilibrium with the clinopyroxenes. The resulting OH values vary from 80 to 600 wt. ppm. Comparing the FTIR data from the dacite with those from the MME, it can be observed that the MME shows uniformly shaped spectra with lower OH contents compared to the dacites with diverse

spectra and slightly higher OH contents. These differences are likely the results of mixing processes before the emplacement of the dyke and post-emplacement effects on the clinopyroxenes. Furthermore, equilibrium ‘water’ contents were calculated from the OH content of the clinopyroxenes based on the method of O’Leray et al (2013) resulting in ‘water’ contents from 0.98 to 4.72 wt.% H_2O. These ‘water’ contents are in the range of island arc and back arc basin basalts described in the literature (Dixon et al., 2004), and higher than those of the alkali basalts from the Bakony Balaton Highland Volcanic Field in the central part of the Pannonian basin (Kovács et al., 2020).

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Data processing and interpretation of a magnetotelluric key section

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Supervisory Authority for Regulatory Affairs

Poster

By combining magnetotelluric (MT) sounding data into several hundreds of km long profiles, MT key sections can be formed which

help to map the distribution of electrical properties on regional scale and gain new insights into the diverse geologic and tectonic settings of an area of interest.

One of the MT key sections being processed and examined at the institute is the MTOA-02 which crosses the western part of Hungary in a NW-SE direction (Zsíra–Badacsony–Buzsák–Sellye). This key section was created mainly from archived data. In addition, a part of the profile (around Lake Balaton) with lack of data points was filled with new supplementary MT stations and also integrated into the dataset.

All these data were analyzed and processed together. We were examining how known geological features appear on a magnetotelluric key section. For the interpretation both inversion results and observations from raw magnetotelluric data were used accompanied with information from other geological-geophysical methods (gravity, magnetism, geologic maps and cross sections) to confirm our conclusions from the resistivity profiles.

As a result, main tectonic elements and geologic units were identified. Main structural lines include the Alpokalja line, Rába line, Balaton line, Kapos line, and Mecsekalja line. Geologic units that can be delineated due to their resistivity contrast include the Lower and Upper Austroalpine Units, the Transdanubian Range Unit, the Mid-Hungarian Megaunit, the Tisza Megaunit and sedimentary rocks filling the sub-basins of the Miocene Pannonian back-arc basin.

Examination of saturation models by comparing petrophysical data and core data

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Poster

In the practice of oil industry coring plays a crucial role as the core sample analysis made in laboratories provide direct measurements of petrophysical properties, helping the calibration of well log data to achieve more reliable estimations.

Since this is an expensive operation and not usual in development wells, previous core data acquired in analysed field should be used as analogue to be integrated into a standard workflow for the balanced

derivation of most important reservoir properties: porosity, water/HC saturation and permeability.

The target of my research was to select, by integrating well log and the core data from two wells within the Derecske Basin, the petrophysical models best suited to the geology of the field. Estimated porosity and saturation were correlated to the corresponding data measured on core samples. The main target was to choose the most appropriate saturation formula out of the three models used for sandstones in the Pannonian basin (Archie, Simandoux and Indonesia). After the coupled iterative calculation of shale volume and porosity, the cementation exponent (m) of the saturation formulas was examined as a function of the shale volume.

The analysis helped understanding as to what extent the cementation exponent depends on rock quality (i.e. shaliness, cementation rate), and this parameter was determined as a function of shale volume. The best water saturation correlation with core data from the local field found to be obtained by using the Simandoux-formula.

The research has shown that laboratory data are very important in quantitative petrophysical interpretation. This field-wise integrated approach is recommended and necessary in industrial practice, considering the lack of core data in new field development wells. In further analysis work it is worth examining other parameters of the formulas building the workflow, in order to reach a complex picture from the specific area.

3RD SESSION

Signs of the Dinosaur hybridisation

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Theoretical

Partial rhabdodontid dinosaur skeletons, recovered from a Maastichtian site (K2) near Vălioara in the western Haţeg Basin are described recently. Those specimens that bear autapomorphic

characters (dentary, scapula, possibly the ischium, frontale) show characteristics of *Zalmoxes shqiperorum*, but the tibiae still resemble that of the other *Zalmoxes* species, *Z. robustus*, while the ilium show mixed characters of this two, maybe sympatric species.

Anatomical differences commonly occurs between individuals of the same species and may arise from individual variation, ontogenetic change, pathological reasons or sexual dimorphism. Another possible reason for the mixed characters may be the interbreeding of closely related species that live sympatrically within an area. This phenomenon occurs in recent animals, furthermore, natural hybridization is widespread among reptiles [1], including in the closest living relatives of dinosaurs such as crocodiles [1][2] and birds [1][3]. Fossil evidence of interbreeding is also known in some vertebrates, such as mammoths [4], and even humans [5] (but they are identified mainly for placental mammals from the Quaternary). As such, interbreeding could have also occurred between dinosaurs, but normally reliable evidence for hybridization or inter-specific gene flow is mainly based on DNA analyses, an information that remains unavailable from the Mesozoic era [6]. Accordingly, assessment of a potential hybridization can only rely on morphological studies corroborated with observations concerning definitely hybrid individuals of recent taxa. Observations of certain mixed morphological features are reported in hybrid crocodiles, albeit mainly related to cranial elements [2], nevertheless, a study also found small but significant differences in the pelvic bones of two different subspecies of *Rhesus* macaques and their admixed offsprings [7]. Just as observed in the K2 ilium, the hybrid individuals usually displayed a complex mosaic of morphological characters of their parental taxa [2][8], although their exact phenotypes depend on the actual level of admixture or introgression [2][8][9]. Unfortunately, most known *Zalmoxes* ilia are fragmentary, so the normal variability of the ilia from different individuals requires further research, but if the pelvic bones from site K2 indeed belonged to a hybrid individual, that may reinforce the assumption that interbreeding is an ancestral quality [1].

The Transylvanian rhabdodontid material is incomplete, and previously defined characters of these taxa are largely based on isolated specimens from different localities. Thus, what we can say with certainty is that the majority of the fossils are mostly similar to

the characteristics of *Z. shqiperorum*, but also show some differences from them, so currently referred this material as Rhabdodontidae indet. The future discoveries of more materials, or examined from the perspective of the hybridization other sympatric, closely relative ornithopods with more complete specimens, such as *Iguanodon*, *Camptosaurus* or *Lambeosaurus* species and the redescription of the *Zalmoxes* genus will help us to examine the possibility of this interbreeding hypothesis.

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Supervised bayesian classification for 3D reservoir characterization: a gas sand case study, pannonian basin

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Applied

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.

Complex geological studies on the combustion metamorphic units of the Novohrad-Nógrád Geopark

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Theoretical

The research is focused on the paralva units of the only documented combustion metamorphic complex in Hungary so far (Horváth & Vágó, 2023). This study aims to answer and clarify questions left open in the previous study such as melting and crystallization processes of the rocks, that were altered and melted by the heat released during coal combustion. Therefore a more detailed study of the in-situ preserved paralava was carried out. The petrography of the macroscopically diverse rock group was complemented by further studies using transmitted and reflected polarised light microscopy, electron microscopy (SEM-EDS and FEG-SEM-EDS) and Raman spectroscopy. In addition to these, ICP-OES bulk composition measurements were made of the protolith (aleurolite), metaaleurolite ("klinker"), buchite and paralava – wich rocks represent different „grades” of combustion metamorphism.

The studied paralava rock is locally characterised by at least 5 different mineral assemblages, with the presence of a diffuse sulphide and phosphate melt that is found throughout the rock. The compositions of the 5 paragenetic types are: cordierite-plagioclase-ilmenite-glass, pyroxene-plagioclase-cristobalite-pyrrhotite, skeletal crystal plagioclase-cristobalite-relict quartz-glass, idiomorphic, tabular, zoned plagioclase-Ti-oxide-glass and cordierite-ilmenite-enstatite-stanfieldite in phosphate rich bands.

In addition to orthopyroxene, cordierite, plagioclase, ilmenite, pyrrhotite, and glass, the SiO_2 and Ti-oxide phases were verified by Raman spectroscopy. SEM-EDS and FEG-SEM-EDS measurements and element mapping, petrography and Raman spectroscopy were used to identify several new minerals previously not described from Hungary: armalcolite, a member of the pseudobrookite mineral group, which contains Cr, Ge, Mn as minor elements; *stanfieldite*, a member anhydrous phosphates; and *indialite*, a hexagonal polymorphic pair of

cordierite. These mineral phases help to estimate more accurately the formation temperature of the paralava units and to better understand metastable crystallisation processes in the pyrometamorphic complex.

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Application of natural radionuclides in the hydrogeological characterization of karst system supplying the Lake Hévíz

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Besides being as one the biggest thermal lakes in the world, Lake Hévíz is also known for its sulphuric therapeutic water. It is located in the southwestern part of the Transdanubian Range's karst system (Hungary), in its regional discharge zone. At the bottom of the lake, a cave is located, where waters with different temperatures are mixing. The aim of this research is a comprehensive investigation of the geochemical parameters of waters in the wider surroundings of the lake (lake water, waters entering the cave at the lake bottom, observation, drinking water, and thermal water wells). The geochemical characteristics of water can be investigated through the innovative application of radionuclides as natural tracers, which may provide information about the flow systems. Within the context of this investigation, we applied uranium, radium, and radon isotopes to identify different order flow systems, and the mixing of fluids and evaluate the mixing end members in the Hévíz karst system. As an inventive approach to measuring uranium and radium isotopes, alpha spectrometry was used on selectively adsorbing Nucfilm discs.

Furthermore, stable isotopic ratios of hydrogen and oxygen (δ^2H and $\delta^{18}O$) were measured to identify waters coming from different flow systems. For quantifying the concentration of major ions ICP-MS, ion chromatography, and UV-Vis spectrophotometry were used. The gathered data about the fluid end members and their chemical compositions are anticipated to provide practical information on the hydrogeological functioning of the Lake Hévíz karst system, which is essential for sustainable water resource management.

Efficiency comparison of deep borehole heat exchangers using Python-driven finite element models

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Theoretical

Geothermal heat is available in virtually unlimited quantities, where Hungary is lucky to have an outstandingly favourable geological environment [1]. In addition to conventional technologies, high energy prices have recently brought other solutions to the fore, many of them are a popular subject of research nowadays.

Among these solutions, heat recovery using abandoned oilfield wells promises to be efficient, although the precise estimation of the amount of heat that can be extracted requires increased precision [2]. The main driving factors of the performance output of these systems can be divided into three groups: geological, well structural, and operational variables, of which, in addition to controlling the inlet temperature and mass flow rate, performance can also be influenced by optimizing the size of the production equipment [3].

An input model, containing the scripted equation system and all boundary conditions has been built using FlexPDE finite element simulation software in cylindrical coordinates [4], which were then coupled into a Python code, providing parametrization of each required input variable. Additionally, our models and the heat equation of the script was vertically scaled for better visualization and for faster simulation runs.

We ran 105 simulations with several casing/tubing diameters and flow rates, whereafter the following results of each simulation had been assessed in a database: peak wellhead temperatures and their

corresponding performance results for each timestep, until 1 week (604 800s) continuous operation.

According to the results, peak performance was achieved at the modelled structures where flow speed is greatly higher inside the production tubing, however if the heat utilization is less (meaning increased fluid null-point temperature), the highest energy output was obtained at lower flow rates.

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4TH SESSION

Mineral chemistry of sphalerite from VMS deposits of the Neotethyan realm

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Theoretical

Though sphalerite is one of the most common mineral in hydrothermal mineralizations, there are still several open questions in terms of its mineralogical characterization. Several elements (e.g. Fe, Mn, Cu, Cd, Co, Hg, Ga, Ge, Ag, In, Tl, Se, etc.) may appear in its structure and some of them may correlate with its formation conditions (e.g., the amount of Fe strongly depends on formation T). Therefore we may assume, that the composition of sphalerite can be a fingerprint of ore deposit type, although, only a few attempts were made to investigate this topic until now. As even critical/technological metals could be enriched in sphalerite (e.g. Co, Ga, Ge, In, Mn, etc.), this topic should be in the spotlight of modern research.

As the lack of data is particularly significant regarding sphalerite of the VMS-type ore deposits, we selected this deposit type for further investigation. The study locations were chosen from ophiolites of the Neotethyan realm (Xylagani from the Hellenides, Greece; Gjegjan from the Dinarides, Albania and Lasail from the Semail Ophiolite, Oman). While Xylagani and Lasail has been identified as Cyprus-type VMS, the classification of Gjegjan ore deposit remain uncertain. Our study supports its VMS related origin (more precise classification would need more detailed studies), but we have proven that its host basalt formed most likely during the Triassic, advanced rifting stage, rather than during the oceanic stage of the Neotethys.

We performed optical microscopic, SEM-EDS and EPMA studies on sphalerite-bearing samples, aiming to characterize their texture, their mineral paragenesis, their mineral precipitation series (focusing on the position of sphalerite) and the mineral chemistry of sphalerite. Based on our observations, sphalerite mostly precipitated at the early stage of mineralization, during the upbuild of the hydrothermal system, though at one place (Xylagani), it also formed as a late product, during the waning of the system. Early sphalerite often suffered "chalcopyrite disease", caused most likely by later impulses of Cu-rich fluids during the main stage of the hydrothermal process. All studied sphalerite precipitated from a moderately warm (238 °C to approximately 60 °C, based on Fe-in-sphalerite thermometry) fluid, characterized by an intermediate sulfidation state ($\log fS_2$). These conditions are typical in submarine hydrothermal systems. We identified chemical anomalies in sphalerite, like Ga in Gjegjan (up to 2260 ppm, mostly in distal part of the mineralization) and Co in Lasail (up to 1230 ppm in massive sulphide lens). Extreme high Ga content favours low temperature conditions, which is supported by the applied sphalerite thermometry, too. However, though high Ga content is commonly accompanied by Ge anomaly as well, we did not observe its presence above the detection limit (460 ppm) of the applied method. Extreme Co enrichment of sphalerite could have been caused by a sudden change in the fugacity of S_2 and/or O_2 in the massive sulphide lens. Fe (1.039–3.973 wt.%), Cd (950–3220 ppm), Mn (b.d.l.–2680 ppm) and Pb (b.d.l.–1260 ppm) was also presented in all samples and good correlations ($R^2 > 0{,}64$) were found between Fe–Zn, Cu–Zn, Fe/Cd–Zn and Fe/S–Zn.

The identified Ga and Co anomalies not only may represent a new source of extractable raw materials for the investigated ore deposits, but understanding the reasons for enrichment of these critical raw materials can help to make mining more economical when exploring other similar ore deposits. Therefore now our objective is contributing to understanding of critical/technology metals enrichment, and thus making mining more economical. In order to reach these aims, we plan to involve additional analytical methods and new deposits from the Neotethyan realm.

Archaeometric study of late Sarmatian ceramics from Tázlár-Templomhegy settlement

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Applied

Sarmatian pottery is one of the most common finds of the Great Hungarian Plain; however, they have been scarcely examined using scientific methods so far. The late Sarmatian settement of Tázlár-Templomhegy we investigated is outstanding because it represents all types of late Sarmatian pottery, which is quite rare. Nevertheless, no raw material suitable for pottery production is found in the vicinity of the site, nor have a pottery workshop been uncovered.

The aim of our research is to gain information about pottery technology, to determine which pottery workshops may have produced the different sherds, and to try to find the provenance of the raw materials used for tempering. To achieve these goals, in addition to petrographic analysis, we employed various analytical methods such as Raman microscopy, cathodoluminescence (CL) microscopy and spectroscopy, and X-ray powder diffraction.

Based on the petrographic analysis, the ceramic samples can be divided into 5 categories. The first group consists of very fine-grained, mostly grey sherds that do not contain tempering. The second group, also grey in color, is tempered with well rounded, coarse to very

coarsed grain sized quartz and feldspar grains with metamorphic origin. The sherds in the third group have opaque, black matrix under microscope with recognizable charred plant residues indicating low firing temperature. The fourth group is characterized by the use of ceramic slag as a tempering material in addition to rock tempering and the sherds of the fifth group are tempered with granitoid rock grains. Based on the analyses carried out, the origin of the raw material of the first and the third groups could not be determined. Ceramics of the second group were presumably made in the pottery workshop of Üllő, while vessels from the fourth group might be from Sándorfalva-Eperjes, and the sherds of the fifth group could have been produced in Nagymágocs-Paptanya pottery workshop. The possible source region of the tempering material of the fifth group was attempted to delineate by petrographic and CL analyses of granitoid tempering grains and samples from their possible source rocks. We have used granitoid rock samples that are closest to the presumed pottery production sites of the samples in question, and which are documented as tempering grains in archaeological pottery from the Carpathian Basin. Our results indicate that the granitoid tempering show the greatest similarity in textural features, mineralogical composition and cathodoluminescent characteristics to the Carboriferous Codru granitoids of the Apuseni Mountains, Romania.

Impact of pore water content on stress sensitivity

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Applied

Understanding the relationship between petrophysical parameters such as permeability with stress sensitivity is important for reservoir evaluation and production prediction. Therefore, the permeability of reservoirs will change when the pressure equilibrium in geological formations is disturbed. This study employs a Permeability-pressure dependent model to examine the permeability evolution under different pressure values with varying of pore water content. In the case of dry samples, it has been observed that the application of stress leads to a reduction in permeability. This phenomenon can be

attributed to the closure of pore throats as a consequence of increased stress levels. The magnitude of permeability reduction in dry samples exhibits variability among different samples, owing to variations in the elastic properties across distinct rock types. This phenomenon highlights the influence of the rock type's specific characteristics on the relationship between stress and permeability. In the presence of water content, it has been observed that the water content acts as a resistance factor against applied stress. Consequently, this leads to a lesser degree of permeability reduction compared to dry samples. That implies that the stress sensitivity coefficient is not fixed but decreases as the pore water content increase. The stress-sensitive damage levels are usually explained by two classical nonlinear models such as exponential, and power-law models. In this study, an optimized exponential-law model for stress-sensitive damage assessment was improved, to describe the permeability with stress sensitivity relationship under different pore water saturations. Based on the model, the initial- and permanent permeability value, as well as the stress sensitivity coefficient are the regression parameters that need to be predicted to guarantee a good fitting between the measured and calculated data. Laboratory measured permeability with different pore water saturation function of pressure were inverted to prove the applicability of the models and to obtain that of parameters. The accuracy checked joint inversion results showed that the calculated and measured data matched perfectly and proved that the refined exponential model performed well in practice.

In conclusion, this research significantly contributes to the understanding of stress sensitivity in tight sandstone oil reservoirs. It presents a practical framework for incorporating water content considerations into stress sensitivity assessments and validating them through experimental data.

Muography in geophysics: model validation and optimization

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Theoretical

Muography uses cosmic ray muons to image the inner structure of large objects like geological formations or artificial buildings. Cosmic muons have wide energy spectrum, while their slow energy loss is proportional to the density and length of the traversed rock. Counting these muons one measures the absorption of the overburden rock, images its inner density structure and reveals anomalies (eg: ore, caves, tunnels).

This multidisciplinary technology requires expertise in particle physics instrumentation, geological knowledge, and industrial design, to became a novel tool for geophysical surveys. In the last decade several research groups started on various methods to develop and demonstrate its practical usability.

The Innovative Gaseous Detector R&D Group in the Wigner RCP in Hungary is a well known team of the muography community that focuses on technological advancement and applications. The group has used this measurement technique in a number of mining, archaeological, and speleological investigations. I will present the series of measurements made for these subsurface applications with the results and practical experiences of our group.

The success of any measurement is based on the right plan, especially in muography, where devices are mounted into hardly-accessible territories while measurements take up to several weeks or months. Choosing the most suitable muograph type and geometry, and estimate the required measurement time for expected anomalies are essential. While in practice it is usually done by experience and educated guess, for new challenges and complex structure it requires mathematical modeling and computation, that could even be used to planning for tomographic inversion series. I will present the developed model for the direct problem,

verify it with laboratory measurements and underground raw data as well.

Mapping of peatlands change by remotely sensed data in Sumatra, Indonesia

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Theoretical

Indonesia has historically experienced massive land and forest fires, which may reflect to regional tropical deforestation and has led to substantial concern for peatlands. Nearly 35% of Indonesia's forest fires occurred in peatland areas. Several peatland types, such as peat swamp forests and dome peat, are likely to have been degraded due to land use activities, including competing and associated demands of palm oil production. Despite peatland widely vulnerable to draining and burning, have not yet been mapped, information on temporal changes of peatland by remotely sensed data is lacking. This study sheds light on the gap by using Sentinel (2, 3) data, and machine learning to assess and identify peatland in Sumatra, Indonesia across certain periods of fire events. Three peatland land use classifications were mapped: industrial timber production, palm oil plantation, and protected peatland. The Sentinel data provide high-resolution imagery data, a robust methodology that overcomes cloud contamination, and temporal change maps that could help understand unsustainable peatland management practices and its impact on emission. Such data, including multiple spectral ranges, can be exported for further geospatial analysis using Geographic Information System (GIS) techniques. The classification of peatlands from this research could also be used to inform prevention and everyday adaptation practices by the government and stakeholders

SATURDAY

5TH SESSION

Enhancing road infrastructure management through ground-penetrating radar (GPR) inspections: a case of study miskolc university campus

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Applied

Roads in operation for several years can experience issues like asphalt wear, cracking, and contamination from soil and vehicle materials, leading to clogging and structural problems. It is crucial to have knowledge of the road's structure, periodic assessments of its condition, and an understanding of contamination levels. This information helps in planning and prioritizing critical sections for restoration and predictive maintenance. Ground-penetrating radar (GPR) was an established non-destructive testing (NDT) device for tunnel inspections in the 1970s. It has acquired significant importance as a useful tool in road construction over time. GPR has become a widely appreciated application in the sector due to its ability to quickly generate exact and continuous profiles of pavement layers while simultaneously locating underlying reasons contributing to the degradation of the structure. Short evaluations may now be completed at regular traffic speeds, modernizing the efficiency and accuracy of road inspections. This paper investigates the use of ground penetrating radar (GPR) for road inspections on the Miskolc University campus, spanning approximately 2 kilometers. The investigation involves collecting and analysing thirteen radargram sections with different lengths, obtained with two antennas operating at different frequencies one of 500 MHZ and another one with 1.2 GHZ. This survey aims to verify the feasibility and effectiveness of GPR in evaluating subsurface conditions and anomalies related to road infrastructure. To interpret the obtained data, some data analytic approaches were used. Our results showed accurate and reliable information throughout the

sections, demonstrating GPR's potential as a formidable tool for road inspections. The analyzed data confirmed GPR's capacity to detect diverse subsurface features and anomalies, offering useful insights for preventative maintenance plans and enhanced road management decision-making. The paper also reveals limitations and provides recommendations for GPR investigations and improvements.

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Rare elements and its mineralogy in rock bodies from NE Hungary

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Applied

Rare element (REE, Nb, Ta, Th, Zr) enriched rock bodies from Bükk Mts., NE Hungary have been known for a few years [1]. These rock bodies are Triassic metavolcanics (Szinva Metabasalt) and siliciclastic sediments (Hegyestető Formation, Felsőtárkány Limestone), occurring near to big structural boundary zones, in the NE and SE part of the Mts. The enriched bodies were previously found by spectral gamma measurement, thanks to the elevated Th content. This method was successfully used recently also in the Uppony and Szendrő Mts., where Ordovician to Carboniferous sandstones, phyllites and aleurolites can have elevated rare element concentrations

(Tapolcsány Formation, Szendrő Phyllite). Both territories are undergone on a low-grade regional metamorphism in the Cretaceous [2]. The situation is further complicated by the fact that several rock alteration processes may have affected the formations.

REE+Y, Nb, Th and Zr ratios of the analysed samples (based on ICP-MS) compared to the upper crust [3] in the Bükk Mts. 1 – 11, 0.8 – 16, 0.9 – 30, 0.7 – 19; in the Uppony Mts. 0.8 – 3.2, 0.6 – 3.7, , 0.6 – 2.3, 0.5 – 1.5; while in the Szendrő Mts. 0.8 – 3.5, 1.1 – 2, 1 – 2.1 and 1.2 – 1.9, respectively. Relatively small values are often the result of mixed materials (peperites in the Bükk). In Szendrő and Uppony Mts. small values can be relatively elevated, compared to the environment. Trace element patterns are various, even within the same formations, but there are common characteristics, like the negative Eu-anomaly, which is most highlighted in the Bükk samples, or the low Sr-concentrations. In the Bükk, depletion of Ba, P and Ti is general, while in the Uppony, Ba, U and P have relatively high values.

The rare elements are incorporated into REE-phosphates (*monazite-(Ce)* — every occurrence, *xenotime-(Y)* — Uppony and Szendrő, *"clear" cheralite* — a single sample from Vesszős valley, Bükk, *monacite–cheralite–huttonite solide solutions* — Uppony and Szendrő); REE-F-carbonates (*parisite-(Ce), bastnäsite-(Ce), synchysite-(Ce)* — unique rock bodies from Középszék and Felső-Kecskevár, Bükk and from Szendrő); REE-Nb-oxides (*aeschynite-(Ce)* and *aeschynite-(Y)* — unique rock bodies from Vesszős valley, Bükk). The main carrier of Zr is the zircon in all the occurrences, although in Uppony and Szendrő Mts. it is usually relict, and newly formed zircon only can be observed in the Bükk. Nb can be incorporated into Ti-oxides, mainly in Bükk samples (up to 6 % Nb_2O_5), rarely in other occurrences (up to only 0.9 % Nb_2O_5). All the observed rare element bearing minerals (except relict zircon) have only micrometric grain size, not observable with optical microscopy. The minerals were identified by EPMA analyses.

The presentation will summarize and compare the trace element geochemistry and mineralogy of the different formations, to find an answer to the cause of rare element mineralization. In the Bükk Mts., enrichment of rare elements is assumed to have hydrothermal origin and connected to an unknown magmatic source. The mineralization in Uppony and Szendrő Mts. is more probably connected to element

mobilisation during the metamorphism. This is proved by some textural and chemical features, like zircon-xenotime associations or the high Th-monazite-cheralite-huttonite compositions. Although newly formed rare element-minerals are present, it is questionable whether we can really talk about enrichment, or the measured concentrations are characteristic to the given rock types.

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Unveiling hidden histories: evaluating the performance of non-traditional geoelectric arrays in archaeological investigations at Szendrő, Hungary

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Applied

The scientific methods of underground exploration that preceded archaeological excavations were greatly changed by the widespread application of geophysical tools in the 20th century. Traditional geophysical exploration methods were limited and often did not provide any additional information about the target object. The first application of geophysics in archaeology dates to the early 1970s in Hungary, Professor Csókás [2] was a pioneer in this field. The reliability of the results has increased greatly over the last 40 years, both for measurements made before and during archaeological excavations [1]. Geophysical research offers the possibility of mapping the physical parameters of rocks in the depth range to be explored, using a system of sections at a chosen investigation depth (the resolution is inversely proportional to the investigation depth). By using the geoelectric measurement technology correctly, useful information can be obtained, and the electric resistivity images can be

used to clearly show the shape and depth distribution of certain buried artificial objects [3], [11].

One of the most common applications among geophysical research methods is electrical resistivity tomography (ERT), a measurement specifically aimed at determining the electrical resistivity of soil and rocks. The method can be used also to detect walls, cavities and other structures in the shallow subsurface. Direct current (DC) resistivity measurement is the most widely used geoelectric method. With a measurement system installed on the surface of the earth, the measurement results in a visualization of the subsurface electrical resistivity distribution. Depth variations are detected by removing the current injection points, and the apparent resistivity variation in both horizontal and vertical direction is detected by measuring in the intended direction at points with appropriate step spacing. The application of the quasi-null arrays opened up a new direction of development of the geoelectric method. Quasi null arrays were derived from null arrays, which measure null potential difference above homogenous half-space [5]. The first null array was presented by [10]. One of their specific groups' review restarted recently [9]. Their non-linearity poses a problem in 2D investigations, although they proved to be successful also in field applications. The only linear geometrical null array, which can be built into 2D multielectrode systems, is the MAN array. The problem rises from its infinite electrode, a solution to this problem can be the application of the infinite electrode at a rather large distance from the other three electrodes. This way we get the quasi-null arrays, which have a very small homogenous half-space value of electric potential, close to zero. The further away the "infinite" electrode is from the other electrodes, the closer the configuration is to the null array situation [5]. Compiled this way, these quasi-null arrays are called γ11n arrays, where γ refers to the AMBN order, (A and B being the current, M and N the potential electrodes), and the 11n refers to the distance between the neighboring electrodes, (1 is the unit distance). According to [6], the depth of detectability of the γ11n arrays is greater than that of the traditional arrays. Numerical results obtained by [7] proved that the γ11n arrays also have better horizontal and vertical resolution than even the best conventional arrays.

The chosen study area gives a perfect opportunity to study the behavior of these arrays in field situations. The mentioned cavities inside the fortress are expected to be mixed structures i.e. the builders took advantage of the natural caves under the hill the fortress is located on, and built artificial tunnels for more escape routes around the city. The bedrock being of carstic origin, therefore sudden and large resistivity changes are expected above cavities. Our strategy was based on historical maps, archeologist suggestions, and the clear evidence of walled and collapsed tunnel entrances. We intended to capture the image of the tunnels with seven sections, and one section was designed for the water well. The aim of this research is to prove the applicability in archeological surveying, and better horizontal sensitivity of the γqnull array than that of the traditional arrays. Furthermore, to delineate the geometry and position of the mentioned archeological structures for future excavations.

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Orbital forcing of the Pliocene/Pleistocene succession from Eastern Hungary

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Applied

This study marks the first application of astronomical age dating to the Pliocene Nagyalföld Variegated Clay Formation (Zagyvai Formation) in Hungary. Utilizing a well situated in the Eastern region of Hungary, we conducted astronomical calibration and cyclostratigraphic analysis on gamma rays (GR). The analysis involved evolutionary correlation coefficient (eCOCO) assessments, revealing a notable cut in sediment accumulation rate (SAR) from 10 to 5.6 cm/kyr. Power spectral analysis exposed significant cycles with ratios resembling Milankovitch cycles, particularly in long and short eccentricity cycles.

The long and short eccentricity cycles were filtered then merged and correlated to the La04 astronomical solution. The new astronomical time scale (ATS) disclosed a hiatus approximately 0.44 myr (4.91-4.47 Ma), aligning with the g4-g3 eccentricity minima node (Plio.1) and the sharp shift in the SAR. According to the revised ATS, the Nagyalföld Formation spans from 0.94 to 6.91 Ma. To further validate these findings, a dynamic noise after orbital tuning (DYNOT) model was employed to assess changes in water levels. The results strongly supported the identified hiatus, indicating a significant decrease in water level at the hiatus boundaries.

This research contributes not only to the understanding of the Nagyalföld Variegated Clay Formation but also establishes a groundbreaking precedent for the application of astronomical age dating in Hungarian Pliocene/Pleistocene geological studies.

The Effectiveness and Environmental Impact of Rooftop Rainwater Harvesting by Shallow Well Infiltration

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Applied

In the Danube-Tisza Interfluve area, groundwater levels have declined significantly in the last decades, due to human activities and climate change. The aim of this study is to demonstrate the potential of local, inexpensive solutions, such as rooftop rainwater harvesting that could contribute to easing the water shortage of the study area.

A rooftop rainwater harvesting and shallow well infiltration (RRWH-SW) experiment was investigated over a period of 26 months, with continuous measurements of water level, temperature and specific electrical conductivity, seasonal groundwater sampling and additional sampling of well bottom sediments and rainwater. To interpret the results in a broader context, archive water level and water chemistry data from drilled wells were evaluated, and seasonal survey of dug wells was conducted in the area.

Using long-term water level and hydrochemical observations associated with the experiment, it was demonstrated that rooftop rainwater harvesting has a positive effect on the quantity and quality of shallow groundwater. The experiment resulted in considerable and sustained reductions of Mg^{2+}, Na^{+}, Cl^{-}, SO_4^{2-}, NO_3^{-} concentrations and total dissolved solids content. Monitoring of water column changes following precipitation events and analysis of infiltration curves helped to identify the clogging process, which reduced the hydraulic conductivity of the well bottom by an order of magnitude.

The results of this research provide information on the effectiveness and environmental impact of the pilot project and can contribute to the extension of the design to municipal level and to similar municipalities in the region. In addition, based on the results and

lessons learned from the experiment, recommendations are made for the implementation of other RRWH-SW systems at the household level, including guidelines for system design, operation, maintenance and monitoring.

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6TH SESSION

3D modeling approach for geological insights in molybdenite-hosted rhenium occurrence study in the Recsk deep-level ore deposit

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Applied

The Recsk Deeps, situated in the Mátra region, NE of Budapest, is a substantial mineralization ore complex with diverse mineralization stages that extends to approximately 1.2 kilometers in depth, which shows a potential geological wealth, particularly in the exploration of molybdenite, rich in rhenium, a highly valuable element that is generally obtainable as a by-product of molybdenum processing in porphyry copper mines [1]. Recsk's copper-molybdenite ore concentrates in rhenium are among the richest molybdenite products in the world. Its enrichment is demonstrably manifested in copper deposits formed in the sub-volcanic depth ranges of medium and low temperatures [2].

A previous and still ongoing study aimed to assess such molybdenite-hosted rhenium within Cu-porphyry and skarn deposits and validate the existence of rhenium in the Recsk Deep-level ore deposit. Petrographic and ore microscopic analysis from the borehole samples were performed, as well as electron probe microanalysis - energy dispersive X-ray spectroscopy (EPMA-EDS) and laser-induced breakdown spectroscopy (LIBS) analysis, aiming to confirm the presence of rhenium by detecting it in the molybdenite-bearing

samples. Unfortunately, there were no detectable fractions of rhenium successfully identified using the aforementioned analytical methods. Generally, the content of the trace amounts of rhenium found in molybdenites usually varies greatly depending on the different genetic types in conjunction with other factors [3, 4, 5].

Complementing this previous study with the generation of a 3D geological model using the Leapfrog Geo, this approach seeks valuable insights into the geochemistry of molybdenite-hosted rhenium, being centered on accessing the presence and distribution of molybdenum content, to gain insights into the lack of rhenium detection from the previous study, and further add to the foundational understanding of mineral occurrences in this geological context.

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Petrographic reambulation of the Pusztaföldvár Basement High, SE Hungary – consequences on spatial correlation

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Theoretical

The model that summarises the basement of the Great Hungarian Plain (GHP) and the spatial relationship of the separated units [1] excludes the crystalline basement high of Pusztaföldvár and its surroundings. This high can be integrated into the current basement

model based on a petrographic reambulation of the Pusztaföldvár basement high (PBH) using modern petrological interpretation. The metamorphic evolution of the PBH needs to be known in detail to interpret the unit in the broader context and to locate it in the basement of the Tisza Megaunit by correlating with other basement highs of the GHP and with the analogies in the Apuseni Mountains.

The detailed petrographic analysis under the optical microscope was followed by SEM-EDX and Raman microspectrometry measurements. Graphite thermometry was applied to estimate the quantitative P-T path.

The PBH comprises rocks from a similar protolith with the same metamorphic evolution, as petrographic and geochemical analysis suggested. According to all studied specimens, the PBH consists essentially of polymetamorphic garnet biotite paragneiss with significant metasomatic overprint. The rocks comprise granoblastic texture defined by locally recrystallised quartz, feldspar grains, and garnet porphyroblasts. The muscovite-rich zones exhibit lepidoblastic texture. The rock has two prominent foliation planes along S1 and S2. The highest metamorphic temperature (Tmax) of the area can be estimated at 560 °C using graphite thermometry.

Most samples contain post-kinematic tourmaline and rutile crystals, which suggest that the complex has been metasomatised by granitoid intrusions. At places, the matrix includes a significant amount of hematite, accompanied by muscovite, siderite, dickite, and chlorite. This mineral assemblage suggests a low-temperature metasomatic overprint (<400 °C) caused by a fluid with increased oxygen and carbon dioxide fugacity. Along fluid migration channels, this process has almost entirely consumed the biotite grains formed during progressive metamorphism. Graphite grains in the matrix can also act as an oxygen buffer. Consequently, in the presence of hematite, graphite thermometry in the most intensely metasomatised samples cannot provide reliable results. To determine the exact location of the PBH in the crystalline basement, it is necessary to compare it to other areas of the GHP and the Apuseni Mountains. The present petrographic and petrological analysis reveals that the PBH shares significant similarities with the Algyő-Ferencszállás-Kiszombor basement high and the Baia de Aires Nappe of the Apuseni Mountains. Since these units belong to the Biharia Nappe System and

all three follow the same strike, we can assume that the Pusztaföldvár Complex is also part of the Biharia Nappe System. According to this hypothesis, the Battonya Granite Complex in the south must represent a tectonic window as it belongs to the lower structural unit, the Codru Nappe System.

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Historical reconstruction of the 18–19th century mineral collection of the Pannonhalma Archabbey, NW Hungary

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Poster

The mineral collection of the Benedictine Archabbey of Pannonhalma, NW Hungary was founded in the early 19th century, primarily for educational purposes. It is currently the second largest collection of verifiable 18th century material in Hungary after the Mineral Collection of the Natural History Museum of Eötvös Loránd University. The core of the collection, which dates from the first third of the 19th century and contains more than 900 specimens of 18th century origin, is the former Spaits and Mitterpacher collections.

The restoration of the mineral collection began in 2021, as the first stage of a project to professionally reconstruct the more than 20 thematic collections of the Archabbey Museum.

The owner of the first part of the collection was István Spaits, a former Jesuit monk, teacher, priest and member of the Jena Mineralogical Society, who was the principal of the Székesfehérvár High School at the time of the sale. The Archabbey bought his mineral collection from him in 1802. The sale and purchase is documented by a catalogue. The Mitterpacher collection was compiled by Lajos Mitterpacher and his nephew György Mitterpacher. Lajos Mitterpacher was a natural scientist and the first professor of agriculture in Hungary, while György Mitterpacher was a major in the Komárom garrison hospital. Little is known about György Mitterpacher's life, but it is certain that as

an enthusiastic amateur he not only preserved his uncle's collection, but also added interesting items such as the volcanic ash from the 1822 eruption of Vesuvius, broken down into daily samples. The collection is characterised by a significant number of specimens from southern Italy - Naples and the Sicilian region - which György Mitterpacher obtained through his family connections. We have not yet found a catalogue for this collection, but we have found another description: in 1804, a German-language daily newspaper in Brünn (Brno, Czechia) gave its readers the latest mineralogical system of Abraham Gottlob Werner, a renowned mineralogist, as a gift in its New Year's supplement. A copy of the newspaper can be found in the library of the Abbey of Pannonhalma, with the Werner items and handwritten notes by Lajos Mitterpacher on his own collection. This part of the collection came to Pannonhalma in 1833 from György Mitterpacher's widow, Borbala Kunz. In the course of the time that has passed since then, the collection has undergone various changes of fate, being rearranged, catalogued and finally, after losing its educational function, returned to the secluded attic of the Archabbey from the second half of the 20th century.

The localities of the specimens in the collection are the same as the major ones of the period. The most common occurrences overlap closely with the borders of the Habsburg Empire and its immediate allies at the last decades of the 18th century, so that the majority of specimens come from the territories of present-day Hungary, Slovakia, Romania, Poland, the Czech Republic, Austria and Italy.

The importance of the collection is due to the fact that few specimens and catalogues from this period survive in Hungarian public collections. On the one hand, many relics have been lost in the intervening years, and on the other hand, the 1820s to 1840s period represented a decline in Hungarian mineralogy and public mineralogical collections. However, major private collections were also included in these public collections during this period, so that the Mitterpacher collection of the Benedictine Archabbey of Pannonhalma has a significant number of specimens from this period. The difference with the Spaits collection is mainly due to the fact that, in addition to the minerals as we know them today, this somewhat younger collection contains more rocks which were already receiving increasing attention in this period.

Application of satellite gravity data for surface and subsurface structural mapping in vicinity of Merwi Dam, Northern Sudan

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Applied

The study area lies in Northern Sudan between 17° – 20°N latitudes and 30° – 35°E longitudes, it is characterized by Bayuda volcanic field

and the Nile River crossing the area from south-eastern to north-western parts with z-shape great bend. The area is dominated by arid climate conditions with long hot summer season extends from March to August with an average temperature of about 40°C during the day. Several investigations have been carried out in the area however majority of them were about the geology and tectonic setting. The present work aims to study different structural patterns occur in the area in addition to relationship between the sedimentary and basement rocks.

Geologically the area characterized by different lithological units range from Precambrian basement rocks to Pleistocene and Recent sediments. The common litho-tectonic units include Arabian Nubian shield to the east and north in addition to the Saharan Metacraton to the west. Bayuda Desert lies within the great bend of the Nile River and situated at the inferred transition between the ANS in the east and the predominantly Saharan Metacraton of Neoproterozoic ages in the west. The significance of the area's structural pattern has increased due to the Nile River's passage through these diverse rocks, particularly since important structure like the Merwi dam is situated across the river.

This study mainly implements gravity data in addition to information from the previous geological and geophysical studies. The grid of Satellite Gravity data has been downloaded from https://topex.ucsd.edu/WWW_html/mar_grav.html (Topex data; Scripps Institution of Oceanography, University of California San Diego), with 1 arc-minute resolution (1'= 1.85 km) in the form of Free Air Anomaly (FAA) together with the corresponding measurement’s elevations. The Bouguer slab effect has been subtracted while the terrain effect was neglected due to the gentle topographic variations in the area and finally complete Bouguer anomaly was obtained for the study area. The complete Bouguer anomaly is cumulative sum of density variation from core to surface of the Earth hence the separation of the long wavelength regional anomalies from short wavelength residual anomalies is crucial to study the Earth’s crust and upper mantle. The upward continuation technique was utilized to obtain regional anomalies while the residual anomalies were retained by subtract the regional from complete Bouguer anomaly. The two-dimensional filters such as First Vertical Derivative (FVD), Second

Vertical Derivative (SVD) and horizontal gradient were used to map the structures and boundaries between different rock units in the area. Radially averaged power spectrum and Euler deconvolution have been used to estimate the depth to the density contrast zone which is attributed to the boundary between the sedimentary and basement rocks.

According to the Bouguer anomaly values which are directly related to the subsurface density distribution, the area is characterized by relatively high-density rocks at the central, northern, and western parts, which indicate shallow occurrence of the basement rocks in these areas. The low-density rocks in the southwestern and southeastern parts are interpreted as sedimentary basins whereas the circular low anomaly in the northeast part is attributed to granitic intrusion. The radially averaged power spectrum analysis has revealed two significant depths, the first one is of the long wavelength anomalies at 22.5km which may be attributed either to the variation of rocks within the Earth's crust or the boundary between crust and mantle. The second depth is due to short wavelength anomalies at 1.4km which indicates the bottom of the shallow sedimentary basins in the area.

For structural manifestation, a compilation of zero contours of residual anomaly and SVD map in addition to maximum value of total gradient were merged in the ArcMap environment. Number of structural patterns had been observed; however, the common directions of these patterns were NE, NW, and N-S; in addition to E-W for lesser extent.

The observations in the vicinity of Merowe Dam have shown that the great significance would be to NW-SE trending structures which are thought to represent major fault that extends in both sides of the dam and can be used to trace out the boundary between basement rocks to the north and sedimentary to the south.