

ASSOCIATION OF HUNGARIAN GEOPHYSICISTS

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INVITATION

to the Meeting of Young Geoscientists

06-07 April 2018

Hajdúszoboszló, Hotel Silver

www.hotelsilver.hu

Useful information:

Accommodation and meals are available only for pre-registered participants.

The talks are open and public.

Official languages of the conference are English and Hungarian.

Registration desk open: from 9:00 am, 6th April onwards

Organisers

MAGYAR GEOFIZIKUSOK EGYESÜLETE
1145 Budapest, Columbus utca 17-23.
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1015 Budapest II., Csalogány utca 12.
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MEGHÍVÓ

az Ifjú Szakemberek Ankétjára

2018. április 6-7.

Hajdúszoboszló, Hotel Silver
www.hotelsilver.hu

Tudnivalók:

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

Regisztrálás: 2018. április 6. 9⁰⁰-tól folyamatosan

Rendező Bizottság

PROGRAMME

06. 04. 2018. FRIDAY

9 ³⁰ - 9 ⁴⁰	OPENING
9 ⁴⁰ - 11 ¹⁵	1 ST SESSION
11 ³⁰ - 13 ⁰⁵	2 ND SESSION
13 ¹⁵ - 14 ⁰⁰	POSTER SESSION – SHORT ORAL SUMMARIES
14 ⁰⁰ - 15 ¹⁵	LUNCH
15 ¹⁵ - 16 ⁵⁰	3 RD SESSION
17 ⁰⁵ - 19 ⁰⁰	4 TH SESSION
19 ⁰⁰ - 20 ⁰⁰	POSTER SESSION – DISCUSSION
20 ⁰⁰	DINNER

07. 04. 2018. SATURDAY

- 9 ⁰⁰	CHECK-OUT FROM THE ROOMS <i>Please leave your room after breakfast, until 9 o'clock. The baggages can be stored in a luggage room.</i>
9 ⁰⁰ - 11 ⁰⁰	5 TH SESSION
11 ¹⁵ - 13 ¹⁵	6 TH SESSION
13 ¹⁵ - 14 ⁴⁵	LUNCH
15 ⁰⁰	AWARD GIVING AND CLOSING CEREMONY

FRIDAY

9³⁰ OPENING

9⁴⁰-11¹⁵ 1ST SESSION

9⁴⁰ *Integrated stratigraphic results from the Lower Pannonian section of the Gușterița clay pit (Transylvanian Basin, Romania)*

T **Dániel Botka**^{1,2}

¹Department of Palaeontology, Eötvös Loránd University, Budapest, Hungary,

²MOL Group, Budapest, Hungary

9⁵⁵ *C/O logging case study from Hungarian oil industry – determine water saturation in cased holes*

A András Szendrei, **Nándor Szegedi**

MOL Plc.

10¹⁰ *The interaction of basin-scale topography-driven groundwater flow and free thermal convection*

T **Márk Szijártó**^{1,3}, Attila Galsa¹, Ádám Tóth^{2,3}, Judit Mádl-Szőnyi^{2,3}

¹ELTE Eötvös Loránd University, Department of Geophysics and Space Science,

²Department of Physical and Applied Geology, ³József & Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary

10²⁵ *Receiver function analysis in the Eastern Alps – Pannonian Basin transition zone*

A **Dániel Kalmár**¹, György Hetényi^{2,3}, Bálint Süle³, István Bondár³, the AlpArray Working Group

¹Department of Geophysics and Space Science, Eötvös Loránd University, Budapest, Hungary, ²University of Lausanne, Institute of Earth Sciences,

Lausanne, Switzerland, ³Research Center for Astronomy and Earth Sciences, Geodetic and Geophysical Institute, Hungarian Academy of Sciences, Budapest, Hungary

10⁴⁰ *Exploration of Keresztes-halom*

T **Virók András**

10⁵⁵ DISCUSSION

11¹⁵-11³⁰ BREAK

11³⁰-13⁰⁵ 2ND SESSION

11³⁰ *A systematic dependence of acoustic velocity on internal pore structure*

A **Muhammad Nur Ali Akbar**
University of Miskolc, Miskolc, Hungary

11⁴⁵ *3D geophysical model of the Danube Basin based on gravity modelling*

T **Zsófia Zalai**
Eötvös Loránd University, Geography and Earth Sciences, Geophysics and Space Sciences, Budapest, Hungary

12⁰⁰ *Research of springs around Esztergom*

A **Emese Pánczél, Anita Erőss, Katalin Csondor**
Eötvös Loránd University, Department of Physical and Applied Geology, József and Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary

12¹⁵ *Evidences of magma mixing/mingling in syenites of the Ditrău Alkaline Massif*

T **Luca Kiri¹, Elemér Pál-Molnár^{1,2}, Anikó Batki^{1,2}, Balázs Kiss^{1,2}**

¹'Vulcano' Petrology and Geochemistry Research Group, Department of Mineralogy, Geochemistry and Petrology, University of Szeged, Szeged, Hungary, ²MTA-ELTE Volcanology Research Group, Budapest, Hungary

12³⁰ *Forecasting karst water level on a former mining area with time series analysis*

A **Kamilla Modrovits, József Kovács**
Department of Physical and Applied Geology, Eötvös Loránd University, Budapest, Hungary

12⁴⁵ DISCUSSION

13⁰⁵-13¹⁵ BREAK

13¹⁵-14⁰⁰ POSTER SESSION – short oral summaries

Particle swarm optimization assisted factor analysis as a new tool for lithological characterization of sedimentary rocks

Armand Abordán^{1,2}

¹Department of Geophysics, University of Miskolc, Miskolc, Hungary, ²MTA-ME Geoengineering Research Group, University of Miskolc, Miskolc, Hungary

Geological mapping on the Balaton Highland with complex geophysical methods

Istvan Bona

Eötvös Loránd University, Budapest, Hungary

Geotourism potential of Fejér County

Nikolett Csorvási

Eötvös Loránd University, Budapest, Hungary

Promoting HC-reservoir production with model investigations on natural and artificially consolidated cores

Roland Dócs, Gyula Varga, Ágnes Fiser-Nagy

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

Feeding preference of Late Cretaceous lizards from Iharkút (Bakony Mountains, Hungary) based on the use of extant analogues

Kinga Gere¹, Attila Ősi¹, László Makádi²

¹Department of Paleontology, Eötvös Loránd University, ²Mining and Geological Survey of Hungary

Preliminary analysis of heterogeneous fault-slip systems in the Felnémet limestone quarry

Gábor Katona

University of Miskolc, Department of Mineralogy and Petrography, Miskolc, Hungary

Structural mapping, well data and stress field analysis in the surroundings of the Nekézseny Thrust Fault, NE Hungary

Éva Oravecz¹, László Fodor^{2,3}, Szilvia Kövér²

¹Eötvös Loránd University, Budapest, ²MTA-ELTE Geological, Geophysical and Space Science Research Group, ³MTA-ELTE Volcanological Research Group

Numerical characterization of multitemporal Sentinel-1 radar imagery for agricultural applications

Vivien Pacskó^{1,2}, Gábor Molná^{1,3}, Zoltán Friedl^{1,2}, Gizella Nádor², Mátyás Rada², György Surek²

¹ELTE Eötvös Loránd University, Hungary, ²Government Office of the Capital City Budapest Department of Geodesy Remote Sensing and Land Offices Directorate of Remote Sensing and Satellite Geodesy, ³MTA-ELTE Geological, Geophysical and Space Sciences Research Group, Hungarian Academy of Sciences at Eötvös University

Preliminary observations on low-temperature shearing and folding of Middle Jurassic siliciclastic formations, SW Bükk, Hungary

Benjamin Scherman¹, Melinda Fialowski¹, László Fodor^{1,2}, Szilvia Kövér¹, Martin Reiser³

¹MTA-ELTE Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences at Eötvös University, ²MTA-ELTE Volcanology Research Group of the Hungarian Academy of Sciences, ³Geological Survey of Austria, Wien

Cross-section restoration of the Zagyva-through, Northern Hungary: possibilities and limits of the extensional balancing in the Pannonian basin

Balázs Soós

MOL Group Exploration CEE & CIS

Numerical modeling of three-electrode laterolog borehole tool with basic geologic situations

Márk Szijártó, László Balázs, Dezső Drahos, Attila Galsa

Eötvös Loránd University, Department of Geophysics and Space Science, Budapest

14⁰⁰-15¹⁵ LUNCH BREAK

15¹⁵-16⁵⁰ 3RD SESSION

15¹⁵ *An Extended Kalman Filter for attitude and position estimation of drones*

T **Ádám Domján**
MinGeo Ltd., Budapest, Hungary

15³⁰ *Petroleum systems analysis of north-eastern Great Hungarian Plain based on simulation results of a 2D numerical model*

A **Zsófia Harold**
Department of Physical and Applied Geology, Eötvös Loránd University

15⁴⁵ *The role of conductivity in GPR wave propagation velocity estimation*

T **Endre Nádas**
University of Miskolc, Miskolc, Hungary

16⁰⁰ *How to use sensitivity and loadability assessment reports for groundwater flow system evaluation?*

A **Zsóka Szabó, Judit Mádl-Szőnyi**
Erzsébet and József Tóth Endowed Hydrogeology Chair, Department of Physical and Applied Geology, Eötvös Loránd University, Budapest

16¹⁵ *Water-rock-gas interactions in geothermal systems at the Great Hungarian Plain*

A **Tamás Kerékgyártó, Nóra Gál, Teodóra Szőcs**
Mining and Geological Survey of Hungary

16³⁰ **DISCUSSION**

16⁵⁰-17⁰⁵ **BREAK**

17⁰⁵ *Silicate melt inclusions and H isotope compositions of amphiboles recording quartzite-basanite interaction processes in the Bulhary(Bolgárom) maar, Nógrád-Gömör Volcanic Field*

T **Thomas Pieter Lange**¹, Tamás Sági¹, Attila Demény², Márta Berkesi^{1,3}, László E. Aradi^{1,3}, Sándor Józsa¹

¹Department of Petrology and Geochemistry, Institute of Geography and Earth Sciences, Eötvös Loránd University, ²Institute for Geological and Geochemical Research, RCAES, Hungarian Academy of Sciences, ³Lithosphere Fluid Research Lab, Eötvös Loránd University

17²⁰ *Identification of carboniferous rocks based on rock physics properties and seismic attribute analysis*

A **Dávid Holló**

MOL Group, E&P Development Geosciences

17³⁵ *Hierarchical cluster analysis and multiple event relocation of Hungarian seismic event clusters between 2000 and 2016*

T **Barbara Czece**¹, Bálint Süle², Gábor Timár¹, István Bondár²

¹Eötvös Loránd University, Department of Geophysics and Space Science, Budapest, Hungary, ²Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences

17⁵⁰ *New results of the Mid-Hungarian Tectonics Zone based on seismic survey and 3D modeling*

T **László Bereczki**^{1,2}, Gábor Markos¹, Balázs Musitz¹, Gyula Maros¹

¹Mining and Geological Survey of Hungary Department of Geological Research, ²Eötvös University Budapest, Department of Geophysics and Space Science

18⁰⁵ *Spatial Correlation Structure of Precipitation Water Stable Isotopes accross the Iberian Peninsula determined by variography*

A **Dániel Erdélyi**

Eötvös Loránd University, Centre for Environmental Sciences, Budapest

18²⁰ *Simulation of the heterogenous nucleation of Mg-bearing calcite from Lake Balaton under controlled conditions*
T **Zsombor Molnár**¹, Tamás Váczi^{1,2}, Ágnes Rostási³, Mihály Pósfai³

¹Eötvös Loránd University, Department of Mineralogy, ²MTA Wigner Research Center, Department of Applied and Nonlinear Optics, ³University of Pannonia, Department of Earth and Environmental Science

18³⁵ DISCUSSION

19⁰⁰-20⁰⁰ POSTER SESSION – discussion

20⁰⁰ DINNER

SATURDAY

CHECK-OUT FROM THE ROOMS

PLEASE LEAVE YOUR ROOM AFTER BREAKFAST, UNTIL 9 O'CLOCK.

9⁰⁰-11⁰⁰ 5TH SESSION

9⁰⁰ *Mobility study of potentially toxic elements from the H2 and H7 waste dumps in the Recsk mining area*

A **Péter Szabó**

Eötvös Loránd University, Department of Petrology and Geochemistry

9¹⁵ *Quantification and visualization of spatial uncertainty of petroleum reservoir models, regarding flow parameters*

T **Mihály Apró**¹, Gergely Dabi²

¹Department of Geology and Paleontology, University of Szeged, ²Department of Mineralogy, Geochemistry and Petrography University of Szeged

9³⁰ *Stable C, O and H isotope composition determination of carbonates from natural CO₂ occurrences*

A **Dóra Cseresznyés**¹, Csilla Király², Zsuzsanna Szabó³

¹Lithosphere Fluid Research Lab, Eötvös University, ²Geographical Institute, Research Centre for Astronomy and Earth Sciences, ³Mining and Geological Survey of Hungary

9⁴⁵ *Pannonian ostracod faunas from Iharosberény-I well, S Hungary*

T Vivien Csoma

Eötvös Loránd University, Department of Palaeontology

10⁰⁰ *Geological and mineralogical characteristics of gold and polymetallic minerals of the mining Maykain “B” deposit (North-east Kazakhstan)*

A Medet Junussov

University of Miskolc, Miskolc, Hungary

10¹⁵ *Corundum trace element studies of samples from Kikeri-tó and Börzsöny Mts.*

T Ákos Kővágó¹, Edit Király², Thomas Pieter Lange¹, Sándor Józsa¹

¹Department of Petrology and Geochemistry Eötvös Loránd University,

²Mining and Geological Survey of Hungary

10³⁰ DISCUSSION

11⁰⁰-11¹⁵ BREAK

11¹⁵-13¹⁵ 6TH SESSION

11¹⁵ *‘Water’ content of quartz-hosted melt inclusions from a silicic Plinian deposit at Bükkalja Volcanic Field*

T Zsófia Pálos¹, Tamás Biró²

¹Lithosphere Fluid Research Lab, Department of Petrology and Geochemistry, Institute of Geography and Earth Sciences, Eötvös Loránd University,

²Department of Physical Geography, Institute of Geography and Earth Sciences, Eötvös Loránd University

11³⁰ *Evaluation of geometrical parameters in the case of structural elements of a deep water submarine fan system (Algyő HC field)*

A Szabolcs Borka

University of Szeged, Department of Geology and Paleontology

- 11⁴⁵ *Mineralogical characterization and genetics of graphite from Dédestapolcsány, Uppony Mts.*
T Livia Majoros
 University of Miskolc, Department of Mineralogy and Petrology
- 12⁰⁰ *Magnetic parameter estimation of archeological object*
A Máté Telek, Péter Steinbach
 Department of Geophysics and Space Science, Eötvös Loránd University
- 12¹⁵ *Modern microseismic monitoring in Hungary*
A Dalma Trosits, Márta Kiszely, Péter Mónus, László Tóth
 GeoRisk Ltd.
- 12³⁰ *Hydrogeophysical characterization of shallow volcanic aquifers around Dangila town, Northwest Ethiopia*
A Mulugeta Fenta^{1,2}, Zelalem Liyew², Adrián Heincz¹, János Szanyi¹
¹Department of Mineralogy, Geochemistry and Petrology, University of Szeged, Szeged, Hungary, ²School of Earth Science, Bahir Dar University, Bahir Dar, Ethiopia
- 12⁴⁵ DISCUSSION
- 13¹⁵-14⁴⁵ LUNCH BREAK
- 15⁰⁰ AWARD GIVING AND CLOSING CEREMONY

ABSTRACTS

1ST SESSION

Integrated stratigraphic results from the Lower Pannonian section of the Guşteriţa clay pit (Transylvanian Basin, Romania)

Dániel Botka^{1,2}

¹Department of Palaeontology, Eötvös Loránd University, Budapest, Hungary

²MOL Group, Budapest, Hungary

Theoretical

Guşteriţa is one of the largest outcrops and one of the most fossiliferous sites of the deep-water Pannonian formations in the Transylvanian Basin, therefore it can be assigned as a key section for the *Congerina banatica* profundal biozone (~11.45–9.6 Ma). In order to fulfil this criterion, different stratigraphic methods (bio-, magneto-, and isotope stratigraphy) were used.

The Wienerberger clay pit and brickyard of Guşteriţa is located at the southern margin of the Transylvanian Basin, in the north-eastern part of Sibiu. The here outcropping thick (~55 metres), high carbonate-bearing (~75%) Pannonian marl has been mined for more than hundred years. Grey laminated and massive silty marl layers and thin very fine cross-laminated sand intercalations are observed in the mine.

Two field trips were taken into the quarry and four sections were studied so far. In October 2015, macrofossils and marl samples for authigenic $^{10}\text{Be}/^9\text{Be}$ isotopic measurements were collected from the lower, middle, and upper parts of the mine (Guşteriţa 1, 2, and 3). Later, in June 2017, the uppermost 25 metres of the quarry (Guşteriţa 4) was sampled for macro- and microfossils, and a detailed magnetostratigraphic investigation was carried out as well.

The Early Pannonian macrofauna of the locality was examined by some earlier authors, but their faunal lists contain relatively low number of taxa. The first is connected to Koch [2], which consists of only three mollusc taxa. The latest and longest faunal list of Lubenescu [3] can be found in her monography with nine mollusc taxa. My detailed taxonomic study demonstrated altogether

22 mollusc taxa, with 13 genera and 18 species pointing to brackish-water deep-lacustrine environment. According to the biozonation of Botka et al. [1], all the four studied sections can be assigned into the *Undulotheca rotundata* lineage subzone of the *C. banatica* assemblage zone (~11.0–10.2 Ma).

The authigenic $^{10}\text{Be}/^9\text{Be}$ isotopic dating method was successfully applied by Šujan et al. [4] on the Pannonian clayey sediments of the Danube Basin. Three samples were taken from different part of the Gușterița section for tentative measurements, which were made in the CEREGE of Aix-en-Provence, France. The calculated age data were a little older than the expected, therefore an age calibration was necessary related to the $^{40}\text{Ar}/^{39}\text{Ar}$ age of the Oarba de Mureș tuff (Sarmatian–Pannonian boundary, 11.62 ± 0.12 Ma) [5].

Up to now, there was no magnetostratigraphic section with biostratigraphic control from the *C. banatica* biozone of the Pannonian of the Transylvanian Basin. From the Gușterița 4 section, two types of magnetostratigraphic measurements (thermal demagnetization and alternating field demagnetization) were performed in the Paleomagnetic Laboratory of Utrecht, the Netherlands. All the relevant results showed normal polarity for the entire section, but based on biostratigraphic considerations, the section can be placed in the C5n.2n magnetic chron (11.056–9.984 Ma).

The research was funded by the Hungarian National Research, Development and Innovation Office (NKFIH – 116618).

- [1] Botka, D., Magyar, I., Šujan, M., Braucher, R. (2017): Stratigraphic research of the Lower Pannonian (Upper Miocene) of the Transylvanian Basin (Romania): New biostratigraphic and authigenic $^{10}\text{Be}/^9\text{Be}$ isotopic data. *Book of Abstracts of the 15th Congress of the RCMNS*, p. 133.
- [2] Koch, A. (1876): Adalékok Erdély geológiájához. V. A cerithium- és congeria-rétegek elterjedéséhez Erdélyben. *Erdélyi Múzeum* **3(9)**, pp. 152–159.
- [3] Lubenescu, V. (1981): Upper Neogene biostratigraphy of the South-West Transylvania. *Anuarul Institutului de Geologie și Geofizică București* **58**, pp. 123–202.
- [4] Šujan, M., Braucher, R., Kovác, M., Bourlès, D. L., Rybár, S., Guillou, V., Hudácková, N. (2016): Application of the authigenic $^{10}\text{Be}/^9\text{Be}$ dating method to Late Miocene–Pliocene sequences in the northern Danube Basin (Pannonian Basin System): Confirmation of heterochronous evolution of sedimentary environments. *Global and Planetary Change* **137**, pp. 35–53.
- [5] Vasiliev, I., de Leeuw, A., Filipescu, S., Krijgsman, W., Kuiper, K., Stoica, M., Briceag, A. (2010): The age of the Sarmatian–Pannonian transition in the Transylvanian Basin (Central Paratethys). *Palaeogeography, Palaeoclimatology, Palaeoecology* **297**, pp. 54–69.

***C/O logging case study from Hungarian oil industry – determine
water saturation in cased holes***

András Szendrei, Nándor Szegedi

MOL Plc.

Applied

Reservoir monitoring in a field with decades of production history is a great challenge. Reservoir depletion, water injection, etc. all change the conditions. Moreover, in our study area the formation water salinity is only 5000 ppm (parts per million), thus tools, which measure the rate of thermal neutron absorption cannot accurately differentiate between oil and water. For example, the TDT Dual-Burst Thermal Decay Time tool needs at least 35000 ppm, constant and known water salinity [1]. But determining the current water and hydrocarbon saturations in cased holes, even under difficult well completion (through tubing, casing and cement), is still possible, with pulsed neutron spectroscopy, carbon/oxygen (C/O) measurements.

In open hole log analysis, saturation evaluation is based on resistivity measurements and known formation water resistivity. Formation resistivity determination behind steel casing is yet possible, via measuring small leakage currents (e.g. Schlumberger's CHFR tool), but water salinity is possibly altered by water injection. Thus, saturation monitoring in cased holes has to rely on radioactive measurements.

Pulsed Neutron Spectroscopy (PNS) tools use neutron generators to emit high energy neutrons, which collide with the elements that are present in the formation and produce characteristic gamma rays. Count rates on specific energy levels are related to the relative abundance of elements. Two of the most important elements, determined in the inelastic neutron scattering spectrum, are carbon and oxygen, because they can be used to compute hydrocarbon volumes, regardless of formation water salinity.

MOL utilized several RPMTM (Reservoir Performance Monitor, by Baker Hughes [2]) logging campaigns in Algyő field, between 2003 and 2008, to determine actual water saturations and gas contacts, in chosen reservoirs. A second objective was to locate bypassed hydrocarbons to aid the planning and selection of drilling targets for subsequent horizontal well drilling programs [3]. A third objective

was to enhance reservoir description through updated lithology identification. In 2016, after eight absent years, another surveillance C/O logging program was carried out. Our study introduces the results of the restarted campaigns, from 2016 and 2017, when altogether 29 wells were investigated.

C/O measurement is affected by the lithology present. In the case of this field the main lithology is sand / shale sequences, but there are also zones of high calcite content in almost all of the wells, as well as relatively thin layers of coal. Thus, when available, RPM analysis and interpretation required continuous revisions with petrophysical analysis, before getting the best coherent solution.

For three phase saturation analysis, GasView mode (PNC - pulsed neutron capture) was also used, because the C/O measurement is not by itself able to distinguish gas from oil. In the PNC logging mode, the detectors record the arrival time of the gamma rays, from which the thermal neutron absorption cross section is determined.

In addition to open hole petrophysical interpretation, basic reservoir and production information, well completion schematics and basic cement evaluation information was provided for each of the wells, to aid in setting parameters for the tool response models.

- [1] Adolph, B. et al. (1994): Saturation Monitoring With the RST Reservoir Saturation Tool. *Schlumberger, Oilfield Review*, vol. 6. p.: 29-39.
- [2] Baker Hughes (2018): RPM brochure [online] <https://www.bakerhughes.com>, Available at: https://assets.www.bakerhughes.com/system/17f32f7dc62a0f43da06eaab2d4a1ca7_30103-rpm_brochure-0810.pdf [Accessed 21 Feb. 2018].
- [3] Pipicz, V. et al. (2005): Case Study of Integrated Solutions Used to Locate and Extract Bypassed Hydrocarbons in the Mature Reservoirs of the Algyő Field, Hungary. *Paper SPE 96407, presented at Offshore Europe 2005 held in Aberdeen, Scotland, U.K., 6–9 Sept. 2005.*

The interaction of basin-scale topography-driven groundwater flow and free thermal convection

Márk Szijártó^{1,3}, Attila Galsa¹, Ádám Tóth^{2,3}, Judit Mádl-Szőnyi^{2,3}

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Theoretical

Based on earlier conception water table variation, was suggested as the unique driving force of regional groundwater motion [1]. Since that time it has been perceived, that density change by heat transfer can induce significant groundwater flow, too. Foremost, *Lapwood* [2] proved analytically the existence of thermal convection in a two-dimensional, horizontally infinite porous medium with permeable upper boundary, when the Rayleigh number exceeds the critical value, $Ra > Ra_{cr} = 27.1$. Although *Domenico and Palciauskas* [3] investigated the relationship between the topography-driven forced and the buoyancy-driven free thermal convection in their pioneering study, they focused only on the importance of forced thermal convection, while the effect of buoyancy was neglected. Recognizing the significance of free thermal convection, for instance, *Cserepes and Lenkey* [4] have been studied the flow pattern as a function of the slope of the topography ($\gamma < 0.1^\circ$) and the Rayleigh number ($Ra < 160$).

In the present study, the combined effect of the forced and the free thermal convection was investigated numerically on the groundwater flow pattern and the temperature field. A two-dimensional homogeneous, isotropic unit basin [5] with constant slope ($\gamma = 1^\circ$) was applied to focus on the physics of the phenomenon. The temperature difference was increased from $\Delta T = 0$ to 150°C between the bottom and the surface of the basin with a thickness of 3 km. This covers the values of $Ra = 0\text{--}3244$ including transition from stationary, forced convection dominated state ($\Delta T < 60^\circ\text{C}$, $Ra < 929$) to time-dependent, quasi-stationary or weekly chaotic, free convection dominated state ($\Delta T > 60^\circ\text{C}$, $Ra > 929$). In order to understand the quasi-periodic behavior of the flow, time series analysis was carried out on the calculated parameters. The increase in ΔT intensifies the ground water flow, heats the basin up and substantially modifies the hydraulic head, inducing both over- and underpressure near and within

the thermal plumes. Additionally, a higher value of ΔT increases the relative area of the basin by up to 40% where thermal convection influences the head. The locations where the hydraulic head is significantly affected by free thermal convection are to be found (1) within and around the plume beneath the recharge area, (2) in the deeper parts of the midline zone, and (3) over the majority of the discharge area. For $\Delta T \geq 60$ °C the head maximum is located at the bottom of the basin, where it acts to separate the local downflow, as a moving divergent stagnation point. This simulation draws attention to the relevance and importance of the combined effect of forced and free thermal convection in basin-scale groundwater flow pattern, temperature and hydraulic head distribution (e.g. thermal water and geothermal reservoir research).

- [1] Hubbert, M.K. (1940): The theory of ground-water motion. – *Eos Trans. AGU*, **21**, pp. 648-648.
- [2] Lapwood, E.R. (1948): Convection of a fluid in porous medium. – *Math. Proc.*, **44**, pp. 508-521.
- [3] Domenico, P.A. and Palciauskas, V.V. (1973): Theoretical analysis of forced convective heat transfer in regional ground-water flow. – *GSA Bulletin*, **84**, pp. 3803-3814.
- [4] Cserepes, L. and Lenkey, L. (2004): Forms of hydrothermal and hydraulic flow in a homogeneous unconfined aquifer. – *Geophys. J. Int.*, **158**, pp. 785-797.
- [5] Tóth, J. (1962): A theory of groundwater motion in small drainage basins in central Alberta, Canada. – *J. Geophys. Res.*, **67**, pp. 4375-4387.

Receiver function analysis in the Eastern Alps – Pannonian Basin transition zone

**Dániel Kalmár¹, György Hetényi^{2,3}, Bálint Süle³, István Bondár³,
the AlpArray Working Group**

¹Department of Geophysics and Space Science, Eötvös Loránd University, Budapest, Hungary, ²University of Lausanne, Institute of Earth Sciences, Lausanne, Switzerland, ³Research Center for Astronomy and Earth Sciences, Geodetic and Geophysical Institute, Hungarian Academy of Sciences, Budapest, Hungary
Applied

We perform receiver function analysis to determine a detailed map of the crust-mantle boundary and the crustal velocity structure of the transition zone between the Eastern Alps and the Carpathian Basin. We use data from the AlpArray temporary seismic network, the permanent stations of the Hungarian National Seismological network,

stations of a private network operated by Georisk Ltd. as well as permanent seismological stations in the neighbouring countries for the time period between 2002 and 2017. Altogether some 150 seismological stations are used in the analysis. Owing to the dense station coverage we can achieve so far unprecedented resolution, thus extending our previous work on the region. We apply three different quality assurance procedures for the waveforms and the obtained receiver functions. Receiver functions are calculated by the iterative time domain deconvolution approach. We present the quality controlled P receiver functions (radial and transversal component) and preliminary results for the Moho map obtained by H-K analysis. We also compare our results to previous active and passive seismological results in terms of Moho depth and crustal velocities.

Exploration of Keresztes-halom

András Virók

Theoretical

During my researches I investigate the subsoil with shallow-depth geoelectric sounding / VES method. The content of my current presentation is ***my exploration of the bygone of Hungary*** (measured in human time). There are many things that help to get know the past, but most of them are hidden beneath the ground. There is a chance to explore indirectly what stories have the time gone by, but these investments require huge earthworks.

The kurgans has been part of my life since my childhood, that is why I made a decision to find out one of the kurgans which I hold very close to my heart, called Keresztes-halom. Based on our current knowledge there are 1692 kurgans in Hungary, 538 of them placed in Békés County.

The Keresztes-halom is on the boundary of Gyula and Szabadkígyós, 50-60 meters away to Southwest from the road Number 4433 (from Békéscsaba to Kétegyháza). On the top of the mound there is a trigonometrical point. Its relative height is 3 meters, the diameter is about 40-50 meters.

During reconnaissances Imre Szatmári and his company discovered a settlement from the Age of Árpád in the kurgan's

immediate vicinity in the fall of 1991. A partial exploration has taken place in the area, which revealed that there was a church on the mound. This single nave church was 14 meter long, 8.15 meter wide with semicircular termination to the sanctuary and had Southeast 14°-Northwest 46° orientation.

The result of measurements is a spatial model of the area around the church and mapping of the foundation of the church. The aim of the research is to explore the mounds in Hungary and to protect them further.

2ND SESSION

A systematic dependence of acoustic velocity on internal pore structure

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Applied

In spite of extensive research on relating acoustic velocity in porous rocks to porosity and permeability of the rocks, it has remained a lack of understanding on how those properties are significantly controlled by internal pore structure. It is in fact well known that rock permeability is determined not only porosity but also geometric details of the pore system. It is thus expected that acoustic velocity should be strongly influenced by the textural properties of rocks. The purpose of this study is to present results of a study on the relation of acoustic velocity to internal pore structure, porosity, and permeability.

The approach used was to utilize Kozeny equation as presently it is the only one that accounts almost all pore geometric details in determining rock permeability. Re-arrangement made on Kozeny equation leads to rock grouping on the basis of pore structure similarity, similar in the value of Kozeny constant. This constant is multiplication of pore shape factor F_s and tortuosity τ . The specific internal surface area S_b plays a role as a parametric variable for a given rock group. This method of rock grouping enables one to

investigate the main influential factors that systematically control acoustic velocity in porous rocks.

This study employs two types of lithology, sandstone and carbonate. There were 43 and 120 laboratory core analysis data sets of P-wave velocity V_p , porosity ϕ , and permeability k available, respectively, for the sandstone and carbonate from several formations in the Middle East, Southeast Asia, and Australia [1, 2]. Implementation of the rock grouping technique to the plugs results in several rock groups for each lithology. Each group has its own Kozeny constant. Based on the needed data available, the relations of V_p versus ϕ , k , $(k/\phi)^{0.5}$, or (k/ϕ^3) were constructed. The important finding is that each relation among the rock groups of each lithology are clearly separated. V_p tends to be high with an increase in Kozeny constant. However, for a given ϕ for all the groups, V_p increases remarkably with a decrease in Kozeny constant. These all mean that V_p increases with either an increase in the complexity of pore systems or, at the same pore complexity, a decrease in specific internal surface area.

Further analysis made on either $V_p - (k/\phi)^{0.5}$ or $V_p - (k/\phi^3)$ relation has resulted in a method for estimating matrix V_p . Reliable results are obtained for the sandstone and the carbonate samples. In conclusion, this work improves the knowledge about the effect of internal pore structure on V_p . Kozeny constant systematically controls the relation of V_p to ϕ and k . The developed method and analysis can be implemented in an arbitrary well having sonic logging data to determine the matrix V_p at the reservoir conditions. For the surrounding wells with no sonic log data, it is possible to generate V_p versus depth once results of the well log analysis provide k and ϕ values needed.

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3D geophysical model of the Danube Basin based on gravity modelling

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Theoretical

The Pannonian back-arc system of Central Europe was affected by large amounts of Miocene extension controlled by subduction rollback that took place in the Carpathians and Dinarides. One of its largest sub-basins, the Danube Basin, is located at the transition zone between the Eastern Alps, Carpathians and the central parts of the Pannonian basin. Back-arc extension resulted in asymmetric crustal and lithospheric thinning, subsidence and accompanied by kilometres of syn- and post-rift sedimentary sequences. Gravity modelling has been carried out in the Danube Basin applying the Oasis-Montaj software in order to refine and connect the brittle upper and ductile lower crustal structures. The modelling is constrained by the interpretation of a dense network of seismic and well data and compared by recent thermo-mechanical basin modelling results [1].

Half-graben geometries are well observed in seismic sections, while the deeper structures are more uncertain and therefore their interpretation required a joint seismic and gravity modelling approach. The gravity forward modelling software allows us to interactively change geometries, depths and lithology-density units; therefore different modelling scenarios can be tested and evaluated. An initial Moho surface and lower crustal geometry were used as a first approximation [2]. This initial model was followed by a series of parameter tests. The final seismic interpretation and gravity modelling results infer 2 km post-rift and 1.5 km syn-rift sedimentary column overlaying an average 15 km of crystalline basement. The asymmetric geometries of the highly thinned brittle upper and ductile lower crust are comparable with observations from other highly thinned back-arc basins.

This project was supported through the New National Excellence Program of the Ministry of Human Capacities.

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Research of springs around Esztergom

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Applied

Springs are discharge features of groundwater flow at the terminal area of flow systems. Temporal changes of the springs' parameters (e.g. temperature, dissolved solid content, discharge amount) provide important information about groundwater flow systems and rock-water interactions along the flow path [1] [2].

The aim of my research is to examine the hydrogeological environment of my hometown, Esztergom with the help of the springs in that area.

First of all, I have defined the border of drainage basin that includes the surroundings of Esztergom. I have selected, summarized and evaluated the data of springs from registers [3] [4]. Afterwards, I have tried to find the springs on the field. I have recorded the characteristics of the springs' environment and measured the field parameters on the spot (temperature, pH, ORP, dissolved oxygen, electric conductivity, discharge, CO₂ content). I have collected water samples and analysed them in laboratory for the main components (HCO₃⁻, Cl⁻, Ca²⁺, Mg²⁺, Na⁺, K⁺, SO₄²⁻). Finally, I have compared my results with the data of spring registers.

As my further research plan, I would like to take monthly repeated measurements, examine the changes and try to explain their causes.

As part of the cooperation between József and Erzsébet Tóth Endowed Hydrogeology Chair (ELTE, Department of Physical and Applied Geology) and the Ministry of Agriculture, my research broadens and actualizes the database of the Hungarian spring register.

My research is supported by the ÚNKP-17-1 New National Excellence Program of the Ministry of Human Capacities.

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***Evidences of magma mixing/mingling in syenites of the
Ditrău Alkaline Massif***

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Theoretical

The Ditrău Alkaline Massif [DAM] located in the Eastern Carpathians is a Mesozoic igneous complex which was formed during an extensional event of the Alpine evolution associated with continental rifting. Structurally, it belongs to the Bucovinian Nappe System and is in direct contact with four of its Pre-Alpine terranes [1]. A wide range of rock types can be observed: ultramafic and mafic cumulates, alkali gabbros, alkali diorites, monzodiorites, monzonites, monzosyenites, syenites, nepheline syenites, quartz syenites and alkali granites.

The petrography of syenites has formed part of previous petrological studies (eg. [1] [2]) and different hypotheses have been made on their petrogenesis. According to Morogan et al. [2] the syenites were emplaced during a two-stage intrusion event of the same magma source involving episodes of mixing. Pál-Molnár [1] assumed that the granites, hornblendites, nepheline syenites and syenites were cogenetic but the syenites originated from a different magma source.

A recent, more detailed petrographic investigation on syenites reveals new textural evidences of magma mixing/mingling which cannot be observed on field or in macro-scale studies.

The syenite host rock is composed of alkali feldspar (67–81 vol%), plagioclase (18–26 vol%) and accessory minerals (0–4 vol%),

the quantity of mafic constituents is negligible (0–1 vol%). Perthitic and antiperthitic texture of feldspars are common. Inclusion-rich cores of feldspars are commonly mantled by inclusion-free zones. They are variably sericitised. Two generations of apatites can be recognised based on texture: 1. prismatic and 2. acicular.

Mafic clots with irregular boundaries form ca. 12 vol% of the studied rocks and are 375–4750 μm in size. The clots occur sporadically or form groups, sometimes they are oriented. The most common minerals of the mafic clots are euhedral–subhedral amphibole (4–80 vol%), subhedral biotite (14–59 vol%), anhedral clinopyroxene (0–7 vol%), subhedral alkali feldspar (1–14 vol%), plagioclase (1–6 vol%), euhedral accessories (0–18 vol%) of apatite (100–350 μm), zircon (100–300 μm) and titanite (100–1500 μm) and opaque minerals (1–18 vol%). Occasionally, amphibole (250–3500 μm) is zoned and includes feldspar crystals, accessory and opaque minerals. Some show biotite alteration. Biotite (900–4500 μm) commonly encloses apatite, titanite, zircon and opaque minerals and marginally chloritised. Green clinopyroxene crystals (660–800 μm) and crystal relicts (80–150 μm) are always enclosed in amphibole macrocrysts and partly decomposed to secondary amphibole.

The mafic clots are evidences of magma mixing and mingling. They represent a discrete portion of a magma occurring within a compositionally different host magma. The presence of two different generations of apatite is also a consequence of magma mixing. Prismatic apatite is formed during the early crystallisation of a fractionated magma, whilst the origin of acicular ones can be attributed to quenching. Formation of inclusion-free zones of feldspar crystals can be interpreted by the interaction of different melts. The formerly grown crystals react to changes in temperature and melt composition. The partly resorbed crystals act as nuclei which are overgrown by a compositionally different new zone.

The green pyroxene crystals are compositionally similar to those found in diorites, tinguaita dykes and ijolite enclaves. Trace element distribution of the calculated clinopyroxene equilibrium melt strongly differ from the syenite bulk composition. The clinopyroxene antecrysts derive from a distinct magma source and have been recycled into the syenitic magma through magma recharge [3].

Whole-rock chemical and geochronological data of syenites previously considered as homogenous rocks should be reinterpreted and handled carefully because of the different origin of the host rock and the incorporated mafic clots.

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Forecasting karst water level on a former mining area with time series analysis

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Applied

Between 1950 and 1990 in the Transdanubian Central Range, Hungary, artificial water extraction took place, resulting in the drastic drop - in some central locations by tens of meters - of karst water level. In 1990 mining was stopped in the area, along with water extraction; as a result, the karst water levels began to rise. In this special hydrogeological situation, the forecast of karst water levels is crucial from economic and technical-engineering aspects as well.

The aims of the study were (i) to group the time series based on their patterns, (ii) to assess whether the karst water levels of the Transdanubian Range can be forecast with “classic time series methods”, i.e. trend estimation and forecasting. If the individual forecasts for the wells are successful, then (iii) to determine the spatial relationship between the measured and predicted water levels, and interpolate (krieg) maps of the forecast karst water levels.

Hierarchical cluster analysis was used for the grouping, allowing us to distinguish which time series did, or did not display the effects of the recovery following the cessation of mining, and furthermore, which hydrographs have different temporal patterns. Different groups

were also represented on the karst water level map of the area for 1990, where their spatial separation may be observed with respect to the center of the depression. For a better understanding of the process of recovery, a trend function was sought, which best describes the rise in water levels as a result of the recovery. Therefore, different types of trend function were fitted. The fitted “classical” trend functions (e.g. linear, logarithmic, and polynomial) forecast a water level increase, which cannot occur under normal circumstances. Thus, 10 different types of growth curves were fitted and evaluated based on the R^2 . These functions can be used for processes characterized by initial fast growth, followed by slowing until a threshold is reached. After fitting, the best ones were chosen for forecasting. With this function, the karst water levels in the wells were predicted for January 2020 and January 2025.

As a final step, variogram analysis was performed for the latest measured time horizon (January 2016), and the two forecast time horizons. Spatial correlation has been observed in the forecast karst water levels, therefore they can be used to obtain interpolated (kriged) maps. The most important result of the research was using the logistic trends has the possibility of expanding the number of methods, which can be used in forecasting groundwater levels.

POSTER SESSION

Particle swarm optimization assisted factor analysis as a new tool for lithological characterization of sedimentary rocks

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Poster

For the independent estimation of shale volume, factor analysis can be effectively used on well logging data [1]. In this study, I combine the algorithm of particle swarm optimization (PSO) as a global optimization method with factor analysis to reduce the misfit

between the observed data and the theoretical data calculated directly by the factor model. PSO is a metaheuristic computational approach [2] that is based on the simulation of swarm intelligence, e.g., bird flocking and fish schooling. As in the traditional factor analysis, the factor loadings are estimated by the non-iterative approach suggested by Jöreskog [3] but for the more reliable calculation of the factor scores, I implement the PSO algorithm.

Shale volume of sedimentary formations of different ages can be directly calculated from the factor scores by the same nonlinear regression model. The added advantage of the implementation of the PSO algorithm is that it enables the calculation of the theoretical values of well-logging data, e.g., sonic, electric, nuclear and even the caliper log. The results of the PSO assisted factor analysis is compared and verified by independent estimates of deterministic modeling.

The study shows that the presented globally optimized factor analysis is very stable in the iteration process and provides an independent in-situ estimate for shale volume that may contribute to the further development of the geological model.

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Geological mapping on the Balaton Highland with complex geophysical methods

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Poster

Thousands of geophysical measurements were done by state institutes (ELGI, MÁFI) in the 80' and 90' in several projects. Reevaluating these measurements with the up-to-date methods and new geological mapping knowledge can lead to new results. The basic of this research is also an archive Vertical Electrical Sounding

measurement campaign, completed with new 2D geoelectrical tomography and magnetic measurements.

This study aims the geological mapping and structural research of the Nagyvázsony Basin with the previous mentioned methods. Several cross-sections were set to show the geology of this area. The pre-Cenozoic and the younger formations shows electrical resistivity contrast, so geoelectrical methods can be used to explore the morphology, and the structures. Specific resistivity value was defined for the theoretical strata. Dolomite cones and ridges also could be found in this 55 km² area. Dolinas of karstified Triassic limestone basement was filled out with bauxitic-red clay, the Vöröstói Formation [1]. The basaltic structures were explored based on their magnetic properties in order to define the origin and shapes of these structures. The five cross-sections show the tectonics of the Nagyvázsony Basin. Strike-slips and normal faults can be detected in the borders of the basin. Pull-apart basin evolution is presumable by these results, but to decide it, further measurements, especially seismic survey is needed.

The main outcomes of this study are the following. The geological formations can be separated by their resistivity. The question of the Lóczy's outcrop was clarified. Tectonics and the geological development history of the area were explored. Furthermore, map of the pre-Cenozoic basement was also created which can be the base of further studies.

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Geotourism potential of Fejér County

Nikolett Csorvási

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Poster

To help geotourism development, we should hold data about the geotourism potential of an area and survey the touristic value of geosites. The aim of my previous research [1] was to find the proper methodology to measure geotourism potential and test it to the

Velence Hills and Eastern Bakony. The chosen workflow is similar to Reynard et al. [2]. After collecting the references and maps to an area, I do systematic field work and I set up the preliminary geosite list. The evaluation of these sites is carried out by the Geosite Assessment Model [3].

Since, I have been applying this selected method to other parts of Fejér County to draw the geotourism potential map of the entire area. The work is completed to Balatonfő, Mezőföld and some parts of the Vértes Hills next to Velence Hills and Eastern Bakony so far.

I would like to invite all the enquirers to discuss the results and the possible future actions related to this project.

The research was supported by the New National Excellence Program.

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Promoting HC-reservoir production with model investigations on natural and artificially consolidated cores

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Poster

During the production of any hydrocarbon reservoir, the most important question what needs to be answered is the maximum of the achievable production ratio. The amount of producible oil and or gas highly depends not only the PVT behavior of fluids occupying the pore volume but on many properties regarding the reservoir rock itself. These so-called petrophysical parameters can be determined throughout laboratory measurements, performed on plug samples taken from the reservoir rock. In the knowledge of these properties mathematical models, as well as physical models made from these plug samples, can be used in order to define the value of this ratio.

The most beneficial solution would be implementing both, unfortunately, these measurements require samples of almost identical parameters, further decreasing the sufficient number of plug samples that could be used. In our institute, hundreds of measurements of this kind had been made throughout the years until reaching the point where artificial samples were made in order to proceed with the experiments. In earlier stages, numerous methods were tested giving ineffective results. At present, a new approach was founded where all requirements were met regarding the petrophysical point of view.

On the basis of the literature, one can use various technologies to produce artificial porous media. Different types of skeleton material (e.g.: sand, glass beads, waste glass, stone fragments) and binder material (e.g.: sodium silicate, borosilicate glass, cement, firing clay, resin) are available. The application area of the produced cores determines the proper ingredients. The samples produced by our laboratory should be reservoir sandstone like i.e. mechanically rigid, and medium or strongly water-wet, with desirable petrophysical properties (e.g.: porosity, permeability). In order that purpose cement was chosen for binder material, which is rigid and water-wet. As skeleton material ground and sieved reservoir sand was used to keeping the nearly original mineral composition. The mixture after homogenization was cast into a metal mold by equable compaction after that constant pressure was applied to the samples during curing. In the end of the producing procedure, the raw cores were resting under optimal conditions to strengthen them, so that sufficient durability could be reached. The accurate sample geometry was created by drilling and trimming, this shaping step is necessary to assure perfect fit into the measurement devices.

Results of the performed basic petrophysical measurements (porosity, absolute and effective permeability, connate water saturation) reached satisfactory conditions, giving nearly identical properties as in case of natural samples taken from a sandstone reservoir of Hungarian origin.

In order to investigate the more complex cases (relative permeability, saturation equilibrium points) whereas a minimal of two fluids (oil, water) are present in the pore volume. Water Flooding-tests were performed on natural sandstone, resin consolidated and the newly developed samples by the application of the traditional

displacement method. During these measurements, the aim was to define the initial saturation values corresponding to the reservoir untouched state, and those present at the end of the primary production state. These data are necessary to find that how fluids tend to saturate the pore volume because of wetting conditions between the fluids and the rock material. After the evaluation of Flooding-tests, results of the newly invented cores were more favorable than resin consolidated cores. Showing identical initial and end point saturations for both oil and water taking into consideration the natural samples data.

In the near future, other Flooding-tests will be performed implementing Enhanced Oil Recovery methods in order to find if tertiary productions will also meet similar results.

The research was carried out in the framework of the GINOP-2.3.2-15-2016-00010 "Development of enhanced engineering methods with the aim at utilization of subterranean energy resources" project in the framework of the Széchenyi 2020 Plan, funded by the European Union, co-financed by the European Structural and Investment Funds.

Feeding preference of Late Cretaceous lizards from Iharkút (Bakony Mountains, Hungary) based on the use of extant analogues

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Poster

Paleodiet reconstruction was first applied on mammals. In such studies, tooth morphology, dental macro- and microwear analyses, and the use of extant relatives were the most important tools. Wear pattern analyses have been applied to dinosaurs and other reptiles as well, indicating the applicability of the methods in other vertebrate groups. However, in many aspects significant differences exist between reptilian and mammalian teeth and wear, making these analyses and interpretation more complicated. This is especially true for groups with no extant relatives.

Surprisingly, in lizards, where many fossil groups have extant analogues in terms of dental morphology, and diet, no previous

quantitative analyses on the wear pattern have been performed. Lizard dentitions are often incomplete, they frequently bear a great number of teeth that can be worn or devoid of microwear. Their dentition is generally homodont but a number of species have 'heterodont' dentition. Some species have suppressed tooth replacement and/or mammal-like morphology.

Dental microwear analyses quantificate and compare different types of microwear features resulting from the abrasion of the dental surface that is caused by the consumption and mastification of food during the final stages of the lifecycle of a vertebrate. The diet of extant species is well-known and using wear pattern analysis in extant and extinct species, we can infer the paleodiet of an extinct species.

Iharkút is an Upper Cretaceous (Santonian) terrestrial vertebrate locality in the Bakony Mountains, Hungary, providing rich (>60,000 specimens) and diverse (>35 species) vertebrate assemblage. So far, seven different lizard species have been reported from here. Their fossils mostly came from a single fossiliferous bed suggesting that they lived in the same terrestrial habitat at the same time. However, they exhibit markedly different tooth morphology suggesting different food preference of these small-bodied land vertebrates. The aim of the present study is to reveal the type of consumed food of these animals and to demonstrate any differences in their feeding ecology with focus on possible dietary niche partitioning.

Three small lizard species from Iharkút had sufficiently well-preserved specimens to produce wear pattern details: *Bicuspidon* aff. *hatzegiensis*, *Chromatogenys tiliquoides* and 'Scincomorpha indet. A', all excavated from the main bone-bearing bed. For comparison, 15 recent species, including varanids (*Varanus niloticus*), teiids (*Tupinambis teguixin*, *Dicrodon guttulatum*, *Dracaena guianensis*, *Cnemidophorus* sp.) and scincids (*Tiliqua scincoides*, *T. nigrolutea* and *T. gigas*) have been sampled for comparative wear studies. The analyses included examination of tooth morphology, as well as morphological and statistical comparison of the dental macro- and microwear features. SEM imaging and Microware 4.02 software analysis of the worn surfaces were applied to detect wear features.

The bicuspid posterior teeth of *Bicuspidon* are morphologically similar to the molariform teeth of *Dicrodon*, with the 50% of pit-scratch ratio in both taxa. *Dicrodon* is a specialized herbivore,

consuming dominantly fruits and leaves. Based on the similar morphology and microwear pattern of the specialized herbivore *Dicrodon* and the *Bicuspidon*, we can assume that this most frequent element of the terrestrial squamate fauna at Iharkút could have also been herbivorous. These results also support previous similar hypotheses for related genera such as *Polyglyphanodon*.

Chromatogenys posterior teeth are globular, similar to the extant *Dracaena*, *Tupinambis*, *Tiliqua* and *Varanus niloticus*. The fossil form has a strongly worn crown ornamented dominantly by pits (83-95%), but the most of the extant genera have more scratches (up to 50%) and less worn crowns. *Dracaena* is the most similar with its intensely brushed crushing teeth. While *Tupinambis*, *Tiliqua* and *Varanus niloticus* are generalized opportunistic feeders, consuming insects, snails, small vertebrates and various fruits or seeds, *Dracaena* is molluscivorous, suggesting that *Chromatogenys* was also a specialized durophagous form.

The third fossil taxon, 'Scincomorpha indet. A' has dominantly scratches on its teeth (>92%), which are morphologically look like of *Cnemidophorus*. However in this extant forms pits can be more abundant (<30%). *Cnemidophorus* consumes various insects in the highest proportion, suggesting a similar insectivorous diet for 'Scincomorpha indet. A'.

Our preliminary results suggest differences in the feeding ecology of these Iharkút lizards. They lived in the same environment, this might have helped them co-exist by the means of dietary niche partitioning. This can provide us further insight into the complexity of food chains of the Late Cretaceous Iharkút land communities.

Preliminary analysis of heterogeneous fault-slip systems in the Felnémet limestone quarry

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Hungary
Poster

The Berva limestone quarry is located at Felnémet, in the Southwest part of the Bükk Mts. It was the site of my observations,

where I carried out my structural measurements. The area of the quarry is 0,3 km². The quarry exposes Triassic platform limestone of cyclic lagoonal facies. Fortunately, this quarry is still active, so deformational features are observable at the active walls, and movement indicators also are preserved on the abandoned walls.

I measured and used 200 orientation data representing fractures and faults as well. Most important of these are the data on striated faults, because these were used for paleostress inversion.

I recorded the geographic location of all measurements by GPS. It was used for studying spatial relationships between the faults which belong to the same phase.

I separated the movement phases with the Win TENSOR program [1]. I applied the improved right dihedral inversion method with rotational optimization method to determine reduced stress tensors of all phases. The combination of the two methods provided an opportunity to make dynamic separation of fault slip sets.

I also used 30 bedding data measured by Felicitász Velledits [2]. At the upper level of the quarry the bedding can be followed easily. Sometimes we find here some fossil rich layers (Megalodus, reef corals etc.) with synsediment vein fillings.

Minimum four faults with slip direction are required to run rotational optimization method. The result of the improved right dihedral method gives the input data, this tensor is rotated around the principal stress axes. Rotational angle is calculated by the minimum value of the misfit function. In the first run we can rotate with high angles ($\pm 45^\circ$), then the routine continuously decreases the rotation angle until the weight average misfit between observed and modelled slip direction decreases and gets finally stabilized. The result image shows the position of principal stress axes, stress regime index (R'), misfit angle, fault plane with sense and number of datas.

The two preformed extensional joint sets related to folding, typical in the ductilely deformed limestone bodies of the Bükk, were not observed here. Bedding surfaces were activated as movement plane in some cases. After processing 85 fault slip data with the right dihedral and the rotational optimization methods, 5 different phases (A-B-C-D-E) were separated.

Unfortunately, only two faults preserved two different sets of slickenlines. Overprinting relationships of these prove that Phase D is older than C.

I compared the results with the previously published articles which deal with similar phase separation and determination of paleostress fields in the Bükk area. Németh [3] based his system on data from the Eastern part of the Bükk Mts. Márton and Fodor [4] combined paleomagnetic (from igneous rocks) and stress data from the Southern foreland of the Bükk Mts. Relative ages of the phases A-E were based on kinematic similarity with the phases published by these studies.

The spatial distribution of the faults belonging to each phases show that the limestone exposed by mining activity was intensively and penetratively deformed. We can't delineate discrete fault zones across the quarry. Probably a network of the conjugate faults supported small scale displacement along each fault plane.

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Structural mapping, well data and stress field analysis in the surroundings of the Nekézseny Thrust Fault, NE Hungary

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Poster

The Bükk and Uppony Mts. located in NE Hungary are two adjacent structural units with different origins: while the nappes of the Bükk Mts. once formed part of the Inner Dinaric nappe system, the Uppony Mts. are correlated with the Western Carpathians [1]. The mainly S-SW-vergent Bükk and N-NW-vergent Uppony Units are separated by the Nekézseny Thrust Fault along which the Bükk-type

Permomesozoic formations are thrust upon the Uppony-type Paleozoic and Senonian formations [2].

Despite of its obvious structural importance, the structural evolution of the Nekézseny Thrust Fault hasn't been studied in details. The possible timing of its movements is between the Senonian and the Early Miocene. In their preliminary structural study Fodor et al. (2005) interpreted the results in the lights of the Paleogene deformation of the Darnó Deformation Zone [3]. On the other hand, based on paleogeographic considerations Schmid et al. (2008) consider the Nekézseny Thrust Fault as the suture zone of the Meliata Ocean thus assume that the age of this structural contact is Early Cretaceous [1].

Consequently, the aim of our study was to understand the deformation geometry and the timing of activity along the Nekézseny Thrust Fault. As part of the study core samples from boreholes that drilled through the supposed structural contact were reviewed, sampled and interpreted. Detailed structural mapping in the surroundings of the Nekézseny Thrust Fault was followed by stress field analysis and preparation of cross-sections.

According to our preliminary results, at least five tectonic phases could be separated. Field work in the gently folded Senonian Nekézseny Conglomerate revealed both pre- and post-tilt low-angle thrust faults. While the pre-tilt thrust faults are clearly the results of NW-SE compression (D1), the post-tilt thrust faults can be separated into three groups that show slightly different N-S, NW-SE and E-W compression (D2). These deviations from the general NW-SE post-tilt compression only appear immediately at the Nekézseny Thrust Fault. The tilting itself is connected to NW-SE compression as well. The subsequent three deformation phases are connected to the later rotational events and extensional deformation history of the Pannonian Basin (D3: Early Miocene NNE-SSW extension, D4: Middle Miocene E-W extension, D5: Late Miocene—Pliocene NW-SE extension) [3] [4]. All this may contribute to understanding not only the deformation history of the Nekézseny Thrust Fault, but the role of the Darnó Deformation Zone during the Mesozoic structural evolution of the area.

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Numerical characterization of multitemporal Sentinel-1 radar imagery for agricultural applications

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Poster

In radar remote sensing ‘polarimetric descriptors’ are the counterpart of reflectance-derived spectral indices in multispectral imagery. The time-series of polarimetric descriptors (also known as phenological profiles) are expected to perform as well as for vegetation characterization and classification as multitemporal satellite imagery.

The intent of my study is to analyse which polarimetric descriptor’s phenological profile shows significant difference between different types of crops and so might be suitable for classification of crop types.

The selected study area is the surroundings of Lake Tisza, Hungary, having different types of crops (e.g. maize, sunflower, rapeseed, etc.) as land cover. Polarimetric descriptors were generated

based on H/A/Alpha decomposition of covariance matrix of Sentinel-1 dual-pol (VV+VH) images. Time series were made from the followings: alpha and its components, anisotropy, eigenvalues of covariance matrix, Shannon entropy and its components.

Studying the numerical characteristics of these profiles could be one important part of the identification of crop types in a further development.

My current study is supported by the ÚNKP-17-2 New National Excellence Program of the Ministry of Human Capacities.

Preliminary observations on low-temperature shearing and folding of Middle Jurassic siliciclastic formations, SW Bükk, Hungary

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Poster

The Bükk Mountains in NE Hungary are part of the ALCAPA unit. It was part of the Neotethys passive margin during the Triassic-Jurassic [1] and got to the recent position during Cretaceous-Miocene plate movements. The Bükk Mountains are built up by four units: 1. Parautochthonous Unit; 2. Mónosbél; 3. Szarvaskő, accretional units and 4. Darnó, sub-ophiolitic melange unit. The structure of the Bükk is controversial. One part of scientists' state that the area is a complex nappe system whereas the others believe that it is a continuous sedimentary-magmatic sequence. The aim of this work is to understand the structural differences between the units/nappes and to reconstruct a deformation history. We have done geological mapping, collected mesoscale field structural data, investigated relevant drill cores and collected samples for fission track measurements.

Balla [2] and Csontos [3] postulated that the area composed of similar folding with axial plane foliation, whereas our field observations show shear zones with uneven spatial distribution. By fault-slip analysis we were able to define four different deformational

phases. D1 pre-tilt E-W compression caused thrusting, that often form duplexes with eastern vergency. These thrusts were locally tilted (folded) and show normal shearing in present setting. We also recognized overturned sandstone lenses in shale, which indicate large rotation, possibly within the shear zone. Sigmoidal faults and fault-bend folds are interconnected. D2 NW-SE compression is responsible for the main folding and tilting, shortening direction varies from NNW-SSE to WNW-ESE. D3 and D4 are post-tilt phases. D3 is a post-tilt phase with NNW-SSE compression when the previously tilted layers got sheared by brittle thrusting. NW-vergent back-thrusting associated with kink folding also belong to this phase. D4 post-tilt normal faults sheared the tilted layers; these are related to Miocene extension. New thermochronological data (ZFT) suggest cooling at 134-143 Ma in the Mónosbél unit and 112-114 Ma in the Szarvaskő unit. It indicates thrusting and folding in the D2 phase at 134-143 Ma and folding and thrusting at 112-114 Ma in the D3 phase.

Our study helps understanding the Alp-Carpathian-Dinaridic systems orogenic evolution. For example, the D1 phase is the earliest deformation and might have been connected to first order stacking. These observations give a direction for further researches to be done in the area.

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Cross-section restoration of the Zaggyva-through, Northern Hungary: possibilities and limits of the extensional balancing in the Pannonian basin

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Poster

In this study a kinematic cross-section restoration method was tested the suitability in the Pannonian basin and to measure the rate of stretching of the Zaggyva-through.

One of the main goals and also the biggest challenge of structural geology and plate tectonics is making reliable plate tectonic reconstruction. It is particularly important regarding the Pannonian basin, because research of this area has been making progress in the past few decades.

Pannonian lithosphere plays an important role in structural development researches. Interpretation and calculation of its stretching is crucial to the plate tectonic reconstruction of the Alpine-Carpathian region.

This study supported that complex research from two point of view. One of the main goal of this study was a deeper understanding of kinematic cross-section restoration in the Pannonian basin. The other result was determining the stretching of the upper crust of Zagyva Through, a sub-basin of the Pannonian basin.

For the restoration as a preliminary step, I built a geological model of the Zagyva-through. This part is based on a well and seismic database provided by Mol Plc. During modelling I divided the studied area into three parts based on the structural pattern. The northern area was determined by north-northeast south-southwest trending more or less isolated faults, on the south there were north-northwest south-southeast trending faults and related block-rotation. Between the two areas there is a third, transfer zone with conjugate Mohr-faults.

Based on this geological model two west-east trending cross sections was restored. One of the section is on the north and one on the south zone of the studied area. I restored the cross sections until the Badenien geometry. It is not possible to study the geometry of earlier periods.

On the restored cross-section restoration we can measure different extension between the two sections. On the northern part 8% extension of the cross section occurs, meanwhile the on the southern part 17% can be measured.

Numerical modeling of three-electrode laterolog borehole tool with basic geologic situations

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Poster

Theoretical conception of the focused electric logging system has been presented in the early 1950s by *Owen* and *Greer* [1] in order to reveal high-resistivity permeable layer even in the case of deep invasion by low-resistivity mud filtrate. Although the three-electrode laterolog tool (LL3) was the first application of ‘Laterolog principles’ [2], it has been expansively used in raw material and hydrocarbon exploration owing to excellent vertical resolution and simple electronics. However, during the interpretation procedure the finite geometry of the LL3 electrode system is not taken into account accurately, correlation factors are used from predefined and generalized tables.

In this study, a finite element numerical simulation has been carried out to investigate quantitatively the response of a real LL3 tool on radial and vertical heterogeneity of the strata. In order to calculate the apparent resistivity, the probe coefficient (K_{LL3}) of LL3 tool with finite electrode extent was determined. Two independent methods, a finite element numerical modeling and a semi-analytical solution were applied to define probe coefficient, which resulted in $K_{LL3} \approx 0.15$ m with relative deviation of 2.4% [3]. Later, it was verified with an accredited field testing by Geo-Log Ltd [4]. It was established that LL3 is only slightly sensitive to the presence of mud when the borehole diameter is $d \leq 30$ cm and the ratio of the rock resistivity and the borehole mud is $1 \leq R_t/R_m \leq 1000$. This statement is in accordance with the interpretation of the pseudo-geometrical factor when the borehole diameter is less than 50 cm. Vertical heterogeneity test pointed out that the layer boundaries can be localized exactly even for thin bedded layer (with a thickness of 1 m) and the presence of low-resistivity borehole mud. Simple correction factors were suggested to decrease the biasing effect of the low-resistivity borehole mud and the shoulder beds on the apparent resistivity observed by LL3. Although the penetration depth of LL3 is lower than LL7 (LLD) [5], LL3 is less

sensitive the effect of shoulder beds. Thus, it was verified that the probe has relatively good penetration depth with excellent vertical resolution (and simple electronic control system), what explains the enduring popularity of LL3 tool in well logging.

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3RD SESSION

An Extended Kalman Filter for attitude and position estimation of drones

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Theoretical

The main goal of the presentation is to demonstrate an Extended Kalman Filter (EKF) algorithm to estimate attitude and position from IMU and GPS data of an Unmanned Aerial Vehicles, also known as UAVs or drones.

EKF, which is a modified version of the standard Kalman filter, is a sophisticated estimation technique based on the Bayes' theorem. EKF is sensitive for stochastic noise of input data, therefore as a first step synthetic IMU and GPS data are used for testing.

In the near future the validated EKF will be augmented with stochastic modelling states to cope with real noisy data.

Petroleum systems analysis of north-eastern Great Hungarian Plain based on simulation results of a 2D numerical model

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Applied

The goal of this study was to create a basin and petroleum systems model defined along a regional 2D seismic transect from the Derecske Trough through the Ebes-Hajdúszoboszló High up to Tiszapalkonya depocenter of the Jászság Basin. The project was designed to specify the burial, thermal and maturity histories of the study area, analyse the effective petroleum system elements and processes, the subsurface pressure conditions, as well as the possible migration pathways and predicted hydrocarbon accumulations. Additionally, it examined the sensitivity of the model regarding the key input parameters.

First, the static geological model with formations (i.e. “layers”) and geological ages assigned to them were reconstructed based on various stratigraphic data. The facies honouring both well data and depositional environments typical of Pannonian Basin were assigned on “sub-layer” scale. Then the potential source rocks of the area were identified by taking all the available geochemical data and organofacies dependent kinetic models into consideration. Next, the paleo-water depth maps varying along the modelled section and through geologic time, as well as the lower and upper thermal boundary conditions were defined to describe the burial and thermal histories as accurate as possible. For the lower condition I determined the basal heat flow maps based on the modified McKenzie crustal model for each geologic event assigned to layers. For the upper one I applied the automated SWIT (sediment water interface temperature) tool of PetroMod that reconstructed the plate tectonic locations of the basin and calculated the corresponding temperatures of the sediment-water interface through geological time.

A crucial step in the modelling workflow was the calibration of the simulated trends to measured porosity, pressure, temperature and vitrinite reflectance data in the key wells of the study area. First, I calibrated the porosities in an iterative way, considering pore pressure, as these two parameters are interrelated and impact each other. Then I

calibrated the thermal model to measured vitrinite reflectance values by changing the input parameters of the McKenzie crustal model.

In Tiszapalkonya Sub-basin the sediment influx keeping pace with a significant subsidence during the Early-Middle Miocene resulted in a thick Middle Miocene deep-water sequence. The climax of the subsidence in the Derecske Trough was a little bit later during the Middle Badenian. However, the sedimentation rate could exceed that of the subsidence in the Early Pannonian only.

Two source rock units were determined in each of the two basins. Their maturity histories were examined with different vitrinite reflectance kinetics and their transformation ratios with different petroleum reaction schemes assigned to them. Simulation results did not fit the measured values when the default vitrinite reflectance kinetic model designed for areas of moderate subsidence and hydrostatic pressure was applied. Kinetic models taking the undercompaction due to rapid subsidence and sedimentation into account provided much better matches, thus I demonstrated that the selection of a proper vitrinite reflectance model has a key impact on the simulated thermal history, timing of hydrocarbon generation and hydrocarbon type.

Several source rock kinetic models using the same thermal history and pressure conditions were also compared. The use of different kinetic models may result in different petroleum accumulations, hydrocarbon phases and components, as the maturity of organic matter takes place at different temperatures and time depending on the type of reaction incorporated into the model.

Due to the complex lithology and facies distribution prevalent in Pannonian Basin from the tested migration methods only two provided acceptable results: the Invasion Percolation and the Combined. The latter one handling better the frequent vertical and lateral facies changes as well as the presence of stratigraphic traps proved to be the most appropriate. The FlowPath and Hybrid approaches demanding surface elements did not handle properly the complex facies distributions.

By means of modifying the input data, a model close to geological reality was created, in which I adjusted the formation layers to pressure conditions and compaction trends prevailing in the basin, furthermore the thermal and maturity histories to measured

thermal parameters, and the modelled petroleum accumulations to known hydrocarbon fields.

The role of conductivity in GPR wave propagation velocity estimation

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Theoretical

In GPR (Ground Penetrating Radar) practice, the accurate estimation of the reflection depth is essential in many cases, and the precise calculation of vertical and lateral resolution is also necessary in survey design. This study deals with the accuracy improvement possibilities of these quantities.

The electromagnetic (EM) wave propagation is influenced by the conductivity, relative magnetic permeability and relative dielectric constant of the medium. All of these petrophysical parameters are frequency dependent quantities. The effect of relative magnetic permeability is neglected properly in the GPR data processing routine. The relative permittivity (relative dielectric constant) is the critical parameter in terms of GPR measurements, because it is the main influencer of the wave propagation velocity and the reflection coefficients. In this study, the effect of conductivity was also taken into account in case of different geological media.

In the frequency range of the GPR measurements, the effect of the displacement current plays the main role, because the radar signal is absorbed at high conduction currents. Thus, the method cannot be applied successfully in the presence of clay-rich and water saturated soils. In the industrial practice, the velocity of the radar waves is expressed by the equation for dielectrics. This approximation is acceptable in case of low-conductivity media, but sometimes, GPR sounding should be performed in lower resistivity (10–100 Ωm) environment. These materials behave as lossy media in fact. In this case, based on the equation for dielectrics calculated wave propagation velocities and wavelengths can differ from the real values. These differences are presented and visualized at three typical GPR frequencies (100 MHz, 500 MHz, 1,2 GHz). The wave

propagation characteristics were calculated at specific dielectric constant values ($\epsilon_r = 1; 5; 10; 20; 40; 80$). The vertical resolution calculated for lossy media was compared to the one calculated for dielectrics, too. In GPR survey practice, the wave propagation velocity is an essential parameter in terms of the depth estimation, and the wavelength is important in the survey design, in determination of the vertical and the lateral resolution.

The results show the characteristics of the velocity and wavelength differences clearly. It can be noticed that the relatively low resistivity range (10–100 Ωm) can be significant in terms of GPR practice. Under these conditions, in case of $\epsilon_r = 5\text{--}10$ values and 100 MHz frequency, the relative difference can be 25–50 % between the propagation velocities calculated for dielectric and lossy medium. This can significantly influence the accurate determination of reflection depth.

How to use sensitivity and loadability assessment reports for groundwater flow system evaluation?

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Applied

The Hungarian Office for Mining and Geology (MBFH) brings out complex sensitivity and loadability assessment reports which are the professional base of publishing mining concessions. These reports contain numerous valuable information which offer great opportunity to investigate groundwater flow systems. The first goal of my research was the systematic extraction and application of these information contained in the reports, and completion of them by public and accessible hydraulic, water chemical and temperature data. As a second goal, to develop a methodological proposal for the evaluation of flow system based on the compiled database.

This methodological recommendation was demonstrated for the concession area of Debrecen, based on the evaluation of the elements of hydrogeological environment, groundwater flow regime and water flow induced phenomena. The aim of the hydraulic data evaluation

was to determine the spatial distribution of groundwater flow pattern by compiling pressure vs. elevation profiles, tomographic fluid potential maps and hydraulic cross section. The water chemical and temperature data evaluation could help to further understand the flow systems. Additional analysis of the groundwater flow induced phenomena was carried out by using historical maps made during The First Military Survey (1763-1787), what could support the results of the data evaluation.

As a result I could give a regional overview of the vertical and horizontal groundwater flow (systems, depths, characters) of Debrecen concession area and propose a methodology, which can be used for the evaluation of other concession areas as well. The significance of the proposed methodology is to better understand the flow systems of the concession areas without any further exploration investment and therefore contribute to the more effective assessment of water, geothermal and hydrocarbon resources.

Water-rock-gas interactions in geothermal systems at the Great Hungarian Plain

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Mining and Geological Survey of Hungary
Applied

Geothermal systems exist all around the world in various geological settings. In Hungary, there are two types of geothermal reservoirs. One of them is found in Mesozoic carbonate formations made of limestones and dolomites, while the other is the Pannonian multi-layered sedimentary strata composed of sand, sandstone and shale. The most important thermal water resource in the Great Hungarian plain is the Upper Pannonian thermal aquifer system.

The utilization of geothermal heat has technical and environmental challenges. On the technical side, the most common difficulties are related to the chemistry of the geothermal fluids, which may contain considerable concentrations of minerals and gases causing scaling and corrosion in wells and surface installations. (1) In the long-term thermal water utilization point of view, it is important to

know the fluid composition and its variation under different pressure and temperature conditions.

Previous studies (2) indicate that some wells produce water which tends to form more precipitation than others. Meanwhile, there are wells with similar chemical composition, but no precipitation (3). To find its reason, it is important to investigate water-rock-gas interactions in the wells and aquifers which may significantly influence the production rate and the sustainability of operation.

During this research PHREEQC computer programme was applied to model geochemical reactions in geothermal water-rock-gas systems using physical parameters (pressure, temperature, etc.), mineral and chemical composition of waters of some production and reinjection thermal well. The figure shows the theoretical draft the production and reinjection geothermal system. Three cases were examined:

Case 1 represents the effect of pressure drop in the vicinity of the production well. Case 2 study the potential scaling and/or corrosion effects, while the abstracted thermal water flows through the different parts of the surface installations.

Case 3 models the effect of the modified re-injected fluid composition in the vicinity of the screen(s) at the re-injection well.

Our aim is to produce a step by step model approach to clearly identify the above processes. First modelling methodology has been tested, then three geothermal systems have been compared considering water-rock, then water-rock-gas interactions.

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4TH SESSION

Silicate melt inclusions and H isotope compositions of amphiboles recording quartzite-basanite interaction processes in the Bulhary(Bolgárom) maar, Nógrád-Gömör Volcanic Field
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Theoretical

Our preliminary petrography and mineral chemistry study showed that the basanite-quartzite interaction from the Bulhary (Bolgárom) maar has led to form an alkaline rich multistage reaction corona around quartzite xenoliths [1]. Similar kind of interaction can be observed between several types of quartz rich rock fragments (eg. quartz mica-schist, sandstone etc.) and basanite [2]. Such xenoliths were collected in a significant number from the Bulhary-, Čamovce (Csomatelke)- and Ragáč (Ragács) quarries.

To better understand the multistage evolution of the Bulhary contact aureola, richterite crystals were separated from it for stable H isotope analyses. To see if silicate melt inclusions contain gaseous phases we studied minerals from „clinopyroxene rich” and „feldspar and clinopyroxene rich” contact zone with RAMAN spectroscopy.

Despite the considerable amount of collected crustal xenoliths, first results show that the multistage type evolution of contact zones described from Bulhary is a unique and characteristic phenomenon of quartzite-basanite interaction, i.e., it cannot be found in contact zones around any other types of quartz rich rock fragments (eg. quartz micaschist, granite) embedded in basanite. Most of the contact aureoles consist only of diopside + sanidine and little amount of aegirine, alkaline amphibole and sometimes volcanic glass (containing minute recrystallized minerals). Leucite together with ilmenite were only detected in one of the Ragáč sample, but not directly next to the xenolith.

The richterite crystals from the Bulhary maar show more negative δD values than would be expected in a volcanic environment. It could be related to the unique crystallization environment of the minerals, which is connected with contact metamorphism.

The size of the studied primary silicate melt inclusions goes up to 100 μm . They are stretched or isometric and are not bound to mineral zonation.

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Identification of carboniferous rocks based on rock physics properties and seismic attribute analysis

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Applied

Quantitative seismic interpretation methods are useful for the projects of HC exploration and production. These exploration techniques and the continuously developing seismic acquisition and processing methods, the performance of the computers and softwares allow getting more information about HC fields. With the new knowledge, we can investigate some of the explored HC fields from a different point of view.

In the developing projects the classic seismic interpretation is often not enough to identify potential upside areas near the HC fields, or to define the extent of a reservoir. If we use seismic attributes to help our work, we have to connect the seismic attribute changes to the real rock-physical property changes. The first step is to investigate the well logs in great detail and identify the zones of interest. The second step is the rock physics analysis, where we can separate the reservoirs

from non-reservoirs and we can investigate the possibility of the separation.

The next step is the seismic inversion with the application of an angle-gathered pre-stack time migrated (pstm) seismic cube. If we have P and S-wave velocity well logs, the recommended techniques are the elastic impedance (EI) and the extended elastic impedance (EEI) inversion. If only P-wave velocity log is available, the only opportunity is the acoustic impedance (AI) inversion. 3D delineation of the rocks with different physical properties is available based on cross-plots of the well logs and the seismic impedance cube. The continuation of the process is to use seismic amplitude attributes that show the best similarity to the well logs, and generate seismic attribute cubes that predict some reservoir parameters of interest. That process allows separating rocks with different physical behaviour. The original seismic interpretation and the local geological concept might be modified based on the results of the rock physics and seismic attribute analysis.

The presentation includes an industrial example from a clastic environment. With the application of the presented technique, there was an opportunity to separate the seal rock from the clastic reservoir rock and other non-reservoir rocks. It is also possible to define the spread of these rocks. These results were applied in the geological reservoir model building process and also in the gross-rock volume (GRV) and original oil in place (OOIP) calculations.

Hierarchical cluster analysis and multiple event relocation of Hungarian seismic event clusters between 2000 and 2016

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Applied

The objective of our work is to develop a workflow that allows us to calculate highly accurate hypocenter parameters in seismic event clusters of aftershock sequences or anthropogenic events. We have used all of the digitally registered seismic events of the last 16 years in

Hungary. The data have been provided by the Hungarian National Seismological Network and the neighbouring countries. First, we performed an initial hierarchical cluster analysis with only spatial distances in the distance matrix. We selected two different probe clusters from the resulting initial seismic clusters – one containing explosions, and another containing earthquakes, then we applied waveform cross-correlation at every station. We repeated the hierarchical cluster analysis, but this time we used the correlation matrix as a distance metrics. The dendrogram analysis refined the initial clustering by creating new subclusters. To prepare for the hypoDD multiple event location analysis, we manually revised the routinely picked arrival times in the HNSB in order to increase the consistency and accuracy of the arrival times. We obtained improved single event locations with the iLoc algorithm to provide initial locations the double-difference analysis. Finally, we performed the double-difference multiple event location on the clusters both on the initial and the refined subclusters. We demonstrate the sensitivity of our results to the refined clustering method.

New results of the Mid-Hungarian Tectonics Zone based on seismic survey and 3D modeling

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Theoretical

The Mid-Hungarian Tectonics Zone (MHZ) is one of the most investigated areas in the Pannon Basin (PB), although it has many unsolved questions. It is a large dextral strike-slip fault system created when the ALCAPA and Tisa units forming the basement of the PB arrived next to each other [1,2,3]. The well-known structures at the Northern boundary is the Balaton line in the Western part, continues as Tóalmás line in the Northern zone, while the Southern border includes the Kapos-, Tamási- and the Kulcs-line [4,5] in W-E direction, altogether called the Mid-Hungarian line. The latest research results have come from the past decade [6,7,8].

Recently, MFGI and its heir MBFSZ have also carried out active seismic research and 3D modeling in the field. These aim to visualize and clarify the MHZ's structure. Additionally, along the tectonics zone, we compare the structural style of different segments, and the rate and character of deformation.

The younger structural phases connected to PB formation can be identified in the MHZ. The most dominant and also the youngest phase is the neotectonics located in the area of the synclines (Ozora) and anticlines (Budafai and Beleznai) of the MHZ [9], their oldest age is 8Ma [10]. During the postrift phase of the PB, active structures are hardly traced, mostly compaction faults can be identified here. Post-Sarmatian inversion can be observed in several parts of the zone: Ozora Trough and the area of Zala anticlines, presented as several smaller wavelength folds, inverted faults and erosions [11.12]. We also find evidence of the synrift structure characterised by troughs filled with thick early and middle Miocene sediments, transfer or ramp structures [13].

The most significant tectonics are the compression stressfield associated with the extrusion period of the PB, forming the basement of the MHZ. The basement's structure developed during this period, as defined in the Paleogene basin by the model of PALOTAI [8], separating a structural (nowadays) and a paleogeographical Tóalmás line at the Northern border of the MHZ. Improving this model, we mapped additional paleogeographical and structural border faults of the zone in different areas. We separated a paleogeographical and a structural Balaton-line, and also a paleogeographical and a structural Mid-Hungarian-line. In most cases the paleogeographical lines are thrust faults located on the edge of two adjacent units, separating the ALCAPA, the Tisza, and the middle Mid-Hungarian Unit. The structural borders are still active strike-slip faults shifting outside of the boundaries, or into the ALCAPA and the Tisza units. In case of Balaton-line we can easily follow the different strike-slip duplexes and pull-apart basins in the Northern edge of the zone from Buzsák, through Adony to Tóalmás-zone. However, southwards these can be observed only in Kapos-line, since strike-slip faults would be possibly found outside of the MHZ, as the continuation of the Kapos-line area.

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Spatial Correlation Structure of Precipitation Water Stable Isotopes accross the Iberian Peninsula determined by variography

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Applied

The aim of the study was to explore the spatial variance of oxygen and hydrogen stable isotope composition (δ_p) and d-excess of precipitation across the Iberian Peninsula to create a stepping stone for the future derivation of a regional Isoscape. Two periods were studied: 24 Global Network of Isotopes in Precipitation (GNIP) stations (October 2002-September 2003) were used to study the spatial

correlation structure of precipitation stable isotope data on a monthly and seasonal scale and 13 GNIP stations were combined with 21 stations from a regional monitoring campaign [1] from NW Iberia (October 2004-June 2006) to explore a quasi-annual scale. First the regional trend describing the δ_p variance was approximated with a best fit multivariate regression model involving latitude, longitude, elevation, distance from the coast as potential explanatory variables. In the procedure, the degree of multicollinearity was controlled using the variance inflation factor. Semivariograms were calculated for the residuals of the monthly- and amount weighted seasonal/annual mean δ_p values. Most of the monthly semivariograms turned out to be of the nugget type, and even those which did have a rising section were unsatisfactory for the determination of a sampling range, due to the lack of data over short distances in the Iberian GNIP network. However, in the case of the merged GNIP and NW dataset, an exemplary empirical semivariogram was obtained with two sills for δ_p , corresponding to spatial ranges of ~ 70 and ~ 500 km, while for d-excess a one-sill model was fitted, indicating a ~ 440 km sampling range. The shorter ranges indicated by the primary isotopic parameters concur with the width of frontal rainbands in extratropical cyclones [2]. Meanwhile, the longer range of δ_p , which also broadly correspond to the range of the secondary isotopic parameter (d-excess), might refer to the spatially variable moisture contribution of the western, Atlantic-dominated, and eastern, Mediterranean-dominated, domain of the Iberian Peninsula [3].

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***Simulation of the heterogenous nucleation of Mg-bearing calcite
from Lake Balaton under controlled conditions***

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Theoretical

Calcite is a widespread carbonate mineral and it is also common in freshwater environments. Under surface conditions the formation of calcium carbonate polymorphs (including calcite) are typically linked to biological activity, but inorganic factors are also able to affect the properties of these minerals [1].

Lake Balaton is an extremely shallow (average depth 3 m), mesotrophic lake with calcareous water, characterized by increasing Mg/Ca mol ratio from W to E (ranging from ~1 to 4) [2]. Previous studies observed calcite precipitation from lakewater in relationship with seasonal algal blooms. The investigated calcite crystals have high Mg content (usually 1:20 Mg/Ca ratio) and are attached to nm-thick smectite flakes. In spite of their aggregate-like appearance, the calcite particles from Lake Balaton are perfect crystals, based on electron diffraction studies. These results suggest that photosynthetic microorganisms induce precipitation of calcite from lakewater. The surfaces provided by other minerals (such as smectite) probably mediate calcite nucleation [3].

In this study we simulate biologically induced calcite precipitation in Lake Balaton with crystallization experiments under controlled conditions. In order to establish whether smectite flakes serve as nucleation sites, we precipitated calcite from filtered lakewater, both in the presence and absence of smectite. Supersaturation of the solution with respect to calcite was achieved by adding diatom culture to the water; photosynthesis by the diatoms caused a shift in water chemistry. We observed the precipitation and crystal growth with optical microscope and scanning electron microscope (SEM) and characterized the solid phases using Raman spectroscopy (RS) and transmission electron microscopy with energy-dispersive X-ray spectrometry (TEM EDS). Based on previous results

[4] we estimated the Mg content of calcite on the basis of features observed in Raman spectra.

We found that the presence of smectite promotes calcite precipitation, but later the calcite crystals appear also on the surfaces of diatoms. The morphologies and compositions of the calcite crystal vary, and depend on the different nucleation sites. We suggest that the nucleation process might be similar as reported in [5], which explains the specific properties of the calcite crystals. According to the Raman spectra and TEM EDS results the calcite crystals have high Mg contents (ranging from 5 to 15 mol%), but we cannot identify any dolomite-like Mg ordering. Based on RS, the Mg content of single calcite crystals kept increasing in four months.

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SATURDAY

5TH SESSION

Mobility study of potentially toxic elements from the H2 and H7 waste dumps in the Recsk mining area

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Applied

Mining activities leave their footprint on the surrounding area during and after active mining as well. The safe deposition and remediation of mine wastes are not an easy task. At village Recsk, Hungary, with more than 150 years of mining, a huge amount of waste material was produced and placed alongside the streams. The post-closure remediation of the mine waste sites failed in the 1970s and they act as contamination sources since then.

In this research detailed environmental geochemical investigation of the flotation mud and the waste rock material of the H2 and H7 dumps was carried out in order to characterize the potentially toxic element distribution and to describe their behaviour in terms of speciation and mobility. We conducted ICP-MS and ICP-OES measurements and static leaching tests on the collected mine waste rock and tailings samples in order to understand the geochemical properties of the waste material such as potentially toxic elements' concentration levels and their mobility, and the acid generation potential of the waste. The obtained geochemical data was analysed with statistical methods which involved correlation, regression and homogeneity studies, and the development of elemental distribution maps in order to identify significant element associations, the possible role of parameters such as pH in element mobility, and to attempt the identification of major driving geochemical processes such as adsorption to secondary minerals.

The results of this research can be used for estimating the current state of these waste heaps and can act as guidelines for future

remediation activities, in addition to the development of secondary mineral resources extraction technologies.

This research was carried out within the framework of a Chinese-Hungarian Bilateral Project (KINAI_TET- K1469).

Quantification and visualization of spatial uncertainty of petroleum reservoir models, regarding flow parameters

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Theoretical

Assessing the uncertainty in hydrocarbon reservoir performance is a very important process during the exploration phase. Examination of spatial uncertainty of the 3D models requires a large set (hundreds) of equiprobable realisations, simulated by a stochastic geostatistical algorithm. Although these Earth models represent possible realities, visualizing the spatial uncertainty, their handling is time- and CPU-consuming in further evaluations, such as flow simulation. Therefore, just a limited number of realisation can be post-processed in industrial practice. The aim of this study is to find a method capable to reduce the huge number of realisation in a specific way, while letting information about the spatial uncertainty be preserved.

Several ranking techniques exist, e.g. probabilistic selection, but all of them are highly dependent on static parameters. During this examination, an alternative data reduction method is parametrized for measuring the pairwise dissimilarity between the simulated reservoir models, with a distance (“transfer”) function [1, 5] based on properties related to hydrodynamics, which refers to the flow response and lets us visualizing the space of uncertainty through Multidimensional Scaling (MDS).

The parameters related to hydrodynamics, for the definition of the distance function, are derived from the models by two image processing algorithms, called *streamline_inspector* and *Topotoolbox* [4] which can take the properties (length, convexity, position, etc.) of the previously generated streamlines and other flow related features of the realisations into account. Based on the produced data, the pairwise

comparison resulted in a dissimilarity distance matrix, which can be plotted by classic, metric MDS, giving rise to a configuration of points in Euclidean space. Thus, the distances between the dots are representing the similarities between the realisations, so if there are two points close to each other, they have similar flow behaviour.

The key point of the data reduction process is the cluster analysis, which can discover inner organizations within the data set by searching for structures in the point cloud. K-means algorithm was applied to divide the data set into proper number of clusters, as defined the previously. The algorithm assigns the point to the randomly selected cluster centre, by minimizing the expected square distance between the points and the cluster centres [3]. The initialization of the randomly selected cluster centres is sensitive to the initial distribution of the points which may lead to an unfortunate grouping. To avoid this, radial basis function, the so called Gaussian kernel was applied. This function can transform the points into feature space and arrange them more linearly, ensuring appropriate clustering [2]. After the back-transformation, inner structures may be discovered within the data set [3]. In most cases, 3 representative realisations (P90, P50, and P10) are selected for dynamical simulation in industrial practice. Nevertheless, in this case the number of selected ones is user-defined or limited by a specific parameter of the kernel function.

The described method was applied to a data set contained porosity logs from 22 wells. The realisations (100) were generated in SGeMS environment by Sequential Gaussian Simulation. The simulated geological phenomena are two zones of a multi-zone prospect of a Lower-Pannonian turbidity sandstone, in Hungary.

The presented method does not need any kind of dynamical simulations or original oil in-place estimations, it relies on the derived flow related properties and the relation between the distance measure and the flow behaviour of the realisations.

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Stable C, O and H isotope composition determination of carbonates from natural CO₂ occurrences

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Applied

As result of CO₂ flooding, new carbonate minerals (e.g. dawsonite /NaAlCO₃(OH)₂/) can form in different geological formations. Stable isotope composition of these carbonate minerals can provide information about the processes triggered by large amount of CO₂ inflow. Stable isotope data of carbonate minerals can help to better understand the CO₂-water-rock interaction and trace origin of the fluids (CO₂ and pore water), which played a role in formation of the new mineral phases.

The stable carbon and oxygen isotope composition of the different carbonates from CO₂-bearing sandstones are generally determined by method, which is widely accepted in the literature ([1], [2], [3]). The whole rock sample containing all different carbonates is reacted with 100 % orthophosphoric acid at 25 °C for 6, 24 and 48 hours to extract the CO₂ sequentially from the different carbonate minerals and analyze the liberated gas by mass spectrometer.

However, according to our results, this method does not enable determination of the composition of different phases, as the liberated CO₂ is not representative for single carbonate phase. To demonstrate this, pure mineral phases (i.e. calcite, dawsonite, dolomite, ankerite and siderite) were used to react with 100 % orthophosphoric acid at 25 °C for 1, 6, 24 and 48 hours, respectively. Within this experiment, we determined the amount and isotopic composition of liberated CO₂. Majority of the calcite and dawsonite were reacted in the first hour and the 6, 24 and 48 hours experiments do not show systematic differences relative to the 1 hour experiments, indicating that the

calcite and dawsonite cannot be separated solely by using 1 and 6 hours reaction time. Majority of the ankerite and dolomite dissolved in the first 24 hours similar to siderite. Thus, these mineral phases also cannot be separated by using different reaction time because CO₂ will be liberated from every carbonate phases in the first 24 hours. These experiments demonstrated that the different carbonate phases cannot be separated by using distinct reaction times as it was proposed by several publications ([1], [2], [3]). Therefore, we recommend to physically separate dawsonite and other carbonate phases from the whole sample and measure their carbon and oxygen isotope composition independently.

Dawsonite contains OH⁻, therefore, stable hydrogen isotope composition could also be determined. According to the stable isotope analyses, the origin of CO₂ and pore water was evaluated ([4], [5], [6], [7]), the $\delta^{13}\text{C}$ compositions of CO₂ vary from +4,55 ‰ to -2,57 ‰ (T=70-98 °C), suggesting that the CO₂ has magmatic origin. The δD compositions of pore water change from -75,47 ‰ to -59,26 ‰, which could indicate meteoric origin.

In summary, we can state that the stable isotope composition of different carbonates cannot be determined from whole rock by sequential solution method. Instead, we suggest to separate the carbonate minerals from the whole rock and to analyze them separately. The results of stable carbon and oxygen isotope show that the origin of CO₂ is magmatic in this area and the origin of the porewater is probably meteoric.

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Pannonian ostracod faunas from Iharosberény-I well, S Hungary

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Theoretical

Ostracods are generally considered good indicators of the depositional environment, but very little is known about the distribution of endemic ostracod species across habitats in the Late Miocene to Pliocene Lake Pannon. The objective of this study is the identification of different ostracod assemblages in different environments (basinal lacustrine, shelf-margin slope, delta, beach-foreshore, and alluvial plain) of that lake. The fully cored Pannonian section of Iharosberény (Ib-I) well was dated biostratigraphically, magnetostratigraphically and cyclostratigraphically. Evolution of the depositional system was reconstructed by means of seismic and sedimentological data.

Well preserved, relatively diverse benthic ostracod faunas were derived from the studied 184 samples. Fourty-five euryhaline benthic ostracod taxa were identified suggesting a limno-brackish environment with low-energy conditions based on their morphological and ecological characteristics. Four ostracod assemblages could be distinguished in the studied Pannonian series.

The ostracod assemblage of the older Pannonian layers (1228 to 1085m), which represented the basinal lacustrine and slope environment, is dominated by *Candona (Turkmenella)* sp. suggesting mesohaline (5-9‰) environment. In the younger strata (997,8 to 658,2m), deposited in different deltaic environments, the specimens of the genus *Candona (Caspiolla)* become dominant beside *Cyprideis triangulata*, *Candona (Thaminocypris) alta* and *Candona (Bakunella)* sp. This assemblage indicates miohaline (3-5‰) environment.

Pectinaria (with 20-30 m water depths) and *Arenicola* (with 8-10 m water depths) trace fossils suggest littoral, well ventilated conditions.

Above these beds, the upper part of the sequence (658,2 to 581,6 m), which represented the delta plain, is characterized by the specimens of the genus *Candona* (*Caspiolla*) and fresh water ostracods which indicate littoral (maximum 15 m deep), freshwater-oligo/miohaline (maximum salinity of 5 ‰) well ventilated conditions with rich vegetation on the bottom. In higher levels of the sedimentary column (581,6 to 49,6 m) fresh water ostracods indicate more reduction of the salinity in alluvial plain environments.

The most important result of the research is that the distribution of ostracod assemblages with different ecological needs clearly follows the major depositional environments (basin, slope, shelf and alluvial plain) and reflects the evolution of the depositional system from open lacustrine to alluvial environments. The palaeoecologic results completed the environmental reconstruction with the salinity trend (5-9‰ to freshwater). Financial support was provided by the NKFIH-116618 OTKA.

***Geological and mineralogical characteristics of gold and
polymetallic minerals of the mining Maykain “B” deposit
(North-east Kazakhstan)***

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Applied

Maykain “B” is a gold ore deposit which also has reserves of another highly demandable ores of polymetallic and critical metals. The deposit is located in Maykain settlement, Bayanaul district, Pavlodar region of North-East Kazakhstan. Moreover Maykain “B” gold-barite-pyrite-polymetal deposit is situated 400 km north-east from Astana city.

The main purpose in this article is a geological outlook of the deposit, such as ore body morphology and ore body bedding, as well as ore mineralogy characteristics.

For a detailed mineralogical characterization, several ore samples were collected from depth 220-280 meters of Maykain “B” mine and optical mineralogy was performed on polished sections.

The ore zone extension is 1 km and its width is nearly 500 m. The ore body has a dip angle to direction of north-west 80° - 90° , dipping down to 230-260 meters depth. In total, there are 15 ore bodies in the deposit. 12 ore bodies of them have low concentration and other 3 ones have more potential [1].

The most important raw material of the deposit is native gold. The native gold is found in composition with several minerals such as pyrite, chalcopyrite, galena, sphalerite and others. In addition, beside as a native element, gold occurs here also as a composition of electrum. The electrum is more widespread then native gold and mostly associates with barite. Electrum occurs together with galena and tantalite, sometimes with chalcopyrite and sphalerite. Electrum forms fairly fine grains (0.07 mm – 0.2 mm) in the barite. Gold in the Maykain “B” mineral deposit occurs in concentration 2-3g/t, which is highly profitable [2].

According to the last reserve estimation reaches 14 million tons and from that net gold attains 35 tons. In 2004 approximately 300 kg of gold, 5 tons of silver and 500 tons of zinc was produced from the deposit. More 519 tons per day raw ores are produced at Maykain “B” deposit.

Based on geological and mineralogical investigations, ore types are classified as barite-polymetallic - 47%, pyritic - 32%, pyrite-polymetallic - 11% and baritic – 10%. Barite-polymetallic ore bodies are comprised of bornite, chalcocite, covellite.

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***Corundum trace element studies of samples from Kikeri-tó and
Börzsöny Mts.***

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Theoretical

In the outcrop of Kikeri-tó (Kikeri lake, Bakony Mts.) Pannonian shallow marine siliciclastic sediments are exposed. On the top of the outcrop, there is a layer of well sorted and cross bedded sand which contains two nearly one-centimetre-thick heavy mineral placer with nice variable transparent heavy mineral fraction included corundum [1].

The goal of my study was to characterise and find the source of corundum and the adjacent heavy mineral assemblage. Heavy minerals of the placer were separated by heavy liquid in the grain size of 63–125 µm and 125–250 µm. Transparent heavy minerals were recognised by polarizing microscope and RAMAN spectroscopy. Trace elements of corundum were analysed by LA-ICP-MS at the laboratory of MBFSZ to determine its geochemical fingerprint.

Some of the heavy minerals such as staurolite, zoisite, kyanite and garnet have most probably medium grade metamorphic origin, while andalusite, corundum, spinel and vesuvian derived from contact metamorphic rocks. The trace element composition of corundum suggested also its metamorphic origin. These results were presented before [2].

In this presentation we display the results of one of the possible source locations of the corundums and contact metamorphic minerals, the corundum bearing pyrometamorphic micaschist xenoliths of Miocene andesites and dacites of Börzsöny. The two xenoliths from Nagybörzsöny were investigated by polarised microscope, SEM-EDS for petrographic description and the corundums with LA-ICP-MS for trace element studies. The xenoliths have lepidoblastic texture, the corundums are idiomorphic-hipidiomorphic, show blue colour and in some thin sections transformed partly into spinel.

Both two datasets fell in the metamorphic field, but the values from Kikeri-tó shows partly different range as the values of xenoliths

from Börzsöny Mts. so we can't say for sure that they are in provenance relation.

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6TH SESSION

‘Water’ content of quartz-hosted melt inclusions from a silicic Plinian deposit at Bükkalja Volcanic Field

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Theoretical

Quantitative micro-FTIR measurements of ‘water’ content (both structural hydroxyl and molecular H₂O) in quartz-hosted melt inclusions as well as OH content of the enclosing quartz host were performed. To achieve this, we first developed a feasible protocol to estimate ‘effective thickness’ of glassy melt inclusions with micro-FTIR. These data then can be used to estimate partitioning coefficients for ‘water’ between quartz and silicate melt. Such partitioning coefficients have already been published for other nominally anhydrous minerals [1], [2], but are lacking for quartz.

Samples were collected from a presumably rapidly cooled Plinian fall deposit [3] from the Eger–Tufakőbánya quarry at the Bükk Foreland Volcanic Field. Although, the syn- and post-eruptive thermal history can significantly affect hydroxyl defect content of the quartz phenocrysts due to their fast diffusion [4], [3], by sampling fallout deposits this effect could be minimized.

The measured inclusions’ thickness has been determined both optically (focusing on the top and the bottom of each inclusion) and an ‘effective thickness’ was determined based on the relation between [2]

quartz thickness and integrated absorbance of Si–O vibrational bands. Challenges and potentials of this approach are discussed providing detailed guidelines for such future studies.

Present results imply the methodology could be applied to homogeneous inclusions containing no daughter minerals and secondary alterations. The work presented could be a great step forward in determining the ‘water’ content of quartz hosted silicate melt inclusions from practical point of view, requiring less sample preparation, analytical time and cost but still with reasonable accuracy.



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Evaluation of geometrical parameters in the case of structural elements of a deep water submarine fan system (Algyő HC field)

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Applied

There are several, relatively new methods (object-based and multiple-point methods) which require geometrical input data to model subsurface, ancient sedimentary systems and their structural elements (channels, splays etc.). The most common ‘tool’ is to use seismic data to obtain geometries. However, in the lack of seismic data, it is possible to reveal geometrical parameters in the presence of

dense well data by application of the conventional sequential indicator algorithm.

The latter method is presented in this work through a case study. The formation is located in the Algyő HC field, SE of The Great Hungarian Plain. It is described as a Pannonian sl. deep-water submarine fan system belonging to the Szolnoki Formation.

The data consists of faults derived from seismic, 163 well data (well logs: GR, RES, SP, POR, PERM etc.) and some core samples (7 wells). These were used to determine a simplified channel-lobe-background (sedimentary facies) system in each well.

The build-up of the structural model included five sandy and five shaly zones. These were considered as sedimentary cycles.

After the semivariogram analysis of each facies, it was possible to use sequential indicator simulation to produce one hundred realizations to establish the facies model. Although not a merged facies model was used for geometrical parametrization, but a so-called facies probability-grid derived from the realizations.

Consequently, the formation possesses meandering channels and terminal lobes, perhaps sand sheets as structural elements of this deep-water submarine fan system. Their geometrical parameters (amplitudes, lengths, widths, wavelengths, thicknesses) were obtained to apply them as input data of multiple-point simulation.

Mineralogical characterization and genetics of graphite from Dédestapolcsány, Uppony Mts.

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Theoretical

Graphite is a polymorphic form of carbon which crystallizes in hexagonal system, its flakes are flexible and has excellent basal cleavage. Its colour varies from black to greyish black, it has metallic lustre and greasy touch. It has become one of the most important industrial minerals from the 20th century thanks to its particular chemical and physical properties such as excellent thermal and electrical conductivity, good compressive and bending strength, and heat resistance at high temperatures [1]. It is used in metal extractive

industry, automobile industry, at steel-making, corrosion-free paints, fireproof materials, lithium-ion batteries, in the high-tech industry and last, but not least in pencil leads [2].

Beside the categorization of industrial graphite (flaky, lump and amorphous), it is also divided into several types according to its geological – economic geological appearance [1]. Graphite is mined in 21 countries, among them China is the leader setting the world market prices. Considering that nowadays graphite is one of the most versatile minerals, its presence supports economic prosperity [3].

To exploit potential opportunities it is important to be aware of the occurrences and types of graphite in Hungary. Therefore, my aim was to examine in detail a Hungarian occurrence from graphite point of view and to place it into the international industrial and geological categorization.

After a short description of mineralogical properties and industrial applications, the internationally accepted economic geological categorization is reviewed.

A compilation of graphite occurrences found in Hungary and in the Carpathian area is briefly presented. My chosen Hungarian occurrence is Rágyincs Valley, next to Dédestapolcsány, Uppony Mountains. The geological formation bearing graphite (siliceous shale) is the member of the Tapolcsányi Formation (Silurian). I examined the samples from there with polarization microscopy and scanning electron microscopy (SEM-EDS), and with X-ray powder diffraction (XRD). Utilising these three methods, the graphite found in the samples can be well characterized. In addition, I carried out a structural geology survey of the area, by which in light of the mineral associations, I try to make a conclusion regarding the origin and evolution of graphitic material.

According to the examinations, two types of graphite can be found and distinguished in the samples: the first one is 1-20 μm sized flaky graphite scattered in the matrix, the second one is 100-300 μm sized flaky graphite, as well, found nearby the polycrystalline quartz veins and structural elements. Sulphur content of graphite and vanadium content of sericite refer to organic material origin.

Mire detailed analysis, the TiO_2 minerals, anatase and rutile also can be found in the samples, which often have Nb and V content. The role of these minerals is important from rock formation point of view.

As a conclusion, graphite was formed through low degree regional metamorphism during which the organic material started to graphitize. Formation of graphite is epigenetic and generally related to shear zones. Graphite from Dédestapolcsány can be categorised to the metamorphic graphite deposit type, graphite in metapsammo-pelites and marbles (regional metamorphism) according to the economic geological categorisation of Dill [1].

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Magnetic parameter estimation of archeological objects

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Applied

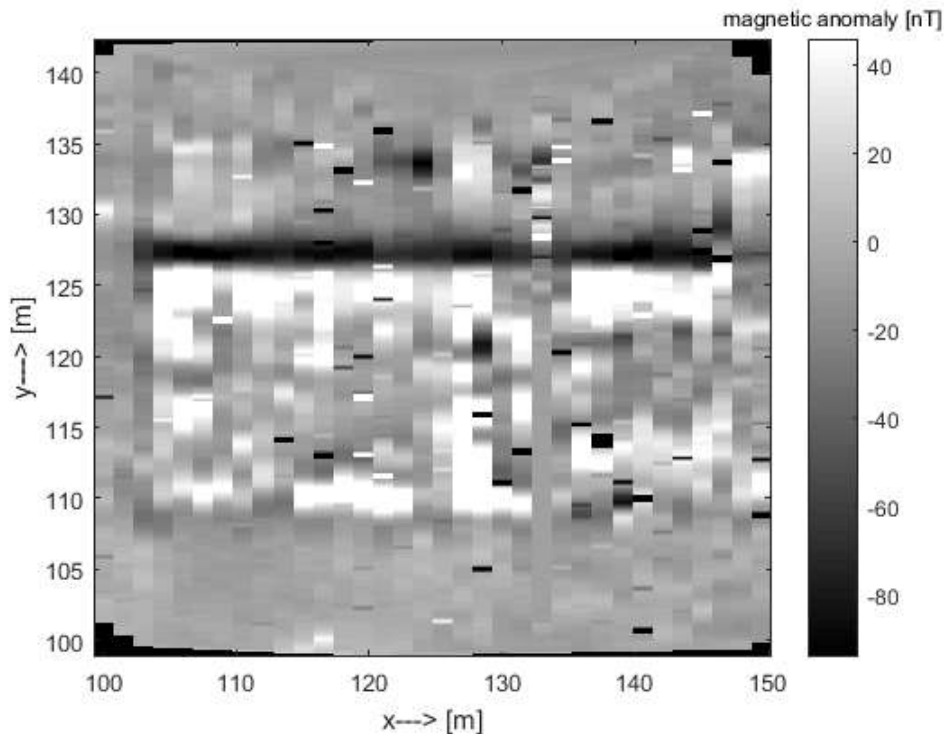
Buried archeological objects appear as ground disturbance in contrast to the unperturbed soil. Consequently, the physical properties of the object can be significantly different from those of the surrounding rocks. This difference can be measured by geophysical prospecting methods.

During my research, I performed magnetic total field measurements at one of the Roman archeological sites of the Dél-Dunántúl (Southern Transdanubia), called Iovia [1], under the leadership of archeologist BERTÓK Gábor. The Roman origin of the town is very promising in terms of my research, because built objects, especially walls are typical of this period, and they can be well detected by magnetic methods.

At the site, I measured a buried rectangular shape object (traces of which were formerly detected on aerial photographs) by an Overhauser magnetometer.

I processed the collected data using MATLAB. I performed the base value correction and the elimination of extreme values. I also

corrected the relative displacement of each measurement profiles (the result is seen in the figure), which was probably caused by the opposite measuring directions.



After the 2D Fourier transform of the data, we used two methods in the frequency domain. Firstly, after an adequate low-pass filtering, we determined the depth of the top of the object by the downward continuation spectral method. Secondly, we applied reduction to the pole (RTP) to find out the accurate location of the object.

As the object with linear shape can be approximated by a prism, two- and three-dimensional parameter estimation also can be applied independently for better insight into the physical properties and for comparison purposes. We used the formulae of KIS Károly [2] to calculate the direct problem of the 2D method, based on which we were searching the parameters giving the best fit.

Using the mentioned geophysical inversion methods, depth, size and magnetic susceptibility of the measured object can be determined. Based on our results achieved so far, the measured object is located shallow (20-30 cm under the surface), and it is surprisingly low (30-40 cm vertically).

TARCSAI et al. [3] have developed a 3D statistical parameter estimation program in 1976, which is also available for me. I plan to use it to clarify our former results.

The archeological application of geophysical inversion can be especially fruitful, because the modelled objects are likely to be excavated in the future, so we can get precise informations about the real form and material of the object, and we can compare them with the results of our models. Remote sensing data, which have been collected during the exploration of the site, can also be compared with the models.

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Modern microseismic monitoring in Hungary

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Applied

1995 was a milestone in the history of Hungarian seismological observations when high sensitivity microseismic monitoring network was installed and started operating. 10 short period, three component stations were installed in the central part of the country with the main goal of monitoring the current seismicity of the Paks NPP site. For the first time, this network made it possible to detect and locate small magnitude unfelt local seismic events in most part of the country. Detection capability of the Hungarian seismological network has been considerably changed to $ML \geq 2.0$ for the most part of Hungary in the past two decades. In 2016, a new era began in the observation by adding 5 borehole seismograph stations to the operating network.

Borehole seismographs represent the most modern measuring technique worldwide. In Hungary, we are using borehole sensors for the first time. Using these in the bottom of a 150 m deep steel cased borehole, noises from the surface can be suppressed successfully. In this presentation observations from the past two years with the

borehole seismographs stations and the microseismic monitoring network itself will be presented.

***Hydrogeophysical characterization of shallow volcanic aquifers
around Dangila town, Northwest Ethiopia***

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Applied

A single hydrogeophysical technique approach for exploration and understanding of complex geological setting volcanic aquifers is less effective than stratified sedimentary aquifers. On the other hand, as the employed techniques increase, the aquifer characteristics can be more understood even in the complex geological settings. The various source data interpretation approach from geological, geophysical, hydrogeological and Landsat imagery better revealed the characteristics of shallow volcanic aquifers around Dangila town of North West Ethiopia. The study comprises 10 well lithology and hydrogeology, rock sample thin section analysis, 23 vertical electrical sounding, 206 ground magnetic survey and the Landsat 7 imagery data of the area to better understand the shallow aquifer system.

Based on the results and combined interpretation, it is understood that the groundwater flow in the shallow volcanic rocks is highly controlled by the intensity, interconnection of fractures and their extension to the recharge areas. Places having fracture layers and connection to recharge are good groundwater potential area. The highly weathered and fractured quaternary basalts, weathered quaternary scoriaceous and scoria rocks are identified as the main aquifers. Despite the presences of weathered and fractured rocks of quaternary age, the good productive wells are located on the main structural line of the area having a connection to the recharge. The variation of the mineral content of the groundwater reservoir rocks is the case for variation of the groundwater chemistry type in a local scale. These mineralogical variations are expected to be caused by magma fractionation.