ASSOCIATION OF HUNGARIAN GEOPHYSICISTS
H-1145 Budapest, Columbus utca 17-23.
Phone/Fax: +3612019815

HUNGARIAN GEOLOGICAL SOCIETY
H-1015 Budapest, Csalogány utca 12.
Phone/Fax: +3612019129

INVITATION

to the **50th** Meeting of Young Geoscientists

29-30 March 2019

Ráckeve, Duna Relax & Event Hotel

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, 29th March onwards

Organisers

MAGYAR GEOFIZIKUSOK EGYESÜLETE
1145 Budapest, Columbus utca 17-23.
Telefon/Fax: 201-9815

MAGYARHONI FÖLDTANI TÁRSULAT
1015 Budapest II., Csalogány utca 12.
Telefon/Fax: 201-9129

MEGHÍVÓ

az **50.** Ifjú Szakemberek Ankétjára

2019. március 29-30.

Ráckeve, Duna Relax & Event Hotel
www.wellnesshotel.hu

Tudnivalók:

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

Regisztrálás: 2019. március 29. 9^{00}-tól folyamatosan

Rendező Bizottság

PROGRAMME

29. 03. 2019. FRIDAY

9^{30}- 9^{40}	OPENING
9^{40}-11^{30}	1ST SESSION
11^{30}-13^{20}	2ND SESSION
13^{20}-14^{10}	POSTER SESSION – SHORT ORAL SUMMARIES
14^{10}-15^{15}	LUNCH
15^{15}-17^{10}	3RD SESSION
17^{10}-18^{45}	4TH SESSION
18^{45}-19^{45}	POSTER SESSION – DISCUSSION
20^{00}	DINNER

30. 03. 2019. SATURDAY

- 9^{00}	CHECK-OUT FROM THE ROOMS *Please leave your room after breakfast, until 9 o'clock. The baggages can be stored in a luggage room.*
9^{00}-10^{55}	5TH SESSION
10^{55}-12^{55}	6TH SESSION
12^{55}-14^{45}	LUNCH
15^{00}	AWARD GIVING AND CLOSING CEREMONY

FRIDAY

9^{30} OPENING

9^{40}-11^{30} 1ST SESSION

9^{40} *Scale formation of geothermal cascade system in Újszeged*

T **Viktor Vincze**

MOL Group, Budapest, Hungary

9^{55} *Palynofacies characteristics of the Upper Cretaceous Mancos Shale in the San Juan Basin, New Mexico, USA*

A **Ahmed H. Moghazi**[1], Mohamed K. Zobaa[2], and Maria Hamor-Vido[3]

[1]Dept. of Mineralogy and Petrology, University of Miskolc, Miskolc, Hungary
[2]Dept. of Geosciences, University of Texas Permian Basin, Odessa, Texas, USA
[3]Dept. of Geology and Meteorology, University of Pécs, Pécs, Hungary

10^{10} *Complex geophysical survey of Keresztes-halom*

A **András Virók**[1], Krisztina Szilágyi[3], Tamás Lukács[1], Zsombor Klembala[2]

[1]ELTE Eötvös Loránd University, Department of Geophysics and Space Science, [2]Budavári Ingatlanfejlesztő és Üzemeltető Nonprofit Kft., [3]Budapest University of Technology and Economics faculty of civil engineering

10^{25} *Existence of thermal convection in the Buda Thermal Karst: free or forced?*

T **Márk Szijártó**

Eötvös Loránd University, Department of Geophysics and Space Science; József and Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary

10^{40} *A wetland mapping method by temporal integrals derived from H/A/alpha decomposition of Sentinel-1 images*

A **Vivien Pacskó**[1,2], Ottó Petrik[2], Zoltán Friedl[1,2], Gizella Nádor[2], Dániel Kristóf[2], Márta Belényesi [2], Gábor Molnár[1,3]

[1]Eötvös Loránd University, Hungary [2]Government Office of the Capital City Budapest, Dept. of Geodesy Remote Sensing and Land Offices, Division of Geodesy and Remote Sensing [3]Hungarian Academy of Sciences at Eötvös University, Geological, Geophysical and Space Sciences Research Group

10^{55} DISCUSSION

11^{15}-11^{30} BREAK

11^{30}-13^{10} 2ND SESSION

11^{30} *Celebration of the 50th ISzA*

C **Attila Csaba Kovács**
Geo-Log Environmental & Geophysical Ltd.

11^{35} *Active faults in the Pannonian Basin?*

A **Dalma Trosits[1]**, László Tóth[1], Péter Mónus[1], Ferenc Horváth
[1]GeoRisk Earthquake Engineering Ltd., Budapest

11^{50} *Examinations of the neotectonic of the Pannonian basin based on 2D restoration and other methods*

T **Kitti Váradi**
Department of Geophysics and Space Science, Eötvös Loránd University

12^{05} *Porosity-Permeability Estimations based on Sonic Velocity, Critical Porosity, and Rock Typing Approaches*

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

12^{20} *Anisotropic geophysical modelling and statistical inversion for shale gas reservoir*

T **Xiaoyang Wu,** Xiangyang Li, Hengchang Dai
Edinburgh Anisotropy Project, British Geological Survey, The Lyell Centre, Research Avenue South, Edinburgh,

12^{35} *Gas hydrate generation in Lake Pannon?*

A **Zsófia Harold[1],** Attila Balázs[2], Attila Bartha[3], Árpád Szalay[4]
[1]Department of Physical and Applied Geology, Eötvös Loránd University, Budapest, Hungary, [2]Department of Sciences, Università Degli Studi Roma Tre, Rome, Italy, [3]Schlumberger, Software Integrated Solutions (SIS), Aachen, Germany, [4]Independent Exploration Geologist, Szolnok, Hungary,

12^{50} DISCUSSION

13^{10}-13^{25} BREAK

13^{25}-14^{10} POSTER SESSION – short oral summaries

13^{25} *Celebration of the 50th ISzA*

C **István János Kovács**

Geodetic and Geophysical Institute Research Centre for Astronomy and Earth Sciences Hungarian Academy of Sciences

13^{30} *Crop yield estimation by Sentinel-1 radar polarimetric data*

Zoltán Friedl[1], Gizella Nádor[1], György Surek[2]
[1]Government Office of the Capital City Budapest, Department. of Geodesy, Remote Sensing and Land Offices[2]MLog Instruments Ltd.

What story are scales telling? Comparative analysis of scales from geothermal systems

István Rába, Petra Kovácsné Bodor, Judit Mádlné Szőnyi, Andrea Mindszenty, Orsolya Győri
ELTE Department of Physical and Applied Geology

Pannonian mollusc biostratigraphy of two large calcareous marl sections from opposite margins of the Drava Trough

Dániel Botka[1], Imre Magyar[2,3], Krisztina Sebe[4]
[1]Dept. of Palaeontology, Eötvös Loránd University, Budapest, [2]MOL Plc., Budapest, [3]MTA-MTM-ELTE Research Group for Paleontology, Budapest, [4]Dept. of Geology and Meteorology, University of Pécs, Pécs

From continental rifting to Alpine shortening: preliminary structural observations in the Trojane Anticline, Middle Slovenia

Benjámin Scherman[1], László Fodor[1,2], Szilvia Kövér[1]
[1]MTA-ELTE Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences at Eötvös University [2]MTA-ELTE Volcanology Research Group of the Hungarian Academy of Sciences

Five decades of atmospheric electric potential gradient measurements at the Széchenyi István Geophysical Observatory

Attila Buzás [1,2], Veronika Barta[1] and József Bór[1]
[1]Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences [2]Department of Geophysics and Space Science, Faculty of Science, Eötvös Loránd University

Granulometric and Mineralogical Analysis of Siliciclastic Sediments derived from Sahara

Alex Kovács[1], János Kovács[1], György Varga[2]
[1]University of Pécs, Department of Geology and Meteorology, [2]Hungarian Academy of Sciences, Research Centre for Astronomy and Earth

A Contribution of the Magnetic Field Data and Geoelectrical Resistivity Sounding for Groundwater Exploration in A Part of Central Sinai, Egypt.

Mahmoud Ibrahim Abdelaziz[1]
[1]Institute of Geophysics and Geoinformatics, University of Miskolc

The gold exploration over the Yamaat area in Mongolia using field measured vertical electrical sounding (VES) and petrophysical measurements

Byambasuren Turtogtoh
Institute of Geophysics and Geoinformatics, University of Miskolc

Application of Horizontal-to-Vertical Spectral Ratio (HVSR) method for estimation of local site effects in Varaždin County (NW Croatia)

Davor Stanko[1], Snježana Markušić[2]
[1]University of Zagreb, Faculty of Geotechnical Engineering, Varaždin, Croatia, [2]University of Zagreb, Faculty of Science, Dept. of Geophysics, Zagreb, Croatia

14^{10}-15^{15} LUNCH BREAK

15^{15}-17^{10} 3RD SESSION

15^{15} *Celebration of the 50th ISzA*

C **Szilvia Kövér**
MTA-ELTE Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences at Eötvös University

15^{20} *Expanded provenance analysis (EPAN) of the early-middle Miocene unconsolidated sedimentary beds from the western Mecsek mountains*

A **Dóra Georgina Miklós,** Sándor Józsa, György Szakmány
Department of Petrology and Geochemistry, Eötvös Loránd University

15^{35} *Pannonian ostracod faunas from South Transdanubia (Hungary): taxonomy, biostratigraphy and paleoecology*

T **Vivien Csoma**
Department of Palaeontology, Eötvös Loránd University

15^{50} *Alginite - a new tool for remediation project in evironmental protection with a hungarian raw material*

T **Tibor Zádeczki**
BIOCENTRUM Ltd

16^{05} *Seismic potential in Nyírség*

A **Bence Ádám Braun**
Department of Geophysics, University of Miskolc

16^{20} *Applications of different earthquake-data clustering methods for the stress inversions in the Vrancea-zone (SE-Carpathians)*

T **Lili Czirok[1,2], Lukács Kuslits[2]**
[1]University of Sopron, Roth Gyula Doctoral School of Forestry and Wildlife Management Sciences, Sopron [2]MTA CSFK Geodetic and Geophysical Institute, Sopron

16^{35} DISCUSSION

16^{55}-17^{10} BREAK

17^{10}-18^{45} 4TH SESSION

17^{10} *Celebration of the 50th ISzA*

C **Attila Ősi**
Department of Palaeontology, Eötvös Loránd University

17^{15} *Application of Artificial Neural Networks (ANN) in geosciences-A case study from Central Hungary*

A **Zsolt Nagy**
MOL Plc., Budapest

17^{30} *Reservoir Characterization using Artificial Neural Network based Well Log Analysis*

A **Sabuhi Tapdigli**
University of Miskolc

17^{45} *Low-temperature deformations of the Mónosbél and Szarvaskő nappes of the SW Bükk Mts., Hungary: a case study from a cross section (Villó, Eger and Almár Valleys)*

T **Benjamin Scherman[1],** László Fodor[1,2], Szilvia Kövér[1], Martin Reiser[3]
[1]MTA-ELTE Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences at Eötvös University [2]MTA-ELTE Volcanology Research Group of the Hungarian Academy of Sciences [3]Geological Survey of Austria, Wien

18^{00} *Mineralogy of the HFSE enrichment in the metavolcanics and metasediments of the SE Bükk Mts*

T **Csilla Balassa,** Norbert Németh, Ferenc Kristály, Ferenc Móricz
University of Miskolc, Institute of Mineralogy and Geology

18^{15} *Textural observations and Raman spectroscopic studies on Praid salt rocks (Transylvania)*

A **Orsolya Gelencsér**
Lithosphere Fluid Research Lab, Department of Petrology and Geochemistry, Institute of Geography and Earth Sciences, Eötvös University

18^{30} DISCUSSION

18^{50}-19^{50} POSTER SESSION – discussion

20^{00} DINNER

SATURDAY

CHECK-OUT FROM THE ROOMS

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

9^{00}-11^{00} 5TH SESSION

9^{00} *Celebration of the 50th ISzA*

C **Péter Zahuczki**
MOL Plc., Budapest

9^{05} *Sea of data or desert of information Groundwater chemical database analysis at the southern foreground of the Villány Hill*

T **Tibor Zádeczki,** Anita Erőss, Katalin Csondor
Department of Physical and Applied Geology Eötvös Loránd University

9^{20} *Geotechnical, geological and hydrogeological investigations on a DNAPL contaminated area*

T **Ramóna Matula**
BIOCENTRUM Environmental Protection and Water Management Ltd.

9^{35} *Springs as telltales of flow systems: hydrogeological study of the city 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

9^{50} *Radionuclide content of groundwater in hydrogeological approach – case study of the adjacent areas of Lake Velence*

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

10^{05} *Heterogeneous geochemical processes in mine waste dumps – Assessing the behaviour of potentially toxic elements (PTEs) in mine waste dumps and tailings in the Recsk mining area*

A **Péter Szabó[1],** Győző Jordán[2], Gábor Földing[3], Imre Gaburi[3], Csaba Alföldi[3], István Kiss[4], Margit Balázs[4], Ildikó Kovács[4], Csaba Szabó[5], Jun Yao[6]
[1]Doctoral School of Environmental Sciences, Eötvös Loránd Univ., [2]Dept. of Applied Chemistry, Szent István Univ., [3]Mecsekérc Ltd., Pécs, [4]Division for Biotechnology, Bay Zoltán Nonprofit Ltd, Szeged, [5]Lithosphere Fluid Research Lab, Eötvös Loránd Univ., [6]Institute for Earth Sciences, China Univ. of Geosciences in Beijing, Beijing, China

10^{20} DISCUSSION

10^{40}-10^{55} BREAK

10^{55}-12^{55} 6TH SESSION

10^{55} *Celebration of the 50th ISzA*

C **László Bereczki[1,2]**

[1]Dept. of Applied Geophysich Mining and Geological Survey of Hungary
[2]Dept. of Geophysics and Space Science, Eötvös Loránd University

11^{00} *Inherited Triassic salt structures in the Silica Nappe, Aggtelek Mts.*

T **Éva Oravecz[1],** László Fodor[2,3], Gábor Héja[2]

[1]Eötvös Loránd Univ., Budapest, [2]MTA-ELTE Geological, Geophysical and Space Science Research Group, [3]MTA-ELTE Volcanological Research Group

11^{15} *Complex evaluation of fluid flow systems and hydraulic trapping of hydrocarbons in the broader area of Hajdúszoboszló and Ebes, Hungary*

A **Zsóka Szabó,** Brigitta Zentai-Czauner, Judit Mádl-Szőnyi

József and Erzsébet Tóth Endowed Hydrogeology Chair, Department of Physical and Applied Geology, Eötvös Loránd University, Budapest

11^{30} *Investigation of groundwater flow system and their driving forces in the Danube-Tisza Interfluve by numerical modeling*

T **Viktor Dániel Balogh,** Szilvia Simon, Ádám Tóth

Department of Physical and Applied Geology, Eötvös Loránd University

11^{45} *'Water' content of quartz from pyroclastic fall deposits (Bükk Foreland Volcanic Area) – first step towards a new correlation tool*

T **Mátyás Hencz[1],** Tamás Biró[1], István János Kovács[2], Zsófia Pálos[3], Dóra Kesjár[4], Dávid Karátson[1]

[1]Department of Physical Geography, Institute of Geography and Earth Sciences, Eötvös Loránd University [2]Geodetic and Geophysical Institute, HAS RCAES [3]Lithosphere Fluid Research Lab, Eötvös Loránd University
[4]Institute for Geological and Geochemical Research, HAS RCAES

12^{00} *Study of quartz xenocrysts and mafic enclaves from "Laleaua Alba" ("White Tulip") composite dacite dome, Gutai Mts., Romania*

T **Ákos Kővágó[1],** István Kovács[2], Sándor Józsa[1], Marinel Kovács[3], Csaba Szabó[1]

[1]Department of Petrology and Geochemistry Eötvös Loránd University, [2]Geodetic and Geophysical Institute Research Centre for Astronomy and Earth Sciences Hungarian Academy of Sciences [3]Tech. Univ. Cluj-Napoca, North Univ. Centre Baia Mare,

12^{15} *Metamorphic history of Algyő High*

A **Henrietta Kondor**

Department of Mineralogy, Geochemistry and Petrology, University of Szeged

12^{30} DISCUSSION

12^{55}-14^{45} LUNCH BREAK

15^{00} AWARD GIVING AND CLOSING CEREMONY

ABSTRACTS

1ST SESSION

Scale formation of geothermal cascade system in Újszeged

Viktor Vincze
MOL Group, Budapest, Hungary
Theoretical

Calcium carbonate lime scaling often appears in large scale in system-forming elements, which puts professionals at a serious operational difficulty. This was not different in the case of fluid produced from the Újszegedi-T-1 well operating in a cascade system, which, due to its high solute content, suffered intensive precipitation in the pipe wall entering the buffer tank at major parts of the transport pumps. In order to sufficient system operation, our primary task was to make a recommendation on the temperature-, pressure-, pH-, flow-, and morphology changes, which may have caused increased or decreased the scaling in the pre-forming units (from the production well to the buffer tank, to the pump barrel. Altogether 7 thin-section samples were available. For this reason, this article the petrographical description of the thin sections from the sampling sites is based on crystalline structures and crystal morphology, as well as an X-ray fluorescence spectrometry (XRF) test on 6 selected ones. Based on my results, all samples showed a skeletal crystal character, often with different morphology (chevron, dendritic, skeletal appearance). The XRF study showed that basically reductive state is presented at the checked sampling points, but occasionally oxygen was also presented, which was found in iron, limonite precipitation in the samples. Where laminar flow was typical, at higher temperatures (pipe wall in front of the buffer tank, choke), the examined carbonates were able to precipitate, more easily than in turbulent flow. In the case of latter, velocity increases locally, at the tested points of the system (pump plate), due to large uneven movements. The process of separation has

been more difficult in such places. Without the addition of an inhibitor, a spherical, kidney crystal morphology developed, with the addition of it the morphology changed.

Palynofacies characteristics of the Upper Cretaceous Mancos Shale in the San Juan Basin,New Mexico, USA

Ahmed H. Moghazi[1], Mohamed K. Zobaa[2], and Maria Hamor-Vido[3]

[1]Department of Mineralogy and Petrology, University of Miskolc, Miskolc, Hungary [2]Department of Geosciences, University of Texas Permian Basin, Odessa, Texas, USA [3]Department of Geology and Meteorology, University of Pécs, Pécs, Hungary

Applied

A detailed palynofacies analysis was carried out on 27 core samples between the intervals (619-1035 ft) from Upper Mancos Shale formation, San Juan Basin, New Mexico, USA.The purpose of this study is to comprehensively characterize various palynofacies types in vertical profile for depositional paleoenvironment and kerogen type determination.The studied section shows two major palynofacies association (PF-1 and PF-2) based upon the relative percentages of three palynological categories of sedimentary organic matter (SOM): phytoclasts, palynomorphs, and amorphous marine organic matter (AMOM).PF -1 (younger) is predominantly composed of degraded and structured phytoclasts, common terrestrial palynomorphs and frequent opaque debris that may have produced by the effect of weathering.PF-2 (older) is characterized by abundant amorphous marine organic matter (AMOM) with lesser quantities of phytoclasts and palynomorphs.Kerogen composition of PF-2 clearly reflects an overall mix of Type-II and Type-III (mostly oil prone), and PF-1 shows characteristics of kerogen type III (gas prone) and occasionally type IV. Palynofacies analysis implies that PF-1 likely accumulated in a dysoxic-anoxic shallow marine environment of deposition with pronounced terrestrial influence, while suboxic-anoxic conditions are interpreted to prevail during the deposition of PF-2.

Complex geophysical survey of Keresztes-halom

András Virók[1], Krisztina Szilágyi[3], Tamás Lukács[1], Zsombor Klembala[2]

[1]ELTE Eötvös Loránd University, Department of Geophysics and Space Science, [2]Budavári Ingatlanfejlesztő és Üzemeltető Nonprofit Kft., [3]Budapest University of Technology and Economics faculty of civil engineering Applied

The kurgans are thousands of years old anthropogenic earth mounds from the late Neolithic, early Bronze and Copper Age. The heaps were used as a dwelling hill, as a border hill and as ritual and sacred places later. In the age of Árpád settlements were built in the immediate vicinity of many kurgan. The chain of the kurgans stretches from the lowlands of the Carpathian Basin to the foot of the Ural Mountains. Keresztes-halom is kurgan on the borderline of Gyula and Szabadkígyós. It is located on the southwestern side of the road leading from Békéscsaba to Kétegyháza. During reconnaissances Imre Szatmári (archaeologist) and his company discovered a settlement from the Age of Árpád at the kurgan's immediate vicinity in 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.

During our instrumental measurements we used three different shallow geophysical methods: multi-electrode's measurement, magnetic measurement and ground penetrating radar method. Using the multi-electrode's method we determined the apparent resistance values of the subsoil. In the course of magnetic research we measured the wider environment of the kurgan for search of other archaeological objects. Ground penetrating radar survey measurements were made to get to know the lower resolution structures underground and to clarify the layout the church. The result of our measurements is a three-dimensional space model from the area around the kurgan with marking of archaeological objects and a distinct mapping and modelling of the foundation of the church.

Existence of thermal convection in the Buda Thermal Karst: free or forced?

Márk Szijártó
Eötvös Loránd University, Department of Geophysics and Space Science; József and Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary
Theoretical

Previously, a comprehensive theoretical examination of combined effect of topography-driven forced and buoyancy-driven free thermal convection was carried out to better understand the basin-scale groundwater flow systems, especially where the geothermal gradient exceeds the mean continental value [1]. Based on the results of that and a former numerical investigation [2], and field observations for the Buda Thermal Karst [3], the existence of free thermal convection can be hypothesized, the measured temperature anomalies can be elucidated by neither thermal conduction nor pure forced thermal convection. The main goal of this study was to confirm this statement. As a first step numerical simulations were accomplished along a simplified, two-dimensional east-west geological section across the Rózsadomb area from Szomor via Buda Hills to Gödöllő Hills [4].

First, regarding the estimated recharge rate, hydraulic head data and groundwater age distribution, an extensive numerical testing of the model parameters and the boundary conditions was carried out to verify the calculations.

Second, on the course of the recent study three simulation scenarios were systematically examined on groundwater flow pattern and the temperature distribution in the recent evolutionary stage of Buda Thermal Karst: (1) steady-state flow system only with topography-driven groundwater flow, (2) steady-state flow system with forced thermal convection and (3) time-dependent flow system with forced and free thermal convection. A remarkable effect of free thermal convection, which is superimposed by forced thermal convection beneath the discharge area, was noticed under the unconfined carbonate region and at the border of unconfined and confined carbonate.

Finally, the origin of the heat anomalies was evaluated by the comparison of the numerical results and the measured data (e.g. temperature-elevation profiles). This study draws attention to the

importance of the understanding the behaviour of thermal convection in deep carbonate sequences, and it can improve the approach of geothermal explorations.

This project and the conference participation were supported by the ÚNKP-18-3 New National Excellence Program of the Ministry of Human Capacities, and the Hungarian Scientific Research Fund (K 129279). This study is part of a project that has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 810980. The water-table data in the area of Budapest were provided by FŐMTERV Ltd.

[1] Szijártó, M., Galsa, A., Tóth, Á. and Máld-Szőnyi, J. (2018): Numerical investigation of the combined effect of basin-scale forced and free thermal convection. Paper EGU2018-455. – *Geophysical Research Abstract, European Geosciences Union General Assembly 2018*, 8-13 April, Vienna, Austria.

[2] Havril, T., Molson, J.W. and Mádl-Szőnyi, J. (2016): Evolution of fluid flow and heat distribution over geological time scales at the margin of unconfined and confined carbonate sequences - A numerical investigation based on the Buda Thermal Karst analogue. – *Marine and Petroleum Geology*, **78**, pp. 738-749.

[3] Mádl-Szőny, J., Szijártó, M., Tóth, Á., Iván, V., Galsa, A., Havril, T. and Molson, J. (2018): Patterns and origin of heat anomalies in a carbonate system - joint interpretation of measured data and numerical simulations. Paper FP-250. − *Abstract Book, 45th International Association of Hydrogeology Congress*, 9-14 September, Daejeon, Korea.

[4] Fodor, L. (2011): A Budai-hegység felépítését szemléltető K-NY-I irányú szelvények [Geological sections across Budapest E-W]. In: A. Mindszenty (ed) (2013): Budapest: földtani értékek és az ember – városgeológiai tanulmányok [Budapest: geological values and man – urbangeological studies]. – *Eötvös Loránd University Press*, Budapest, pp. 20.

A wetland mapping method by temporal integrals derived from H/A/alpha decomposition of Sentinel-1 images

Vivien Pacskó[1,2], Ottó Petrik[2], Zoltán Friedl[1,2], Gizella Nádor[2], Dániel Kristóf[2], Márta Belényesi [2], Gábor Molnár[1,3]

[1]Eötvös Loránd University, Hungary [2]Government Office of the Capital City Budapest, Department of Geodesy Remote Sensing and Land Offices, Division of Geodesy and Remote Sensing [3]Hungarian Academy of Sciences at Eötvös University, Geological, Geophysical and Space Sciences Research Group

Applied

Wetlands are dynamic and diverse ecosystems, and play important role for example in decreasing the likeliness of floods or in filtering, and cleaning of surface and waste water. The identification and monitoring of them is essential to preserve them as ecosystem service providers.

For reaching good classification result with an ensemble learning method like Random Forest, the selection of input data is

fundamental. When the land cover is as complex as wetlands, and the collected reference data is uncertain or not up-to-date, selecting the best remote sensing input layers becomes even more significant. So the intent of my study is to find proper temporal integrals of polarimetric escriptors that could support a supervised classification in finding wetlands.

The studied time period is from October, 2014 to October, 2018, that means more than a hundred acquisition dates. Polarimetric descriptors were generated based on H/A/Alpha decomposition of covariance matrix of Sentinel-1A dual-pol (VV+VH) data. From the downloaded SLC images we extracted scattering coefficients (Sigma0), and derived the following ten descriptors: alpha and its two components, anisotropy, entropy, the two eigenvalues of covariance matrix, Shannon entropy and its two components.

In this study, the examined area is one from the Kiskunság region, Hungary, having different types of wetlands, grasslands, scrubs, and agricultural habitats. The reference data is provided by Ministry of Agriculture, Department for Nature Conservation, and its categories correspond to the General National Habitat Classification System.

My current study is supported by the ÚNKP-18-2 New National Excellence Program of the Ministry of Human Capacities.

2ND SESSION

Active faults in the Pannonian Basin?

Dalma Trosits[1], László Tóth[1], Péter Mónus[1], Ferenc Horváth
[1]GeoRisk Earthquake Engineering Ltd., Budapest

Applied

Seismicity in the Pannonian Basin is relatively low comparing to the peripherals, and the distribution of earthquake epicenters shows a rather scattered pattern at the first glance. Assigning earthquakes to actual faults is a great challenge in Hungary, although geological structures are well known from numerous 2D seismic profiles for the biggest part of the sedimentary basin.

Microseismic monitoring of areas like this one is essential to investigate characteristics of occuring earthquakes and gives inportant input for seismic hazard assessment. It also helps to identify possibly active underground structures and to create plausible seismotectonic models for PSHA. For the past 25 years, records of a high-sensitivity microseismic monitoring network are available for the central parts of the Pannonian Basin.

Recent investigations gave a picture of underground structures with an unprecedented accuracy for the very central part of the basin. A previously identified fault zone has been studied with several geophysical, geological and seismological methods. Using this extensive interdisciplinary knowledge and observations from the past 25 years of microseismic monitoring, we are able to draw some conclusions about the recent activity of the fault zone.

Examinations of the neotectonic of the Pannonian basin based on 2D restoration and other methods

Kitti Váradi
Department of Geophysics and Space Science, Eötvös Loránd University
Theoretical

In my work, I examined the neotectonic relation of the Pannonian basin based on seismic sections from various sudfields of the basin. The objects of the research were to quantify (in meter and in percent) the horizontal shortening along the sections caused by the neotectonic compression. Furthermore, to investigate the change of this shortening through a time unit in the neotectonic phase, as well as to define the time of the neotectonical activity.

Beside already published sections, I carried out seismic interpretation in some others too. In these sections I managed to isolate different time horizons from the disposition of the roll-over point of the clinoforms. I prepared the 2D restoration of these horizons, which is an area-preserving structural modelling method used for reconstruction of the status of the geological layers before its deformations. In case of the two sections from the eastern region of the Great Plain I tried to deduce the change of the neotectonic inversion in time from the activity of the neotectonical active faults.

From the results, I was able to define the exact extent of the shortening, which regionally is not more than 3% and in the local scale this is approximately 1%. Furthermore it has been established that the maximum of the compression caused by neotectonic inversion in the basin was migrated slower than it was supposed previously.

Porosity-Permeability Estimations based on Sonic Velocity, Critical Porosity, and Rock Typing Approaches

Muhammad Nur Ali Akbar
University of Miskolc
Applied

Many extensive kinds of research have been done and it is a well-recognized fact that sonic wave velocity is not only influenced by its rock-solid materials but also by the pore architecture details of the rock bulk. This situation still brings a lack of understanding and this study is purposed to clearly explain how acoustic velocity correlating with porosity, permeability and Internal pore structure in porous rocks.

This study employs 67 sandstone and 120 carbonate core samples collected from several countries in Europe, Australia, Asia, and USA. The measured parameters are available for porosity ϕ, permeability k, and compressional velocity V_p in saturated and pressurized conditions. Then, a proposed method is developed by re-arrangement on Kozeny equation to perform rock typing on the basis of pore structure similarity which called as pore geometry-structure (PGS). The proposed rock typing method allows investigating the main influential factors that control acoustic velocity and quality factor. Besides that, basic rock physics equations for sonic velocity and critical porosity concepts are also involved and derived to obtain the new solution to predict porosity and permeability.

At least eight rock groups are established from rock typing with its Kozeny constant. This constant is a multiplication of pore shape factor F_s and tortuosity τ. Then, the relations of versus porosity, permeability, pore geometry $(k/\phi)^{0.5}$, and pore structure (k/ϕ^3) are constructed. The important finding is that each relation among the rock groups of each lithology is clearly separated and produce high correlations. Velocity tends to be high with an increase in Kozeny

constant. However, for a given porosity for all the groups, velocity increases remarkably with a decrease in Kozeny constant. These all mean that velocity increases with either an increase in the complexity of pore systems or, at the same pore complexity, a decrease in specific internal surface area. Another finding is that each rock group for both sandstone and carbonate has its own critical porosity and it strongly correlates with velocity and porosity. Finally, critical porosity becomes a specific property of rock groups having similar pore geometry and structure.

As a novel, the empirical equations are derived to estimate compressional velocity based on petrophysical parameters. Furthermore, this study also establishes empirical equations for predicting porosity and permeability by using compressional wave velocity, critical porosity, and PGS rock typing.

Anisotropic geophysical modelling and statistical inversion for shale gas reservoir

Xiaoyang Wu, Xiangyang Li and Hengchang Dai
Edinburgh Anisotropy Project, British Geological Survey, The Lyell Centre, Research Avenue South, Edinburgh, EH14 4AP UK

Theoretical

Shale gas is considered as important transition energy from fossil fuels to renewable energy in facilitating the progress of decarbonisation. However, shales are poorly understood as reservoir compared to their conventional sandstone or carbonate counterparts due to their heterogeneous and anisotropic character. Shales are rocks with various mineralogies and complex fabric, which exhibit strong anisotropy. The change in effective velocities due to kerogen content and pore geometry influences the AVO (Amplitude Versus-Offset) behavior of shale-gas formations. How the conventional seismic survey plays its role in understanding the reservoir properties of shale gas is a key issue. Recent experimental work on realistic synthetic rock with controlled fracture properties indicated that the anisotropic parameters are a complex function of fracture, fluid and rock types. Better understanding the rock physics mechanism of fractured reservoir will improve the ability of using anisotropic rock physics relations for quantitative estimation of fracture properties. In this

paper, a methodology is introduced for the simultaneous inversion of facies and fracture properties from seismic measurement. It includes anisotropic rock physics theory, reflection calculation and statistical inversion.

Anisotropic Rock physics theory

Understanding the reservoir rock type, pore geometry, saturated fluids and fracture systems is a key issue for the choice of appropriate anisotropic rock physics model. These knowledge can be derived from the X-Ray Diffraction (XRD), the Scanning Electron Microscope (SEM) analyses and the Formation Micro-Imaging (FMI). Hudson's model (1980) for cracked media characterize Transversely Isotropic (TI) media with horizontal or vertical cracks, which can be applied to scenarios such as hydraulically fractured shales. Schoenberg and Heiberg (1997) proposed an orthorhombic model to estimate the elastic stiffness of Transversely Isotropic (TI) medium with a set of vertical fractures. This model can be used to estimate the elastic stiffness of laminated shales with vertical fractures. We introduced a general rock physics modelling process to estimate the elastic properties from mineralogy and rock texture by combination of different rock physics models.

Reflection calculation

An efficient approach to calculate the seismic reflections from elastic properties is using approximations from Zoeppritz equations. For weakly anisotropy, simple approximation such as Ruger (1998) equation can be used to calculate the reflection coefficient, as well as analyse the relation of anisotropic parameters with seismic Amplitude Variation with AZimuth (AVAZ) response. The limitation of these approximations is the error become obvious at large offset. Schoenberg and Protazio (1992) proposed an explicit solution to the Zoeppritz equation for the calculation of plane-wave reflection and transmission coefficients. This method was used to calculate the AVAZ response from the interface of HTI-orthorhombic shale media.

Statistical inversion

The Bayesian theorem is used for estimating posterior probability of facies and rock properties. In this method, a set of seismic facies is defined, together with a prior probability distribution for each, which can be derived statistically from drilling. Within each facies f, a P-wave and S-wave velocities relation, as well as prior probability

distributions for P-wave velocity, porosity phi, water saturation Sw and fracture density fd are defined from well log data. This allows to forward model the AVAZ response for each realization of facies and rock properties through appropriate sampling techniques such as Monte Carlo or Markov Chain Monte Carlo samplings. Then the posterior probability of each facies and model parameters when given seismic data is derived from the prior probability and the likelihood function which describe the similarity of forward modelling data with real seismic data.

Gas hydrate generation in Lake Pannon?

Zsófia Harold[1], Attila Balázs[2], Attila Bartha[3], Árpád Szalay[4]
[1]Department of Physical and Applied Geology, Eötvös Loránd University, Budapest, Hungary, [2]Department of Sciences, Università Degli Studi Roma Tre, Rome, Italy, [3]Schlumberger, Software Integrated Solutions (SIS), Aachen, Germany, [4]Independent Exploration Geologist, Szolnok, Hungary
Applied

Two 2D basin and petroleum system models were carried out to investigate the development and preservation of Gas Hydrate Stability Zones (GHSZ) in the Great Hungarian Plain. The numerical models calibrated to pore pressure and temperature data enabled the reconstruction of these zones in the deep Neogene depressions such as Derecske Trough, Jászság Basin and periphery of Békés Basin.

During the evolution of Lake Pannon the paleo water occasionally reached the depth, where the GHSZs could be formed and preserved.

Critical pressure and temperature conditions for gas hydrate generation started to develop below 500 m water depths from the beginning of post-rift phase around 10 Ma. Based on numerical simulation results hydrate zones with maximum thicknesses of 100 to 200 m could be formed, but no estimations regarding the generated gas hydrate volumes were made.

These gas hydrate zones could play an active role in focusing, diverting and retaining the gases coming from different sources and contributing to the generation of both mixed and biogenic gas accumulations present in the reservoirs of the Pannonian Basin.

Few million years later, the rapid subsidence and sedimentation changed the critical pressure and temperature conditions at the

sediment-water interface causing the dissociation of the GHSZs starting from 9.0 to 7.0 Ma.
Isotopically mixed gas accumulations discovered in fractured basement and Miocene reservoirs could be the proof of the once existing GHSZs. These accumulations are deeper (1500-2000 m) than the younger accumulations containing isotopically lighter biogenic gases only at shallower depths (500-1200 m).

POSTER SESSION

Crop yield estimation by Sentinel-1 radar polarimetric data

Zoltán Friedl[1], Gizella Nádor[1], György Surek[2]
[1]Government Office of the Capital City Budapest, Department of Geodesy, Remote Sensing and Land Offices, [2]MLog Instruments Ltd.
Poster

The Synthetic Aperture Radar is an active remote sensing technique, which has growing influence in Earth Observation. The Sentinel-1 C-band dual-polarization (VV+VH) satellite series give a high temporal resolution with 6 days returning. The biggest advantage of SAR system is that it is independent from the weather, although it make very noisy data. Nowadays, SAR data has became an important data in agricultural monitoring as well. Furthermore the polarization give the possibility to analysis change of scattering mechanism in growing period, due to this it is connected well with the main phases of agricultural crop's growing period. In this presentation the connection of radar polarimetry data and crop yield was examined by using Sentinel-1 dual-pol (VV+VH) time series data including backscatterer coefficients and polarimetric descriptors. The polarimetric descriptors were generated based on Cloude-Pottier's H/A/Alpha polarimetric decomposition of covariance matrix.

In this study we concentrated the winter wheat and the sunflower, which are really different type of crops including the growing period, crop features and phenology phases. Sunflower shows a very characteristic temporal profile and it has a high volume scattering, due to these it is suitable for this analysis. In contrast the winter wheat has

a vertical dominance in structure and the volume scattering is lower than double bounce scattering, which cause a noisy temporal profile. Thus, crop yield estimation of winter wheat by radar data is complicated more. The reference data concern to 40-50 parcels per crops for Békés county which were given by Research Institute of Agricultural Economics. Winter wheat shows a high correlation (70-80%) with the crop yields in different periods especially the backscatterer coefficients and alpha polarimetric descriptors. Alpha descriptor is sensitive for the appearance of winter wheat and this change in radar features correlated well with crop yields. The sunflower surprisingly not correlated well with the crop yields, which is explicable with drought and noisy data. However, the combination of radar features can raise the correlation well.

What story are scales telling?
Comparative analysis of scales from geothermal systems

István Rába, Petra Kovácsné Bodor, Judit Mádlné Szőnyi,
Andrea Mindszenty, Orsolya Győri
ELTE Department of Physical and Applied Geology
Poster

We meet in our every day life to limescales. We face them in our bathroom, shower, toilet, water tap, even in our long since not washed dinner set or glasses. These mineral percipitations can be beautiful with the impressive structures of the scale, but can be harmful for our water supplying systems.

This scaling event happens in geothermal systems too. The operators of the geothermal plans face increasingly these problems. The limescale can decrease the inner diameter of the geothermal pipes, even enterily close them.

In my research I compared the limescales from two different geothermal systems (Mályi and Bőny) for this reason, in many petrological-, mineralogical- and geochemical analyses. These surveys were macro-and microsopic characterization of the thin sections of the samples, XRD analysis and Scanning Electron Microscope analysis, Mössbauer-spectroscopy, γ-spectroscopy, and ICP-MS survey. The first two methods were used for making a basic view of the samples.

The X-ray diffraction could tell me what content of minerals of the scales have, and with the Scanning Electron Microscope I could get photos of this minetal content. The Mössbauer-spectroscopy showed which oxidation state of the iron attending in the samples. With the use of γ-spectroscopy I could get information of the contest of natural radionuclids. With the ICP-MS analysis I can compare the geo-chemical contest of the samples and, in my case, I personally visited on of the geothermal plans, and I could sample the geothermal fluid from there. Unfortunatelly that is not true for the other system, I only had data from the log-book of the drilling.

In my research I compared these two different mineral percipitation in many different ways, and from these data I tried to correspond them or to make a distinction between them.

My goal with this method was to interpret the difference between the two scale samples and that can lead us to compare the two geothermal systems. I hope my research can point out the differences of the systems, can help to set up a better strategy to reduce the quantity of scales, and help to increase the sustainability of the geothermal plans.

The research was funded by the European Union, Hungary and the European Regional Development Fund.

Pannonian mollusc biostratigraphy of two large calcareous marl sections from opposite margins of the Drava Trough

Dániel Botka[1], Imre Magyar[2,3], Krisztina Sebe[4]

[1]Department of Palaeontology, Eötvös Loránd University, Budapest, [2]MOL Plc., Budapest, [3]MTA-MTM-ELTE Research Group for Paleontology, Budapest, [4]Department of Geology and Meteorology, University of Pécs, Pécs

Poster

The lower part of Lake Pannon sedimentary succession is dominated by offshore calcareous marls in the southern part of the Pannonian Basin. Although, special attention is paid by the unconventional hydrocarbon exploration to these marls as potential source rocks, we have only insufficient knowledge on their depositional environments and ages [1]. They are known only from boreholes in the Great Hungarian Plain, but they can be studied in surface outcrops in Northern Croatia, in Northern Serbia, in the Transylvanian Basin, and in some places in the southern foreground of the Mecsek Mts. in Hungary.

Because different biostratigraphic systems are used in the different countries, we compared the molluscs and the mollusc biostratigraphy of two large sections from the opposite margins of the Drava Trough: Pécs-Danitzpuszta sand pit in the Mecsek Mts., northern margin of the Drava Trough, Hungary, and Našice cement quarry in the Krndija Mts., southern margin of the trough, Croatia. Actual investigations of the outcrops focused on lithology, stratigraphy, and their fossil contents. Both sections revealed the Sarmatian/Pannonian boundary, several Pannonian mollusc biozones, and an unconformity that separated the marls from the overlying much younger Pannonian sediments.

The Pannonian sediments can be studied in two sand pits at Pécs-Danitzpuszta. The larger one is an operating sand pit west of the Route 6. Here, tilted, alternating layers of thin-bedded limestones, marls, and clays are observed, while upwards the succession is dominated by light greyish calcareous marls with clay and sand intercalations. These layers include the *Congeria banatica* profundal biozone and the *Lymnocardium schedelianum* subzone of the *C. czjzeki* sublittoral biozone (~11.45–10.2 Ma). In a new trench dug recently on the top of the northern wall, continuously older sediments (Pannonian – *C. banatica* profundal and *L. praeponticum* sublittoral biozones, Sarmatian, and Badenian) were exposed. Above the Sarmatian/Pannonian boundary, a layer packed with small pioneer lymnocardiids, indicating environmental stress, was exposed. The other, abandoned mine, east of the Route 6, revealed horizontally layered sand and clay truncated by an unconformity. From the clay, molluscs characteristic for the *Undulotheca nobilis* subzone of the *C. banatica* profundal biozone (~11.3–11.0 Ma) appear, while above the unconformity, white, well-cemented sandstone was found with young Pannonian molluscs.

The cement quarry of Našice also reveals Badenian to Pannonian sediments [2]. On the western wall, a continuous Sarmatian/Pannonian succession can be traced. The earliest Pannonian white, platy limestone is characterized by massive occurrence of the pulmonate *Radix croatica*, and planorbid and hydrobiid snails. In contrast to Pécs-Danitzpuszta, lymnocardiid bivalves are relatively rare in the *L. praeponticum* sublittoral biozone (~11.62–11.45 Ma), suggesting a somewhat different depositional environment. The succession is

continuing with the *Velutinopsis velutina* (~11.45–11.3 Ma) and *U. nobilis* profundal subzones (~11.3–11.0 Ma) of the *C. banatica* biozone. In the northern part of the mine, a new section exposed an angular unconformity between old Pannonian (~10.2–9.6 Ma) and younger Pannonian/Pliocene? sediments.

To conclude, the two outcrops exposed coeval Pannonian sequences; however, the Pécs-Danitzpuszta succession was probably deposited in more proximal environment, as indicated by the scarcity of deep-water snails (which are abundant in Našice), the abundance of cardiids, and the presence of large *Lymnocardium* species (which are missing from the Našice layers). The presence of the unconformity that truncates both successions may be a regional pattern, as similar phenomenon was observed in Northern Bosnia and in the Fruška Gora in Serbia as well.

The research was funded by the NKFIH – 116618 and the TÉT_16-1-2016-0004 projects.

[1] Király, A., Milota, K., Magyar, I., & Kiss, K. (2010): Tight gas exploration in the Pannonian Basin. In: Vining, B. A. & Pickering, S. C. (eds): Petroleum Geology: From Mature Basins to New Frontiers. *Proceedings of the 7th Petroleum Geology Conference*, Geological Society, London, 1125–1129.

[2] Vasiliev, I., Bakrač, K., Kovačić, M., Abdul Aziz, H., & Krijgsman, W. (2007): Paleomagnetic results from the Sarmatian/Pannonian boundary in north-eastern Croatia (Vranović section; Našice quarry). *Geologia Croatica* **60**/2. 151–163.

From continental rifting to Alpine shortening: preliminary structural observations in the Trojane Anticline, Middle Slovenia

Benjámin Scherman[1], László Fodor[1,2], Szilvia Kövér[1]

[1]MTA-ELTE Geological, Geophysical and Space Science Research Group of the Hungarian Academy of Sciences at Eötvös University, [2]MTA-ELTE Volcanology Research Group of the Hungarian Academy of Sciences

Poster

The Trojane Anticline is a part of the Alpine retro-wedge system in Middle Slovenia [1]. It is situated in the transition zone of the Alps and Dinarides, south from the Periadriatic Line [2]. This rather complex area was subject of Triassic preorogenic rifting, Paleogene nappe-stacking during the Dinaric deformation phase, and Neogene folding and thrusting during the formation of the Alpine orogenic belt. These 3 major events resulted in complex deformation pattern, which is the subject of our recent study.

This area was part of the Neotethys passive margin during the Middle Triassic, when intracontinental rifting was dominant. Formations of the Dinaric platform and the Slovenian basin are also present in the area [3]. In the northern part of the study area the formations of the Slovenian Basin are present, in the southern part the Dinaric Platform, is represented by sedimentary formations and platform carbonates over Paleozoic siliciclastic sediments.

During the Paleogene Dinaric phase folding occurred and the basin type sediments thrusted over the platform with NW-SE strike. During the Neogene Alpine phase, the latest folding occurred which created the E-W striking Sava Folds, partly overprinting the earlier deformations [2]. According to Bavec et al. [4] the basin was thrust over the platform, along the Marija Reka Fault, which is part of the Neogene Sava Fault System. According to our preliminary field observations, a third set of fold axes is also present with NE-SW strike. It either belongs to a new structural phase or represents interference between the other two phases. The main goal of our study is creating a N-S cross section across the Trojane Anticline, for balancing in the future. We would like to understand the role of the pre-orogenic fault system during the two phases of compression, kinematics and nature of the Marija Reka Fault, and the numerous young-on-older thrusts depicted on the existing geological maps. After the balancing of the E-W fold system, we can retro-deform the Dinaric deformation, and hopefully, we can gather some information on the continental rifting and passive margin evolution during the Middle Triassic to Late Jurassic time.

A better understanding of the passive margin evolution may help our correlation with units, that were displaced by the Peri Adriatic Line. These related units are found in the area of the Bükk Mountains in NE Hungary. These goals give relevance to preliminary observations and results.

[1] Schmid, S. M., Bernoulli, D., Fügenschuh, B., Matenco, L., Schefer, S., Schuster, R., Tischler, M., Ustaszewski, K., 2008: The Alpine-Carpathian-Dinaridic orogenic system: correlation and evolution of tectonic units. — Swiss Journal of Geosciences 101(1), 139-183.
[2] Placer, L. 1999. Structural meaning of the Sava folds. Geologija 41, 191–221.
[3] Rožič, B., Goričan, Š., Švara, A. & Šmuc, A. 2014. The Middle Jurassic to Lower Cretaceous Succession of The Ponikve Klippe: The Southernmost outcrops of the Slovenian Basin in Western. Rivista Italiana di Paleontologia e Stratigrafia 120, 1, 83-102.
[4] Bavec, M., Pleničar, M., Ogorelec, B., Novak, M., & Pirc, S. 2009. Geologija Slovenije: The geology of Slovenia. Ljubljana: Geološki zavod Slovenije.

Five decades of atmospheric electric potential gradient measurements at the Széchenyi István Geophysical Observatory

Attila Buzás [1,2], Veronika Barta[1] and József Bór [1]
[1] Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, [2] Department of Geophysics and Space Science, Eötvös Loránd University
Poster

The magnitude of the atmospheric electric potential gradient (PG) measured near the surface is equal to the intensity of the vertical electric field, whereas its direction is reverse. The PG is one of the most frequently measured quantity in atmospheric electricity research, owing to the fact that it is a fundamental and relatively easy to measure parameter of the Global atmospheric Electric Circuit (GEC) – currents in the neutral atmosphere powered by the global thunderstorm activity connecting the lower ionosphere and the ground. The monitoring of the PG provides the scientific community with important information about the variation of Earth's electric environment. However, the interpretation of PG measurements is a challenging task since many local, site-specific factors have an impact on it.

At the Széchenyi István Geophysical Observatory of the Geodetic and Geophysical Institute near Nagycenk, Hungary (NCK, 47° 38' N, 16° 43' E) the PG measurements have commenced in 1962 and have been continuously operating to date. A PG dataset covering such an exceptionally long time period yields a unique opportunity to study the long-term changes in Earth's electromagnetic environment.

A long-term decline in the fair weather PG time series obtained at NCK has been reported in 2003 [1]. There the authors suggested a dominantly global origin for the long-term decrease. In a subsequent study [3], this theory was questioned on the basis of taking into consideration the time-dependent shielding effect of trees in the vicinity of the measurement site. Based on electrostatic theory and numerical modelling, *Williams et al.* [3] have concluded that the time-dependent screening effect of trees alone accounts for the decline. Although the authors of the first paper have acknowledged the shielding effect of trees [1, 2], but they have not attributed the whole reduction to this effect and questioned the applicability of the model

used in the analysis by *Williams et al.* [4]. Therefore, the debate about the origin of the long-term decrease has remained unsolved.

The aim of this poster is to present the PG measurements spanning five decades at NCK and to interpret the long-term reduction found in the PG time series measured at NCK. We present the method by which the time-dependent shielding effect of the trees at NCK has been quantified and was eventually eliminated from the time series. The method is based on on-site measurements and numerical modelling. The results suggest that the PG time series corrected for the shielding effect of nearby trees at NCK do not support directly and unambiguously the presence of a decreasing trend in the examined time range.

[1] MÄRCZ, F. and HARRISON, R. G., 2003, *Annales Geophysicae*, **21**: 2193-2200
[2] MÄRCZ, F. and HARRISON, R. G., 2005, *Annales Geophysicae*, **23**: 1987-1995
[3] WILLIAMS, E., MARKSON, R. and HECKMAN, S., 2005, *Geophys. Res. Lett.*, vol. **32**, L19810
[4] MÄRCZ, F. and HARRISON, R. G., 2006, *Geophys. Res. Lett.*, vol. **33**, L12803

Granulometric and Mineralogical Analysis of Siliciclastic Sediments derived from Sahara

Alex Kovács[1], János Kovács[1], György Varga[2]
[1]University of Pécs, Department of Geology and Meteorology, [2]Hungarian Academy of Sciences, Research Centre for Astronomy and Earth Sciences

Poster

Approximately 1 to 3 billion tons of mineral dust is emitted globally into the atmosphere by dust storms annually. The Sahara Desert is responsible for more than 50% of the global dust emission, as well as the dust storms, which reach Europe. My research focuses on two such dust events, occurred in January and April 2018. This study aims to identify the possible source area of those dust storms using geological methods.

During my research seven sediment samples were collected and analyzed with the following measurements: laser diffraction, X-ray powder diffraction (XRD), automated static image analysis, and scanning electron microscopy (SEM). Similarities were expected in the results of desert-originated samples and samples collected in Hungary. This is how the possible source area was going to be determined.

According to the laser diffraction and the image analysis results, an active dust emission is taking place at the location of investigated desert samples, and the samples collected in Hungary can be the particles out-blown from these source areas. The evaluated mineralogical results show that every sample contains quartz and phyllosilicates. Along with the results above, the source area cannot be identified.

The dust source area cannot be identified from SEM micrographs and image analyses, but these results assume that the samples collected in Hungary are from the same area.

Using HYSPLIT application, trajectories of two analyzed dust events were made. They reveal that one desert sample, as a possible source is excluded and that the two trajectories cross each other at a junction point above North Africa. This point can be the sought possible source location. My hypothesis is even proved by several kinds of literature.

A Contribution of the Magnetic Field Data and Geoelectrical Resistivity Sounding for Groundwater Exploration in A Part of Central Sinai, Egypt.

Mahmoud Ibrahim Abdelaziz[1]

[1]Institute of Geophysics and Geoinformatics, University of Miskolc

Poster

Recently great investments and governmental effort have been done for developing Sinai Peninsula, Egypt. So the present study aims to identify the surface and subsurface geological and hydrogeological settings controlling the groundwater occurrences in a part of Central Sinai and to delineate the most proper sites for drilling water wells. Hence, the magnetic and geoelectrical resistivity sounding methods were integrally concerned to achieve such aims. Different techniques of processing and interpretation of the magnetic data were applied; such as frequency filtering, spectral analysis, 3D Euler deconvolution and 3D modeling. The results of acquired magnetic data interpretation show that, the depth of the basement surface in the study area is ranging from 1658 m to 1857 m below the sea level, which is shallower in the western part than eastern and northeastern parts of the study area. Also the study area is affected by three major structural

trends; NW – SE (Gulf of Suez trend), NNE – SSW (Aqaba trend) and NEE – SWW (Syrian arc system trend). In additional, seventeen deep vertical electrical soundings (VES's) using Schlumberger array with maximum AB/2 ranging from 5 to 3000 m were measured in order to detect the depths of the main deep Nubian Sandstone aquifer in the study area. The results of the resistivity data interpretation showed that, the Nubian Sandstone aquifer (fourth geoelectrical unit) has its upper surface at depth ranging from about 316 m to 956 m. This aquifer attains resistivity values ranging from about (50 Ω.m to 412 Ω.m) which makes it the main aquifer for probably fresh and good quality groundwater accumulations; as recorded from some of drilled water wells. In general, according to the integrated results, the western part of the study area is suitable for further drilling water wells.

The gold exploration over the Yamaat area in Mongolia using field measured vertical electrical sounding (VES) and petrophysical measurements

Byambasuren Turtogtoh[1]

[1]Institute of Geophysics and Geoinformatics, University of Miskolc

Poster

This paper presents a result of vertical electrical sounding (VES) and physical parameters for gold exploration over the Yamaat area in Mongolia. One of the features of the research area is distributed the placer gold deposit and gold deposit.

In the first, the objective of vertical electrical sounding was done to identify horizontal zones and thickness of placer gold deposit in the research area. VES was carried out along one profiles using Schlumberger electrode system at eleven stations along one surveying profile. The maximum current electrode (A, B) distance was 100m and the profile length was 1000m. The VES results revealed the horizontal structure of the subsurface. To sum up, it is possible to control the distribution of placer gold.

In the second, the fuzzy C-mean clustering applied on the dataset of two physical properties measured on the core samples from the gold deposit. The objective of this research will be to develop

advanced geostatistical technique for mineral exploration based on chargeability and resistivity. The interpretation of rock distributed in the research area can help us obtain information about the rocks distribution and data information more effectively in terms of accuracy and physical parameters. This method is useful for the very quick processing of massive rock physical properties and may become an important technology in geophysical survey and mineral exploration.

Furthermore, the result of research will be used to improve the quality of the integrated geological-geophysical models in the research area. Next step, we will develop joining the fuzzy c- mean cluster analysis (physical properties) and inversion of the direct current (DC) geoelectric survey in gold exploration.

Application of Horizontal-to-Vertical Spectral Ratio (HVSR) method for estimation of local site effects in Varaždin County (NW Croatia)

Davor Stanko[1], Snježana Markušić[2]
[1]University of Zagreb, Faculty of Geotechnical Engineering, Varaždin, Croatia,
[2]University of Zagreb, Faculty of Science, Dept. of Geophysics, Zagreb, Croatia
Poster

Varaždin County is located in the northwestern Croatia and belongs to the Varaždin-Ivanščica-Kozjansko epicentral area where moderate to strong $M_L \geq 3.5$ earthquakes occurred in the past. One of the most important and the encountered problems in earthquake engineering practice is the evaluation of the local ground response to predict the site amplification in surface ground motions (due to the specific geological site characteristics, geometrical features of the soil deposits and the surface topography). This research presents estimated local site parameters, fundamental soil frequencies, HVSR amplitudes and estimated bedrock depths from the application of HVSR method for estimation of local site effects of three specific local geological sites in Varaždin County: City of Varaždin, City of Ivanec and historical Trakošćan Castle site.

3RD SESSION

Expanded provenance analysis (EPAN) of the early-middle Miocene unconsolidated sedimentary beds from the western Mecsek mountains

Dóra Georgina Miklós[1], Sándor Józsa[1], György Szakmány[1]
[1] Department of Petrology and Geochemistry, Eötvös Loránd University
Applied

The siliciclastic rocks and sediments have great economical and scientific importance as for example reservoirs for hydrocarbon and water or remnants of totally eroded mountain belts. The precise petrography of their detrital components and identification of their source area are important research directions for both areas. Traditionally, two main trends have been developed for the provenance research of unconsolidated clastic sequences: Pebble petrography, which deals with the petrography of individual pebbles larger than a few centimetres and the heavy mineral analysis, which targets the sand fraction. To eliminate deficiencies of these two methods, the fine-grained pebble examination (FPE) method [1] has been introduced into the petrographic examinations in the last few years. Together with this connection between different heavy minerals and source rock types still could not be proved directly. The aim of this work is to present a grain determination procedure that allows identifying the source rock types of clastic deposits with improved accuracy, by reducing the uncertainty that would arise from using one or the other method separately. Our approach – the Expanded Provenance Analysis (EPAn) – is a combined procedure of five different grain/clast determination methods. These include both, previously utilised techniques and one that is proposed herein for the first time. We present the application of the EPAn method on the early-middle Miocene unconsolidated sedimentary beds from the Borjúsréti-valley in the Western Mecsek Mountains. Our aim is to identify the source rocks and the provenance area of the early- middle Miocene siliciclastic beds.

In large territories of the Mecsek Mountains situated in the southwestern part of the Pannonian basin several hundred meters thick Miocene unconsolidated sediments represented by sand, pebbly sand

and sandstone can be found. This fluvial material of Szászvár Formation were transported from the southern uplifted territories towards the north. The grain composition of this Miocene fluvial sequences in the Western part of the Mecsek is polimict but invariable enough to use the Expanded Provenance Analysis (EPAn) method. To use this procedure perfectly five different methods on detrital material with three different grain sizes have to be used and evaluated together: 1. Thin-section petrography of large pebbles (P-LP), 2. Thin-section petrography of fine-grained pebbles (P-FP), 3. Thin-section petrography of the sandstone matrix (P-SM), 4. Heavy mineral analysis of the sandy matrix (HM-SM), 5. Heavy mineral analysis of individual large pebbles (HM-LP). The exact composition and proportion of eroded rock types can be determined by combinative use of P-LP and P-FP. With the joint evaluation of HM-SM, HM-LP, P-FP and P-LP methods we can connect exactly the different heavy minerals to different rock types. With other combinative evaluations of EPAn method, among other conclusions the weathering relationships during debris transport can be clear up.

The combined evaluation of the data of HM-SM and P-LP methods showed that the main source rock type of the Miocene sandy matrix was a staurolite, garnet, kyanite, sillimanite bearing micaschist. With the help of the P-LP, P-FP, HM-SM and HM-LP methods we distinguished two micaschist types: the more resistant micaschist exists in form of large pebbles and the less resistant micaschist appears as heavy mineral grains in the examinated beds. These types of micaschists contain similar heavy mineral types but in different ratios. The more resistant micaschist contain lots of garnet, apatite and tourmaline, and less staurolite, kyanite, while the less resistant micaschist contain lots of staurolite, garnet, kyanite and less apatite and tourmaline. These types of micaschist pebbles could be transported from the same source area and metamorphic unit. Similar rocks were detected from the XII. structure well [1] in the Slavonian-Drava terrain, located 18 kilometres to the south from the examinated area.

Bradák, B., Kiss, K., Barta, B., Varga, Gy., Szeberényi, J., Józsa, S., Novothy, Á., Kovács, J., Markó, A., Mészáros, E., Szalai, Z. 2014: Different paleoenvironments of the Pleistocene age identified in Verőce outcrop, Hungary: Preliminary results. Quatrenary International, 319, pp. 199−136.

Török, K. 1986: Adatok a Dél-Dunántúl kristályos aljzatának felépítéséhez. Kézirat, szakdolgozat, ELTE TTK, Kőzettan-Geokémiai Tanszék, Budapest, 114 p.

Pannonian ostracod faunas from South Transdanubia (Hungary): taxonomy, biostratigraphy and paleoecology

Vivien Csoma[1]

[1] Department of Palaeontology, Eötvös Loránd University, Budapest

Theoretical

Ostracods comprise one of the most important fossil groups – in addition to palynomorphs and molluscs - to reconstruct the depositional environments of Lake Pannon. Pannonian ostracod faunas of three fully cored boreholes from the South Transdanubian region of Hungary have been studied from taxonomic, biostratigraphic and palaeoecologic points of view. Broken valves were characteristic in older layers, on the other hand single valves with good preservation potential were observed in younger ones. Fourty-three ostracod taxa were identified with the help of classic taxonomic and modern morphometric methods. The lower part of the Upper Pannonian studied sequence from boreholes PAET-26, PAET-34P, PAET-29P and PAET-30 belongs to the *Sinegubiella sublabiata-Amplocypris nonreticulata* zone, while its upper part and the section of borehole PAET-27 between 407,7 and 137 m belong to the younger *Bakunella dorsoarcuata-Thaminocypris pontica* zone. In boreholes PAET-26 and PAET-27, two ostracod assemblages were distinguished based on their ecological traits and their distribution in the various deltaic environments. The "proximal" assemblage is characteristic for water depths of 10-15 m, and the "distal" one is typical for water depths of 10-80 m. The ostracod faunas and their diversity changes are very similar in boreholes PAET-26, PAET-34P and PAET-29P. The assemblages of the older Pannonian strata suggest meso- to pliohaline (5-16 ‰) sublittoral (with 10-80 m water depths) depositional environment. Above these beds, the sequences are characterized by *Cyprideis seminulum* which indicates littoral (maximum 15 m deep), freshwater-oligohaline (maximum salinity of 5 ‰), well ventilated conditions with rich vegetation on the bottom. In boreholes PAET-27 and PAET-30, the microfauna suggests sublittoral (10-80 m deep) depositional environment with unstable meso- to pliohaline (5-16 ‰) salinities. The fluctuating salinities are caused by periodic freshwater inputs. In higher levels of the strata in PAET-30 the assemblages indicate a slight increase in salinity. Correlation of the studied

borehole profiles and the palaeoenvironmental reconstruction based on the ostracod assemblages represent the progradation of the shelf-margin of Lake Pannon from northwest to southeast during the Late Pannonian.

The research was supported by the European Union and the State of Hungary, co-financed by the European Regional Development Fund in then project of GINOP-2.3.2-15-2016-00009 'ICER'. Financial support was provided by the NKFIH-116618 OTKA and Hantken Foundation.

Alginite - a new tool for remediation project in evironmental protection with a hungarian raw material

Tibor Zádeczki
BIOCENTRUM Ltd.

Theoretical

The alginite discovered by Gábor Solti in 1973 during the exploration work of the Hungarian Geological Institute at Pula. The alginite formed in vulcanic crater lakes. The formation of this material required a large amount of algae and heat, which provided by the crater lake. As a result, the material has a high organic concentration. The biomass mixed with volcanic sediments (tuff), which eventually created the alginite 3-5 million years ago by diagenesis.

After it is discovery it was used for agricultural purposses due to the high organic matter concentration. Alginite was used for soil improvment and fertilizer supplement. Subsequent studies have sown very good adsorption and absorption properties of the material. Due to these properties, the environmental protection use of the material has also arisen.

In 2016, a consortium was formed with the participation of three companies and two universities to exploit alginite for enviromental protection purposses. In 2017, thanks to a winning EU tender work can begin on this project.

In this presentation I would like to present the results of alginite mapping with other aspects of the research. I would like to point out that these results are the results of a project involving several institution and researchers. However, the mapping was done by Biocentrum Ltd.

Seismic potential in Nyírség

Bence Ádám Braun
Department of Geophysics, University of Miskolc
Applied

It is well known that seismic survey has a vital part in oil and gas exploration. However, there might be some cases, when the seismic method is inadequate for reflection imaging.

In this study, the concession areas of Nyírség and Szatmár-Bereg counties are presented, where the conventional, short-offset P_dP_u-reflection seismic measurement was unsuccessful because of the lithological character and location of the geological formations. All this is due to a thick subsurface Miocene igneous complex, which forms a strong barrier for wave propagation and causes problems during the interpretation of pre-Neogene basement. Sharp reflections are available only about the Pannonian layers and the top of volcanic zone.

The primary purpose of the study is to sum and present the regional deep geology, to construct multi-layered, complex geological-geophysical model based on the available dataset and to investigate the possibilities of their seismic imaging. In course of this procedure, the Zoeppritz equations and modeling software are utilized to calculate the reflection coefficients at the layer boundaries, the result of which allows to propose a new strategy for measurement design.

Applications of different earthquake-data clustering methods for the stress inversions in the Vrancea-zone (SE-Carpathians)

Lili Czirok[1,2], Lukács Kuslits[2]
[1]University of Sopron, Roth Gyula Doctoral School of Forestry and Wildlife Management Sciences, [2]MTA CSFK Geodetic and Geophysical Institute, Sopron
Theoretical

The south-eastern part of the Carpathians is a geodynamical active region due to the ongoing subduction processes. The research focused on the large seismically active Vrancea-zone which is found in the exterior part of the Carpathian Bend.

The authors had 60 focal mechanism solutions (FMS) for the analysis of the variations in the recent stress field.

Before carrying out the stress inversions, it is necessary to create some subareas based on the used focal mechanisms, the geographical coordinates and focal depths of the studied earthquakes. Since there are large numbers of seismic events in a relatively small region, so the authors also applied automatized clustering algorithms, e.g. hierarchical or density-based spatial clustering of applications with noise (DBSCAN) to generate the clusters and compared the results with created clusters by the manual method.

Moreover, the authors have started to create a fully-automated algorithm to the clustering of the earthquakes. This algorithm would be based on the principle of the nearest neighbor clustering methodology.

The resulting stress tensors include the orientations of the principal stress axes (σ_1, σ_2 and σ_3) and the shape ratio (R) that describes the relationship of the principal stress axes. These data identify the direction of maximum horizontal compression (S_{hmax}, the azimuth of the σ_1-axes) - that equals to the orientation of the stress field - and the typical tectonic regime (plunges of σ_1-, σ_2- and σ_3-axes) in the study area.

Generally, the results of this study are similar to previously published information. In some cases, the main orientations of their stress fields follow the curve of the mountain range.

This presentation was supported by the ÚNKP-18-3-I New National Excellence Program of the Ministry of Human Capacities.

4TH SESSION

Application of Artificial Neural Networks (ANN) in geosciences A case study from Central Hungary

Zsolt Nagy[1]
[1]MOL Plc.
Applied

Artificial neural networks (ANN) have been developed based on the concept of human brain [1]. These are mathematical models, which can find iteratively the connection between the input and one or more output parameters.

The biggest advantage of the networks that they can “learn”. The “learning” is implemented as a difference minimalization process between the estimated and the measured data, which are used for training. There are two different type of networks from the learning point of view, supervised and unsupervised learning. Networks can handle two main type of problems curve fitting and pattern recognition (e.g., voice, picture, lithology recognition) [1][2].

The smallest building unites of the networks are the neurons, which are organized into more layer. The number of neurons and the layers are customizable in accordance with the investigated problem. However, the simplest network builds up from one input, one hidden and one output layer. Functions (linear, tan-sigmoid, log-sigmoid) are applied to connect the layers.

Application of neural networks might be advantageous when the examined output parameter depends on more than one input parameter and if the relationship between the in- and output parameters are not linear. The architect, the training and the disadvantage of this method will be the focus of this case study.

Artificial neural networks were developed for estimating the missing acoustic travel time from gamma-ray and bulk density logs. In order to test this method, log data from three wildcat wells were applied. In the first phase, the dataset from W-1 was separated, so the networks were tested on data, which weren’t involved in the training process (blind data). During the second phase networks were constructed and trained on the dataset of W-2 and W-3, using two training algorithms for the supervised training process. Performance monitoring of networks were carried out during the training phase, when correlation coefficient, mean squared error and difference between measured and estimated data were calculated. Finally, the networks were tested on the blind well logs, and the synthetic DT log were compared with the measured one.

Biggest challenge of ANNs is overfitting, meaning that the network could “memorize” the training data and able to deliver almost perfect correlation with measured data. In contrast, applying the network on a blind dataset resulted in underperformance. Overfitting occurred when only one hidden layer was applied, and the neuron number exceeded the 50.

The most satisfactory results were delivered by the network, which contained two hidden layers and was trained with Levenberg-Marquardt (LM) algorithm. The calculated correlation coefficient was higher than 0.88 in case of every network, the most accurate one reached 0.94. The 80 % of differences between the estimated and measured data are less than 8 μsec/ft.

[1] Rogers, S.J., Fang, J.H., Karr, C.I., Stanley, D.A. (1992): Determination of lithology from well logs using a neural network. *AAPG Bulletin*, V. 76, No. 5, pp 731-739.
[2] Saggaf, M.M., Nebrija, E.L. (2003): Estimation of missing logs by regularized neural networks. *AAPG Bulletin*, V. 87, No. 8, pp 1377-1389.

Reservoir Characterization using Artificial Neural Network based Well Log Analysis

Sabuhi Tapdigli
University of Miskolc
Applied

Porosity and permeability are complex and important petrophysical properties of hydrocarbon reservoirs. These two parameters have a crucial impact on formation evaluation and reserve calculation. In modern well log analysis, multivariate statistical techniques and machine learning approaches can be favorably used for enhancing the reservoir characterization.

In this study, Artificial Neural Networks (ANN) are tested using field data to predict porosity and permeability distribution in a Norwegian offshore hydrocarbon field. The suggested workflow starts with a learning process in which ANN is used to reveal the connection between the observed wireline logs as input and porosity/permeability as output. By using this knowledge, in the next phase, the latter is estimated to missing depth intervals along a borehole and other neighboring wells. We use natural gamma-ray intensity, neutron-porosity, bulk density, full-wave acoustic travel-times, deep resistivity, spectral gamma-ray intensity, photoelectric absorption index, borehole caliper and spontaneous potential data to train the network and optimize the individual weights of neurons in forming the output response. Then, we give estimation to porosity and permeability along a borehole by using the same network. Based on detailed regression analysis, we make an optimal parameter selection and quality analysis of the estimation result. In addition, not only porosity and permeabili-

ty are predicted, but also water saturation and the amount of shaliness in the studied Norwegian petroleum system including carbonates and sandstone reservoirs.

Low-temperature deformations of the Mónosbél and Szarvaskő nappes of the SW Bükk Mts., Hungary: a case study from a cross section (Villó, Eger and Almár Valleys)

Benjamin Scherman[1], László Fodor[1,2], Szilvia Kövér[1], Martin Reiser[3]
[1]MTA-ELTE Geological, Geophysical and Space Science Res. Group [2]MTA-ELTE Volcanology Res. Group [3]Geological Survey of Austria, Wien
Theoretical

The Bükk Mountains in NE Hungary is related to the Dinarides. During the Triassic-Jurassic it was part of the Neotethys passive margin. However, during Cretaceous-Miocene plate movements it has drifted to the position in which it is today. [1] According to Dosztály et al. [2] the Bükk Mountains are built up by four units: (1) "Paraautochtonous" Unit; (2) the Mónosbél; (3) Szarvaskő, accretionary units, and (4) the Darnó sub-ophiolitic melange unit. The relationship between these units are controversial. One part of the geologist's state that the area is a complex nappe system [3, 4] whereas the others believe that it is a continuous sedimentary-magmatic sequence [5]. My goal is to understand the structural differences between the units/nappes and to reconstruct a deformation history. I have done geological mapping, collected mesoscale field structural data, investigated relevant drill cores and collected samples for thin section analysis meanwhile fission track measurements were carried out.

According to Balla [3] and Csontos [4, 6] the area is composed of similar folds with axial plane foliation. My field observations in this part of the SW Bükk were; shear zones with uneven spatial distribution and shear bend folds. The presence of axial plane foliation was not confirmed.

In order to reconstruct a deformation history by field and microscopic observations and fault-slip analysis I was able to define five different deformational phases.

D0 phase contains all sedimentary and synsedimentary structures.

D1 phase the bedding parallel schistosity (S0-1) is formed during the building of an accretional arc. This structure is present in almost every outcrop

D2 a subphase pre-tilt E-W compression/shortening which has caused thrusting, that often form duplex structure with eastern vergency. These thrusts were later tilted (folded). I also recognized overturned sandstone lenses in shale. These lenses (asymmetrical boudins) indicate large rotation, possibly within shear zones. Sigmoidal faults and fault bend folds are interconnected. D2b NW-SE compression is responsible for the main folding and tilting, shortening direction varies from NNW-SSE to WNW-ESE. D2c, D2d and D3, D4, D5 are post-tilt phases. D2c and D2d are a post-tilt phase with NNW-SSE compression when the previously tilted layers got sheared by often low-angle brittle thrusting. NW-vergent back-thrusting associated with kink folding belong to D2d 115 subphase.

D3, D4 and D5, post-tilt normal faults displaced the already folded Jurassic and Miocene formations; these are related to Miocene extension. These phases are in correlation with thermochronological data. The ZFT (zircon fission track) data suggests cooling at 134-143 Ma in the Mónosbél unit and 112-114 Ma in the Szarvaskő unit. It indicates thrusting and folding in the D2b phase before 134-143 Ma and folding and thrusting before 112-114 Ma in the D2c phase. AFT (apatite fission track) analysis suggests a 73 Ma exhumation that can be correlated to D2d phase as a major backthrust event.

This study contributes to the understanding of the Alp-Carpathian-Dinaridic orogenic evolution. Also provides new steps in the understanding of the Bükk Region.

[1] Dosztály, L., Gulácsi, Z., Kovács, S. (1998). Észak-magyarországi jura képződmények rétegtana. In: Bérczi, I. & Jámbor, Á. (ED.): Magyarország geológiai képződményeinek rétegtana. MOL Rt., MÁFI Kiadv., 309—318.

[2] Haas, J. Kovács S., Krystyn L. & Lein, R. (1995). Significance of Late Permian-Triassic facies zones in terrane reconstructions in the Alpine-North Pannonian domain. Tectonophysics, 242, 19–40.

[3] Balla, Z. (1983). Stratigraphy and tectonics of the Szarvaskő synform (Hung.). Ann. Rep. Hung. Geophys. Inst. for 1982, 42-65.

[4] Csontos, L. (1999). Structural outline of the Bükk Mts. (N Hungary). Földtani Kölöny, 129/4, 611–651.

[5] Pelikan, P. & Dosztaly L. (2000). A bükkzsérci fúrások (D-Bükk) jura képződményei és szerkezetföldtani jelentőségük. Földtani Közlöny, 130, 25–46.

[6] Csontos, L (2000). A Bükk hegység mezozoós rétegtani újraértékelése. Földtani Közlöny, 130/1, 95-131.

Mineralogy of the HFSE enrichment in the metavolcanics and metasediments of the SE Bükk Mts

Csilla Balassa, Norbert Németh, Ferenc Kristály, Ferenc Móricz
University of Miskolc, Institute of Mineralogy and Geology

Theoretical

A rock alteration characterised by enrichment of high field strength elements (HFSE) was discovered recently in the SE part of the Bükk Mts [1]. Altered rock bodies are situated in the boundary zone of two major tectonic units. They are thin metavolcanic and metasediment layers interbedded into limestone, which doesn't contain the alteration minerals. The metasomatism overprints the textures and mineral assemblages formed by previous regional metamorphism and other alteration processes like potassic metasomatism of the metavolcanics.

The presentation will introduce the results of the mineralogical and geochemical study of the rock types affected by the alteration. The HFSE minerals are mostly zircon, titanium oxides with high Nb-Ta- content and REE phosphates or carbonates. Typical grain size does not exceed 10 μm, therefore altered rocks are hard to distinguish from the unaltered ones. Sampling was supported by radiometric measurements indicating the enrichment of thorium. Study methods were XRF for the bulk chemical composition, XRD and electron microscopy for the mineralogy and textural properties, and EPMA for chemical composition of the mineral grains.

The metavolcanics are divided into two groups by the boundary zone. In general the southern group is richer in potassium (because of the potassic metamorphism), but the most altered rock bodies belong to the northern group. Metavolcanics include peperites, volcanic and sedimentary material is mixed in several cases.

The main rock-forming minerals are micas, also in metavolcanics and metasediments. Other phyllosilicates, quartz, feldspars and calcite are abundant too, the latter mainly in case of the metasediments.

The HFSE minerals are associated mainly with silicate minerals (potassic feldspars, micas) or occur adjacent to Fe- and Ti-oxides. The potassic feldspars occurring mainly in the metavolcanics may be the products of the metasomatism too, the albite is relict.

The solutions causing the alteration probably moved along the fault systems. HFSE mineralization usually takes place in alkali environment, but in the Bükk Mts. there isn't any known magmatic source.

[1] Németh N., Baracza M. K., Kristály F.,Móricz F., Pethő G., Zajzon N. (2016): Ritkaföldfém- és ritkaelem-dúsulás a Bükk hegység délkeleti részének vulkáni eredetű kőzettesteiben. *Földtani Közlöny*, **146/1**, p. 11-26.

Textural observations and Raman spectroscopic studies on Praid salt rocks (Transylvania)

Orsolya Gelencsér

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

Theoretical

Evaporites are characteristic rocks indicating arid climatic formation conditions. Their highly important feature is that they are the weakest rocks in deformation systems. The post-salt evolution of an area is very important in the geodynamic point of view. In the eastern Carpathian-Pannonian region (CPR) a salinity event happened in the Badenian time (Badenian Salinity Crisis - BSC below) as a result of the closure of the Middle Paratethys. Recently, the Badenian salt crops out in the edges of the Transylvanian Basin (TB). The estimated thickness of the salt in the TB is cca. 300 m. During the last 10 million years, the salt went through structural change because of the increasing lithostatic pressure and geothermal effects.

This study focuses on Praid salt diapir, which is situated in the eastern margin of the Transylvanian Basin (TB). The main aim of this study is to reconstruct the formation environment of the Praid salt rocks with petrographic and geochemical study of primary (P-type) fluid inclusions bearing halite. In addition, secondary (S-type) fluid inclusion assemblage is distinguished also. Using microthermometry, we determined the homogenization temperature (Th), which shows the crystallization temperature, and eutectic temperature (Te) depending on the chemical composition of the fluid solutions. The last melting temperature (Tm) of P-type fluid inclusion gives information about the H_2O content of the inclusions. I also applied Raman spectroscopy to determine solid, liquid and gas components of the salt rock. The

cryoscopic measurements constrained the composition of P-type fluid inclusions as salt hydrates in low temperature.

The studied salt body is highly tectonized but contains primary halite remnants. Two types of textures can be distinguished. One is containing a remarkable amount of chevron structure relicts with P-type fluid inclusions. Two population of grain size was identified, one varies from µm to mm other from 1 to 2 cm. Another has lower range of grain size (< cm) and halite chevrons are missing. The microthermometry gives a range of Th (10-24 °C) which is in good correlation with the Th-data from the BSC halite fluid inclusions from TB. The (Te) is very low and varies between -56 and - 41 °C suggesting the presence of CaCl in the Badenian brine. (Tm) is between -10 and -2 °C referring remarkable H_2O content. The Raman spectroscopic studies provide information about the formation environment and the post-salt history: 1/ P-type fluid inclusions have a consistent - Na^+-Ca^{2+}-Mg^{2+}-SO_4^{2-}-Cl^--H_2O - composition. 2/ S-type gas-rich fluid inclusions suggest N_2 and CH_4-rich fluid migration events after the salt was form.

This work was completed in the ELTE Excellence Program (783-3/2018/FEKUTSRAT) supported by the Hungarian Ministry of Human Capacities.

SATURDAY

5TH SESSION

Sea of data or desert of information
Groundwater chemical database analysis at the southern foreground of the Villány Hill

Tibor Zádeczki, Anita Erőss, Katalin Csondor
Eötvös Loránd University, Department of Physical and Applied Geology

Theoretical

In the era of digital information we can find anything on the internet. We build large databases automatically. Today we have more available data on our phones than a library. But everyone who work with large databases know one thing. Quality and quantity is not the same thing.

The hungarian General Directorate of Water Management build and maintain a database of waterchemichal data of groundwater. In this work I have three aims. The first aim was to create a general picture of the area hydrogeochemical. The second aim was to assess the useability the multivariate data analysis tools in this database. The final aim was to write general database building rules for database creators.

The Villany Hill has scaly geological structure. Because of this structure the chemical image of the groundwater is also complex. In this environment a wide variety of water-rock interaction can occur. Using the databese I used classical and multivariate data analysis tools. During the processing I applied facies analysis, cluster and discriminant analysis and CCDA method as well.

The importance of this work is due to the fact that the utilization of the Villany karst reservoir is multi-purpose. The groundwater is the primary source of the water supply. In addition groundwater is used for balneological and industrial purposes. For these reasons the examination of the state and trends of water chemistry is essential.

Geotechnical, geological and hydrogeological investigations on a DNAPL contaminated area

Ramóna Matula
BIOCENTRUM Environmental Protection and Water Management Ltd.

Theoretical

In this case study a factory has bought some new areas with the aim of extending their industrial activity without preliminary environmental survey. During an Integrated Pollution Prevention and Control (IPPC) investigation chlorinated aliphatic hydrocarbon contamination was detected in groundwater. The main compounds were tetrachloroethylene with 9780 µg/l highest concentration, trichloroethylene with 232 µg/l maximum concentration and dichlorethylene with the same concentrations as trichloroethylene. The contaminated area was in the management of the local municipality previously. At past engine repairing workshop and a dye house could be found in that field. Furthermore a warehouse is situated in this field, which was suitable for storage of barrels with different chemicals.

Chlorinated hydrocarbons are denser than water (Dense Non-Aqueous Liquid Phase = DNAPL). Chlorinated solvents have high volatility, low viscosity and interfacial tension, low absolut solubility but high relative solubility, low partition with solids and degradability, and can trap only on layers with low permeability. Therefore the identification of preferential migration paths and morphology of aquitard is very important, in order to evaluate the migration of DNAPL contamination and identify the potential risks on and nearby the contaminated area.

Site assessment was set by BIOCENTRUM Environmental Protection and Water Management Ltd. between 2017 and 2018.

Temporary boreholes were installed by drilling to characterize the shallow aquifer zone and identify the first lowest permeable layer on this field. In addition cone penetration tests (CPT) were done to determine the geotechnical properties of soil and assess subsurface stratigraphy. Tip resistance, local friction and pore water pressure were registered during the measurements. CPT data could be correlated with macroscopic observations. Hydraulic tests were accomplished in boreholes to define hydraulic properties of the porous aquifer with regard to hydraulic conductivity, storage and transmissivity.

Hydrocarbon contamination of soil was detected by in situ soil gas measurements. The aim was to determine the volatile hydrocarbon compounds in soil gas, then compare the results with laboratory measurements. The results of laboratory measurements and in situ soil gas measurements revealed good correlation.

With the help of modern in situ field measurements we got a good insight to the structure of shallow lithology and hydraulic properties of the area that could help us terminate DNAPL plum, characterize the main migration paths of chlorinated aliphatic hydrocarbons and accomplished risk assessment.

Springs as telltales of flow systems: hydrogeological study of the city Esztergom

Emese Pánczél, Anita Erőss, Katalin Csondor
Eötvös Loránd University, Department of Physical and Applied Geology, József and Erzsébet Tóth Endowed Hydrogeology Chair, Budapest, Hungary
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 the present research is to examine the hydrogeological environment of the city Esztergom with the help of the springs in that area. During the work particular attention was given to the karst springs situated in the target area through a retrospective research. Since Esztergom was the first capital of Hungary, significant number of historical sources were written about the utilization of the karst springs during the centuries [3]. These documents contain very important information about the natural, undisturbed hydrogeological conditions of the area. Based on the analysis and comparison of the retrospective research and the current data of the karst springs in the target area, additional information about the vulnerability and the hydrogeological characteristics of the karst system were concluded. This area was significantly influenced by karst water extraction because of coal mining during the 20th century. Due to the high volume water extraction ($10^8 m^3$/year) the flow system was disturbed, but after the closure of the mining activities at the end of the century, the regeneration of the flow system has started [4]. This process is traceable in the variation of the discharge amount and other parameters of the springs from the beginning of the 20th century to the present.

During the field work the springs appeared in the registers were looked up and their characteristics were recorded including the springs' environment and the field parameters of the water (temperature, pH, ORP, dissolved oxygen, electric conductivity, discharge, CO_2 content). Water samples were collected and analysed in laboratory for the main components. With the actually measured

data and the literature study the database of the Hungarian spring register was complemented and actualized.

The research is supported by the ÚNKP-18-1-I New National Excellence Program of the Ministry of Human Capacities.

[1] Tóth, J. (1971): Grondwater discharge: a common generator of diverse geologic and morphologic phenomena. *Int. Association of Scientific Hydrology Bulletin,* **16 (1-3)**, p.7-24.
[2] Tóth, J. (2009): Springs seen and interpreted in the context of groundwater flow-systems. *Portland GSA Annual Meeting*, Paper No. **57-4**
[3] Horváth I. - H. Kelemen M. - Torma I. (1979): Komárom megye régészeti topográfiája - Esztergom és a dorogi járás. Akadémiai Kiadó, Budapest
[4] Sárváry I. (1995): A budapesti termálkarszt kitermelhető vízkészleteinek felülvizsgálata, *Hidrológiai Közlöny,* **75/2**, p. 87-93.

Radionuclide content of groundwater in hydrogeological approach – case study of the adjacent areas of Lake Velence

Petra Baják, Katalin Csondor, Anita Erőss
Erzsébet and József Tóth Endowed Hydrogeology Chair, Department of Physical and Applied Geology, Eötvös Loránd University, Budapest
Applied

During the interaction with its environment groundwater can mobilize radioactive elements which are ubiquitous in different amount in the rocks. The most important contributors to natural radioactivity in groundwater are the members of the natural ^{238}U decay chain such as uranium, radium and radon isotopes. To understand and reveal the spatial distribution of the natural radioactivity of the groundwater, the flow system have to be taken into consideration along with the geological composition.

The hydraulic behaviour of uranium and radium depends on the redox conditions, pH and chemical composition of groundwater. The uranium is mobile under oxidising conditions and the presence of organic matter and carbonates, phosphates can enhance its mobility. On the other hand radium is soluble under reducing conditions in the presence of carbonates, sulphates and chlorides. Both element's solubility favor circumneutral pH conditions.

The above mentioned physicochemical parameters varies along the groundwater flow path and with regard to the change of regime characteristics. Therefore in the aspect of regime types the nature and amount of dissolved radionuclids in groundwater can be presumed.

Radioactivity of groundwater, as a possible threat and its hydrogeological background had not been widely investigated until

recently. In Hungary 97% of the drinking water is originated from the groundwater, therefore it is crucial to understand which factors can influence its radioactivity. Following the Euratom Drinking Water Directive the radioactivity of drinking water is screened in Hungary by total alpha and total beta activity measurements. Whenever the measured concentrations surpass the limit values the long term consumption of the water can lead to health issues.

Based on data provided by the National Public Health Institute high values of total alpha activity can be found in the southern foreland of Lake Velence. Previous studies already showed high uran concentration values (compared to average crust values) related to the Velence Granite Fm. and to the carbonatic and organic rich beds of the Ujfalu Fm but no observations or measurments were made regarding the radioactivity of the groundwater. Therefore, uranium, radium and radon concentration measurements on water samples were carried out in the wider area and interpreted in flow system context.

The samples were taken from surface water bodies as well as from groundwater. Alpha spectrometry applied on Nucfilm discs was used to measure the uranium and radium activity while radon activity was determined by TriCarb 1000 TR liquid scintillation detection. Pressure-elevation (p(z)) profiles were compiled to understand the flow regime. The areal distribution of the activity concentration values were interpreted regarding the groundwater flow system, physico-chemical parameters measured onsite and in the laboratory. Hydraulic data evaluation using pressure-elevation profiles are powerful and easy methods to determine the vertical flow conditions of an area since it is based on archival well documentation available in public institutions.

Those areas can be delineated where according to the flow conditions and the related geochemical environment the mobility of the uranium or radium and thus elevated activity concentration can be expected in groundwater, where natural geological background exists. This novel approach may facilitate safe water management of drinking water supply systems.

This study was supported by the ÚNKP-17-4 and ÚNKP-18-3 New National Excellence Program of the Ministry of Human Capacities and has also received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 810980.

Heterogeneous geochemical processes in mine waste dumps – Assessing the behaviour of potentially toxic elements (PTEs) in mine waste dumps and tailings in the Recsk mining area

Péter Szabó[1], Győző Jordán[2], Gábor Földing[3], Imre Gaburi[3], Csaba Alföldi[3], István Kiss[4], Margit Balázs[4], Ildikó Kovács[4], Csaba Szabó[5], Jun Yao[6]

[1] Doctoral School of Environmental Sciences, Eötvös Loránd University, Budapest, Hungary, [2]Department of Applied Chemistry, Szent István University, Budapest, Hungary, [3]Mecsekérc Ltd., Pécs, Hungary, [4]Division for Biotechnology, Bay Zoltán Nonprofit Ltd, Szeged, Hungary, [5]Lithosphere Fluid Research Lab, Eötvös Loránd University, Budapest, Hungary, [6] Institute for Earth Sciences, China University of Geosciences in Beijing, Beijing, China

Applied

The safe deposition and remediation of mine wastes is a significant challenge everywhere in the world, and almost each type of mineralisation requires a different approach. At the Recsk Mining Area, Hungary, with more than 150 years of mining history, a large amount of waste material has been produced and placed alongside the local streams. The post-closure remediation of the mine waste sites failed in the 1970s and they still act as contamination sources.

A 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 characterise the potentially toxic element distribution and to describe their behaviour in terms of speciation and mobility; furthermore, to assess the acid generation potential. We conducted ICP-MS, ICP-OES and XRD measurements, coupled with static and sequential leaching tests on the collected mine waste rock and tailings samples for understanding the geochemical properties of the waste material. The obtained geochemical data was analysed with statistical methods involving descriptive statistics, regression models, homogeneity tests and calculation of mobility factors, in order to identify significant element associations and the possible role of factors controlling PTE mobility, such as pH, clay content, carbonate content, iron oxyhydroxide content, etc.

The results of this research are used for designing and implementing microbiologically stimulated remediation and secondary mineral resources extraction technologies.

This research contributes to a Chinese-Hungarian Bilateral Project (TÉT_16_CN-1-2016-0006)

6TH SESSION

Inherited Triassic salt structures in the Silica Nappe, Aggtelek Mts.

Éva Oravecz[1], László Fodor[2,3], Gábor Héja[2]
[1]Eötvös Loránd University Budapest, [2]MTA-ELTE Geological, Geophysical and Space Science Research Group, [3]MTA-ELTE Volcanological Research Group Theoretical

The Permian to Lowermost Triassic Perkupa Evaporite forms the base of the enigmatic Silica Nappe which is the uppermost tectonic unit of the Aggtelek Mts. This evaporitic sequence played the role of the main detachment level of the Silica Nappe during the Cretaceous shortening. Several previous studies suggested that there may be salt diapirs rooting in this evaporitic detachment level [1][2][3] but for the lack of structural data the geometry and deformation history of the supposed salt diapirs have not been studied in details.

In this study detailed structural mapping in the area of Perkupa, Szin, Szinpetri and Jósvafő followed by fold axis estimations, fault-slip analysis and cross-section construction were carried out in order to understand the geometry, kinematics and timing of deformation of the salt structures present in the Aggtelek Mts, as well as their role during the subsequent deformation phases.

According to the results not only simple salt diapirs but complex salt structures, salt walls and salt anticlines originally related to Triassic normal faults, transfer zones and pull-apart basins are present in the Silica Nappe. Significant thickness variations observed in the Early Triassic sequences prove that syn-sedimentary salt tectonics must have initiated as soon as in the Early Triassic. As salt movements are always coupled with folding the first tilting event was Triassic. The scale and extent of this tilting is unknown but locally, directly next to the flowing salt bodies even sub-vertical dips may have been reached. This means that not all folds observed in the Silica Nappe is related to the Cretaceous shortening but some were formed much earlier, contemporaneously with the Triassic extensional and salt deformation. Moreover, the inherited pre-orogen extensional faults and salt structures had strong influence on the nature and geometry of the Cretaceous deformation. This is also supported by the

fact that the deformation history of all three of the most important structural elements of the Aggtelek Mts. (Jósvafő-Bódvaszilas Line, Jósvafő-Szin Strike-slip Fault and Jósva Anticline) can be traced back to the Triassic deformation. Consequently, unraveling the still debated nappe transport direction of the problematic Silica Nappe is possible only by first separating the salt-related structures from the purely shortening related structures.

The research was supported by the research found NKFIH OTKA 113013 and the ÚNKP-18-2 New National Excellence Program of the Ministry of Human Capacities.

[1] Grill, J. (1989): Structural Evolution of the Aggtelek-Rudabánya Mountains, NE Hungary — *Annual Report of the Hungarian Institute of Geology from 1986, pp.* 69-103.
[2] Less, Gy., Kovács, S., Szentpétery, I., Girll, J., Róth, L., Gyuricza, Gy., Sásdi, L., Piros, O., Réti, Zs., Elsholz, L., Árkai, P., Nagy, E., Borka, Zs., Harnos, J., Zelenka, T. (2006): Explainatory book for the geological map of the Aggtekek-Rudabánya Mts. (1:25 000) — Hungarian Institute of Geology, Budapest.
[3] Zelenka, T., Németh, N., Kaló, J. (2005): The structure of the gypsum-anhydrite dome at Alsótelekes — *Földtani Közlöny* **135/4**, 493-511.

Complex evaluation of fluid flow systems and hydraulic trapping of hydrocarbons in the broader area of Hajdúszoboszló and Ebes, Hungary

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

Groundwater flow mobilises, transports and accumulates hydrocarbons, thus the evaluation of recent fluid flow systems contributes to the mapping of hydraulically favourable places for hydrocarbon trapping and preservation. The aim of our research was (i) to understand the recent fluid flow systems and regional pressure field in the broader area of Hajdúszoboszló and Ebes, Hungary, (ii) to find potential areas for hydraulic trapping in the study area and (iii) to explore the hydraulic connection between Hajdúszoboszló and Ebes gas fields and their surroundings.

First the hydrostratigraphic build-up was determined based on borehole sequences, seismic horizons and sections. Then mapping of the fluid-potential field was carried out from measured hydraulic (pressure and hydraulic head) data by pressure vs. elevation profiles, tomographic fluid-potential maps, and hydraulic cross sections. This

evaluation was complemented by water chemical and temperature data analyses by TDS (total dissolved solids content) and temperature vs. elevation profiles, tomographic isoconcentration and isotherm maps, as well as cross sections.

As a result of the data processing, two distinct flow systems were identified and characterized, namely the nearly hydrostatic, gravitational, and the overpressured flow systems, which are well known in the Pannonian Basin. The connection between the flow systems and the areas of Hajdúszoboszló and Ebes gas fields were analysed in detail. The favorable hydraulic conditions of entrapment and accumulation right here are provided by coincidences of different factors. Namely, in the area of the Hajdúszoboszló gas field upward gravity-driven flow dominates from the elevated Pre-Neogene basement, which may focus flows of the underpinning overpressured system from the South, up to the land surface. This upward flow zone could force the dominantly horizontal SW-directed gravitational flows to turn upward, whilst pressure and temperature drop, as well as salinity increase and these together decrease the solubility of hydrocarbons in groundwater. Furthermore the differences related to the topography of the Pre-Neogene basement between the Hajdúszoboszló–Ebes High and the Derecske Trough were described, as they determine the pressure and heat dissipation and secondary migration pathways for hydrocarbon as well.

These conclusions demonstrate the significance of hydraulic studies in the understanding of secondary hydrocarbon migration and accumulation. Combining these methods with the commonly used practice in industry as a hand-in-hand experience, can help to reach better scores in hydrocarbon exploration.

These results are contributing to a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 810980 and was supported by Vermilion Hungary Ltd. as well.

Investigation of groundwater flow system and their driving forces in the Danube-Tisza Interfluve by numerical modeling

Viktor Dániel Balogh, Szilvia Simon, Ádám Tóth
Department of Physical and Applied Geology, Eötvös Loránd University
Theoretical

Flow systems of the Danube-Tisza Interfluve were already revealed by hydraulic data processing, analysis of hydrochemical data and geophysical measurements. Two different flow systems with different impelling forces could be distinguished: a gravity-driven freshwater flow system and an overpressured saline groundwater flow system with deep origin. The two systems communicate across the sequence of Neogene aquifers and aquitards along hydraulically conducting faults and through highly permeable lences. Both systems discharge in the valley of Danube and Tisza where as a consequence of flow pattern, salinization occurs.

The main goals of this study were to (1) investigate the existance of the two main driving force by simulation, (2) validate the flow pattern based on hydraulic data, (3) examine the effect of hydostratigraphic units and faults on the flow pattern, (4) review the effect of flow systems on the surface phenomena. Furthermore, (5) heat was also considered as a driving force.

During numerical modelling Comsol Multiphysics 5.1 was used to achieve the purposes. Three sections in different scales, a regional deep, a regional shallow and a local sections, along the same section line across the Danube-Tisza Interfluve were set, both are presented in [1]. In order to understand the behaviour of layers and faults, different scenarios were studied. All sections were validated by measured head, discrepancy between real and simulated groundwater levels was calculated and the flow pattern was also compared with hydrochemical data.

As a result of the study (1) the overpressure was proved as the main driving forces of the cending saline water, and the presence and distribution of the gravity driven system was supported with the simulation. (5) Heat also can be taken into account as a driving force, however its effect on flow pattern much less important than overpressure and gravity. (2) The simulated flow patterns of the sections are in good agreement with the flow patterns resulted from

hydraulic data processing. In addition, the model of the local section gave more detailed idea about the water flow at local scales. According to the flow pattern, local regimes are nested on the top of the ascending saline water, thus saline water can move upward to the surface only at the discharge zones of local systems, which confirmed the results of earlier studies in this area [2].

During scenario modelling, (3) aquifers played a main role in conducting water from the bottom of the sections toward the surface and aqutards only deflected slightly the water flow in all sections. Therefore, the geometry of sections strongly affected the flow patterns.

Vegetation types and simulated flow patterns (4) showed good correlation. In all of the three sections, saline vegetation could be found over discharge zones of the upwelling saline water and freshwater meadows were located in the area of gravitational freshwater systems. At local scale, where local regimes affected the distribution of saline water, one of the discharge zone of local systems and the upwelling saline water could be found at Kelemen-szék, which is a proved discharge point of the overpressured system by complex hydrogeological investigations and geophysical measurements.

In conclusion, this study can help to better understand the groundwater systems and regimes in the Danube-Tisza Interfluve. The results supported the flow patterns derived from hydraulic data and also gave new details, principally at local scales. Nevertheless, models could be improved in the course of further studies and coupled solute transport could also be carried out in order to clarify the connection between salt transport and salinization on the surface.

[1] Mádlné Szőnyi J., Tóth J. (2009): A hydrogeological type section for the Duna-Tisza Interfluve, Hungary. *Hydrogeology Journal,* **17.** p. 961-80.

[2] Simon Sz. (2010): Characterization of groundwater and lake interaction in saline environment, at Kelemenszék Lake, Danube-Tisza Interfluve. *PhD Thesis,* Eötvös Loránd University, Hungary, 167 p.

'Water' content of quartz from pyroclastic fall deposits (Bükk Foreland Volcanic Area) – first step towards a new correlation tool

Mátyás Hencz[1], Tamás Biró[1], István János Kovács[2], Zsófia Pálos[3], Dóra Kesjár[4], Dávid Karátson[1]

[1]Department of Physical Geography, Institute of Geography and Earth Sciences, Eötvös Loránd University, [2]Geodetic and Geophysical Institute, HAS RCAES, [3]Lithosphere Fluid Research Lab, Eötvös Loránd University, [4]Institute for Geological and Geochemical Research, HAS RCAES

Theoretical

Nominally anhydrous minerals (NAMs) are silicate phases that do not contain hydrogen in their theoretical chemical formula (e.g. feldspars, olivine, pyroxene, quartz). However, tiny amount of hydrogen in the form of structural hydroxyl (OH^-) as well as molecular water (H_2O) can be incorporated via various lattice defects and trace element substitutions [1]. Estimating the original 'water' content of NAMs from volcanic systems, that was equilibrated in the magma chamber prior to eruption is challenging, because it can be heavily modified during eruption, pyroclast transportation and deposition. At volcanic temperatures (>500°C) hydrogen diffusion in NAMs is very fast. During the eruption deposition and cooling the temperature remains high, although a drop in pressure and hydrogen activity is typical, which induce diffusional loss of water from NAMs, especially during the post-emplacement slow cooling in thick, massive pyroclastics [2].

In this study 'water' content of quartz phenocrysts were measured from a pyroclastic fall deposit at the Bükk Foreland Volcanic Area (BFVA). Pyroclastic succession from a large-volume, extensive, silicic volcanism deposited at the BFVA from the middle to the late Miocene (20-13 Ma). Most of the pyroclastic sequence originated from large explosive eruptions, which dominated by pyroclastic density currents (PDC) resulted in the deposition of massive ignimbrites and subordinate fallout activity.

To avoid the effect of post-eruptive hydrogen loss, quartz phenocrysts for this study were collected from a well-defined fall deposit cropping out at Bogács and Tibolddaróc. This layer was correlated previously by physical volcanological methods [3]. Water content of quartz from fallout pyroclastics was not hitherto investigated in details.

We separated 50-50 quartz phenocrysts with approximately 1 mm in diameter from sieved pyroclastic deposits. These unoriented crystals were embedded in high viscosity glue. After a while these mounts were grinded, polished, and then phenocrysts were dissolved with aceton. They were reversed, and embedded in low viscosity glue. After becoming dry, the mount was ground to about 200-250 µm of thickness, polished and separated from the glass plate. Unpolarized micro-FTIR spectroscopic measurements were at the HAS RCAES with a Bruker Hyperion 2000 IR microscope attached to a Bruker Vertex spectrometer. 'Water'-content of the phenocrysts were calculated using Beer-Lambert law.

Average calculated 'water' contents of the investigated quartz phenocrysts are 5.3±0.8 wt. ppm (Bogács) and 5.4±0.8 wt. ppm (Tibolddaróc). The similar concentrations imply, that the structural hydroxyl content of NAMs could be used as a potential tool to correlate eruptive units if post-eruptive hydrogen-loss was insignificant (e.g. fall deposits).

Several study measured 'water'-content of quartz from different environment (e.g. granite [range: 0.4 – 27.7 wt. ppm], sandstone [average: 16.6 wt.% ppm], beach sand [average: 6.5 wt.% ppm]) with polarized FTIR method [4,5]. Our results compared with these show that 'water' content of our measured quartz phenocrysts is in the lower 'water' content region of these measurements.

[1] Johnson, E.A. (2006). Water in Nominally Anhydrous Crustal Minerals: Speciation, Concentration, and Geologic Significance. Reviews in Mineralogy & Geochemistry, 62, pp. 117-154.

[2] Biró, T., Kovács, I. J., Karátson, D., Stalder, R., Király, E., Falus, G., Fancsik, T., Sándorné, K. J. (2017). Evidence for post-depositional diffusional loss of hydrogen in quartz phenocryst fragments within ignimbrites. American Mineralogist, 102, pp. 1187- 1201.

[3] Biró, T, Hencz, M., Karátson, D., Márton, E., Bradák, B., Szalai, Z. in prep. Characteristics of pyroclastic deposit from silicic phreatomagmatism at the Bükk Foreland Volcanic Area

[4] Stalder, R., Potrafke, A., Billström, K., Skogby, H., Meinhold, G., Gögele, C., Berberich, T. (2017). OH defects in quartz as monitor of igneous, metamorphic, and sedimentary processes. American Mineralogist, 102, pp. 1832-1842.

[5] Stalder, R., Neuser, R. D. (2013). OH defects in detrial quartz grains: Potential for application as tool for provenance analysis and overview over crustal average. Sedimentary Geology, 294, pp. 118-126.

Study of quartz xenocrysts and mafic enclaves from "Laleaua Alba" ("White Tulip") composite dacite dome, Gutai Mts., Romania

Ákos Kővágó[1], István Kovács[2], Sándor Józsa[1], Marinel Kovács[3], Csaba Szabó[1]

[1]Department of Petrology and Geochemistry Eötvös Loránd University, [2]Geodetic and Geophysical Institute Research Centre for Astronomy and Earth Sciences Hungarian Academy of Sciences, [3]Tech. Univ. Cluj-Napoca, North Univ. Centre Baia Mare,

Theoretical

We studied quartz xenocrysts and mafic enclaves from the Laleaua Alba ("White Tulip") composite dacite dome. The dome is located just above the Dragoş¸ Vodă deep-seated fault system [1] in the southern part of the Gutai Mts. (Romania). It is 8.5-8.0 Ma old [2], and famous for its numerous magmatic enclaves.

The enclaves were classified into two groups based on observations in the field and thin sections. According to their mafic minerals the first group is charcaterized only by amphibole, whereas the second one by both amphibole and clinopyroxene.

The textures of the enclaves of the first group is akin to diktytaxitic, but without the vesicular glassy groundmass. The second type shows panidiomorphic texture and it could refer to slower cooling rate compared to the first group. The enclaves could have crystallised from a mafic melt underplated to a cooler felsic melt. The crystallisation may have happened between the contact of the two melts or along the walls of the magma chamber [3].

Quartz xenocrysts with clinopyroxene coronas, which could be found in both types of mafic enclaves, may record different stages of magma evolution [4]. If we study these quartz xenocrysts and their pyroxene coronas we will get information about the evolution of magmas beneath the volcanic field.

We used major and trace element composition of the minerals to complete the petrographic observations. The mineral compositions and bulk rock chemistry of the enclaves suggest a basaltic parental melt. FTIR spectrometry and Raman spectrometry were carried out to determine the volatile content of the NAM's and the silicate melt inclusions to better understand the conditions of the crystallisation of the enclaves and the pyroxene corona. According to the FTIR

measurements the hydroxyl content of the minerals increases from the quartz xenocrysts towards the enclave.

[1]Tischler, M., Gröger, H.R., Fügenschuh, B., Schmid, S.M., (2007): Miocene tectonics of the Maramures area (northern Romania): implications for the mid-Hungarian fault zone. *International Journal of Earth Sciences*, *96*, **pp 473–496**

[2]Kovacs, M., (2002): Petrogenesis of Subduction-related Igneous Rocks from the Central-Southeastern Area of the Gutâi Mts. *Editura Dacia Cluj-Napoca*, **pp 201** (in romanian)

[3]Miller, T.P., Chertkoff, D.G, Eichelberger, J.C., Coombs, M.L., (1999): Mount Dutton volcano, Alaska: Aleutian arc analog to Unzen volcano*, Japan Journal of Volcanology and Geothermal Research*, *89*, **pp 275–301**

[4]Kovacs, M., Seghedi, I., Yamamoto, M., Fülöp, A., Pécskay, Z., Jurje, M., (2017): Miocene volcanismin the Oaş–Gutâi Volcanic Zone, Eastern Carpathians, Romania: Relationship to geodynamic processes in the Transcarpathian Basin. *Lithos*, *294–295*, **pp 304–318**

Metamorphic history of Algyő High

Henrietta Kondor

Department of Mineralogy, Geochemistry and Petrology, University of Szeged

Theoretical

The Algyő High is an elevated metamorphic block in the Békés-Codru Unit (Tisza Unit) with orientation NW/SE. The block is covered by thick Neogene sedimentary rocks constituting one of the greatest hydrocarbon reservoirs of Hungary. In spite of it, the lithological character and structural development of the crystalline basement is only less known. Questionable, whether it has reservoir potential and / or what was its role in hydrocarbon migration?

The aim of this study was to reveal the geological history of the basement by core samples, thin sections and geochemical analysis. Based on the results, thermobarometric models had been constructed, which are well-applicable for the identification of lithological and structural boundaries. These elements are essential from the point of view of fault mechanism, because a fault or fault zone may provide a conduit for fluid migration, or even act as a seal. In course of the petrographic evaluation, the structural, textural and mineralogical description of metamorphic rocks assisted the accurate determination of deformation events and mineral assemblages. The thin section analysis resulted the spatial and temporal separation of the major rock types. The mineral assemblage of the referring P-T conditions (i.e. greatest metamorphic grade) was calculated by software Domino/Theriak.

In the northwestern and southeastern parts of Algyő High, garnet-bearing (somewhere kyanite-bearing) polimetamorphic paragneiss and metapelites can be found. Due to the textural aspect of garnet and kyanite grains and the concerning foliations, two metamorphic events might be considered. The first event associated with biotite, garnet and rutile; while the second one associated with biotite, garnet, kyanite and rutile. By the textural position of kyanite, the garnet was replaced by it. Some core samples and thin sections showed mylonite and cataclasite rocks. In the latter, feldspar σ-clast had been identified denoting the mylonite renewal as cataclasite. In the central area, coarse-grained, feldspar-bearing monometamorphic gneisses, epidote- and clinozoisite-bearing polimetamorphic gneisses, chlorite-muscovite schists and garnet-bearing polimetamorphic gneisses were revealed.

By thin section analysis, equilibrated mineral assemblages and their stability ranges can be defined / modeled. Two samples were selected from every locally separated rock type for thermobarometric calculation. The samples from northwest and southeast are very similar in petrography and in their P-T conditions (P≈9,6-12,2 kbar; T≈480-510 °C), as well. The samples in the central part show differences in petrography, but their P-T conditions are similar (P≈11-11,6 kbar; T≈580-600 °C).

In light of the results, the basement might be characterized as locally distinct blocks suffered different metamorphic evolution. Presumably, post-metamorphic or retrograde structure boundaries are between them. If these structures are coupled with brittle deformation, fluid migration is probable through the basement.