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DIM ESEE-2 innovative workshop – Innovation in exploration



20th - 22nd October 2021

Dubrovnik, Croatia // hybrid mode (online participation enabled)

♦ WHAT IS DIM ESEE-2?

DIM ESEE v.2: Implementing innovations is a lifelong learning project focused on rising innovativeness among raw materials professionals in the region of Eastern and Southeastern Europe (ESEE), and is based on positive results and success of previous DIM ESEE school (2016-2020).

The aim is to enhance entrepreneurial and innovative capacity of the region's higher education institutions' graduates and alumni by organizing the following topics:

- Innovation in exploration (20th 22nd October 2021),
- Innovation in process-oriented orebody characterization (19th - 21st October 2022),
- Innovation in extraction (18th 20th October 2023), and
- Innovation in ore processing (16th 18th October 2024).

DIM ESEE 2021: INNOVATION IN EXPLORATION

Innovative workshop *Innovation in exploration* focuses on innovative solutions for mineral prospecting and exploration via module divided into three days:

- 1. Main challenges and needs in innovative mineral exploration and robotization.
- 2. Remote-sensing- and sensor-based techniques and their application in the construction of 3D models.
- 3. Advanced geophysical data processing and geostatistical methods and their innovative applications for mineral exploration.







Funded by the European Union

→ WHO CAN APPLY?

Raw materials professionals with good command of English language and basic knowledge related to annual school topic, working in one of the following fields: Geology, Geological engineering, Geophysics, Mining Engineering, Applied Earth Sciences and similar.

We particularly encourage applications of professionals from the following countries: Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Georgia, Greece, Hungary, Italy, Kosovo, Latvia, Lithuania, Malta, Moldova, Montenegro, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Turkey, Ukraine.

Participation fee covering accommodation, meals and all workshop activities: **400,00 € + VAT**

> Fee for online participation (payments by 13th September) **100,00 € + VAT**





LECTURER

Name of the lecturer: Assoc. Prof. Ferenc Mádai

Ferenc Madai PhD, LLM is a geologist graduated as exploration geologist (Moscow, USSR), working at the University of Miskolc as an associate professor and mid-tier manager (Deputy dean, Head of department). Second degree is an LLM from CEPMLP, University of Dundee, UK, in specialization of Mineral Law and Policy.

Between 2005 and 2011 he participated in developing standardized methods for characterisation of wastes from the extractive industry. In 2012-2014 he participated in the CriticEl project, an EU-supported Hungarian research project focusing on resource potential of critical elements from Hungarian primary and secondary resources. In 2015-2017 he has participated in the INTRAW H2020 project, as a WP member developing studies on raw materials policy of the EU and overseas target countries (Canada, USA, Japan, Australia).

In January 2016 he joined the team of the MINLEX project as WP leader, completing a report on "Legal framework for mineral extraction and permitting procedures for exploration and exploitation in the EU".

Recently, he is the coordinator of the MOBI-US EIT RawMaterials project and works as the institutional coordinator for other EIT RM projects such as TrainESEE v2, AMIR-RIS. Since July 2017 he is an appointed member of the EIP Raw Materials OG.



Name: Ferenc Mádai Title: Associate professor, Head of Institute Institution: Institute of Mineralogy and Geology, University of Miskolc Relevant website: <u>https://geology.uni-miskolc.hu/</u> Contact number: +36 46 565-111 / 12-07 E-mail: <u>askmf@uni-miskolc.hu</u>











Lecture D1U1: General (EU) policy framework for need of innovative methods in mineral exploration

This is an introductory lecture before the technique- and technology-focussed topics, showing the major documents and achievements of the last 12 years of the European minerals policy, with the focus on how these effect on the conditions of and needs for mineral resource exploration activity within the EU. Most important documents from the 2008-2012 period are the Raw Materials Initiative (RMI) and the Strategic Implementation Plan (SIP) which initiated several research and development projects for improvement of exploration techniques and technologies as well as studies and evaluations (e.g. INTRAW, STRADE, MINLEX) which analysed the socio-environmental, legal and administrative pitfalls for the exploration activity in the EU. Recent policy changes of the EU relevant to our topic are the European Green Deal and the new industrial strategy for Europe (COM (2020) 102 final) will require the update of the SIP, however, exploration for CRM shall be still an important target.

The lecture will analyse whether these important policy steps could achieve an efficient change in the volume of mineral exploration of the EU. Recent studies (STRADE project report; Regueiro et al., 2021) show that exploration activity in Europe is still low, there are little achievements concerning the second pillar of the RMI. However, some EU Member states show good examples and the rapidly developing technologies can make a breakthrough.

Wednesday, 20^{th} October, 11:00 - 11:45











LECTURER

Name of the lecturer: Richárd Z. Papp

Richárd Z. Papp has completed his BSc studies in the Eötvös Loránd University in Budapest as an environmental scientist and his MSc in the Miskolc University as an engineering geologist. He is currently finishing his PhD in mineralogy and geochemistry. His research area is sulphosalt mineralogy electron microscopy, meanwhile, he is working on developing new sensor technologies for underwater and aerial remote sensing. He has experience in different Horizon 2020 and EIT RawMaterials projects, (e.g., UNEXMIN, UNEXUP projects).

He is a research fellow in the University of Miskolc, Institute of Mineralogy and Geology and the CEO of the UNEXMIN GeoRobotics Ltd. The company is an R&D and commercial technology service provider capable of significantly extending the framework for mineral exploration and data acquisition methods, with robotic solutions (initially with underwater surveying and aerial remote sensing) and integration of all available geoscientific data acquired for greenfield or brownfield deep deposits exploration/development, covering land, the continental shelf, ocean floor and other harsh and difficult to access areas. The company is mainly commercializing the technology of the UNEXMIN/UNEXUP projects and developing.













Lecture D1U2: Innovative solutions for and challenges in underwater spaces: sensor development, robotization

In our modern world, there is a growing demand for raw materials, but many factors can stand in the way of mining, such as low-grade ore, ultra-depth or simply high-grade ore but too small deposits. Moreover, the deposits can be underwater in the ocean, on self, or on inland. To solve these difficulties, selective mining, better sorting and sensing techniques are necessary to be developed.

The future of mining shows toward the green economy, digitalization and robotization. In the lecture, the current autonomy of the mines will be described.

For sensing techniques to be able to use them in the underwater environments in operating or abandoned mines need to go through a high technical and technological development. The water and the pressure have high impact on the electromagnetic spectrum, as they modify or absorb partly or totally the electromagnetic radiation. In the lecture, the noncontact and the contact methods will be shown in detail. The currently available sensors and sensor types, moreover the own developed instruments will be shown. Via examples, the correction and limitation in the calibration method will be presented, as well as the data processing, data fusion and visualization.

Wednesday, 20th October 12:00 – 13:10 (Part 1) 14:10 – 15:30 (Part 2)

Also co-presenting

Lecture D2U3

with Boglárka Anna Topa

Thursday, 21st October 15:40 – 16:40 (Part 1) 16:50 – 17:50 (Part 2)











LECTURER

Name of the lecturer: Assoc. Prof. Norbert Zajzon

Norbert Zajzon completed his MSc and PhD studies about mineralogy, geochemistry and solid mineral resources at the Eötvös Loránd University, Budapest. His research subject was instrumental mineralogy and geochemistry related to global environmental crises, mass extinctions. Until now he is dedicated to numerous analytical techniques in the geoscience field.

He is currently an associate professor at the Institute of Mineralogy and Geology, and head of the Mineralogy – Petrology Department, University of Miskolc (Miskolc, Hungary), teaching instrumental mineralogy, ore deposits and astronomy and planetology and head of the microprobe laboratory (<u>https://geology.uni-miskolc.hu/munkatarsak/Dr--Zajzon-Norbert</u>), and co-leader of the 3D laboratory. He has experience in numerous H2020 projects, like Robominers, or UNEXMIN (<u>unexmin.eu</u>) where he was the coordinator. UNEXMIN project. The UNEXMIN results leaded to its continuation the EIT Raw Materials financed UNEXUP project (<u>unexup.eu</u>) where he also is the coordinator. He is also the scientific advisor of the UNEXMIN Georobotics Ltd, which was founded by the UNEXMIN consortium.

Nearby his university carrier, he also works for the geological society, as Co-president of the Hungarian Geological Society and fellow of the Society of Economic Geologists.

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Lecture D1U3: Case studies: exploration of flooded underground spaces, the UNEXMIN-UNEXUP story, sea-floor exploration

Via case studies, the testing and working of the specific autonomous robots in the different environments will be presented. The "technical evolution" of the autonomous robots will be shown from the UNEXMIN (UX-1 robots) to the UNEXUP projects (UX-1Neo robot).

The three robots of the UNEXMIN projects use non-invasive methods for autonomous 3D mine mapping for gathering valuable geological, mineralogical, and spatial information. This can possibly open new exploration scenarios so that strategic decisions on the re-opening of Europe's abandoned mines can be supported by actualized data that cannot be obtained by any other ways, without major costs and/or risks. The robots were tested in different underwater environments, such as the abandoned Kaatiala pegmatitic rock mine in Finland, the abandoned Idrija mercury mine in Slovenia, which is a UNESCO Heritage site, the abandoned Urgeirica uranium mine in Portugal, the abandoned Ecton copper mine in the United Kingdom or in the thermal water filled Molnár János cave in Hungary.

The UN-1Neo robot is the upscaling and improved version of the former UX-1, developed in the UNEXMIN project. UX-1Neo is a lighter, modular vehicle with better hardware, software, and geoscientific instruments. These improvements resulted in a more versatile and effective robot in the field, with more productive and cost-effective missions. This robot was tested in the abandoned Urgeirica uranium mine in Portugal, in the Csór water well and the thermal water filled Molnár János cave in Hungary, as well as in the Solotvyno salt mine in Ukraine.

Wednesday, 20th October, 15:45 – 17:15











LECTURER

Name of the lecturer: Dr. István Márton, Phd

Brief description of academic/work background (up to 200 words):

István MÁRTON has obtained BSc and Msc in Romania at the Babeş–Bolyai University, Cluj and University of Bucharest, respectively. Following a 3 years period working as Exploration Geologist in Apuseni Mts (Romania) he continued studies at the University of Geneva (Switzerland), where he obtained PhD in 2008. After a short academic post-doc research period he has joined the exploration industry and since then, he has been working in the exploration and mining industry as an Exploration Geologist and Geochemist. The lecturer has been involved in target generation, greenfield- and brownfield-exploration and geometallurgical works in 8 countries being focused on Cretaceous–Miocene epithermal Au-Ag, polymetallic carbonate replacement Pb-Zn-Cu-Au, porphyry Cu-Au-Mo, sedimentary rock-hosted gold and Archean orogenic gold deposits. Since 2009 he is working also as visiting lecturer at the University of Babeş–Bolyai University teaching *Introduction to Ore Deposits* and *Economic Geology* courses and supervises bachelor/master student projects. More recently the Lecturer is acting as principal geoscientist consultant at Dundee Precious Metals with focus on exploration geochemistry, 3D modelling and drill target generation efforts of the company in greenfield and near-mine projects in Bulgaria, Serbia, Armenia and Canada.



Name: István Márton Title: PhD Institution: Stockwork Geoconsulting Ltd & Babeş–Bolyai University (Cluj, Romania) Relevant website: <u>https://scholar.google.com/citations?user=NRvSb2EAAAAJ&hl=en</u> Contact number: +40 740 314 927 E-mail: Istvan.Marton@stockwork.ro, Istvan.Marton@ubbcluj.ro











Lecture D2U1

Part 1: Review of new analytical methodologies in exploration geochemistry

Part 2: Geochemical vectors in mineral exploration: integration, interpretation and modelling of high-precision multielement and hyperspectral datasets

Recent developments in exploration geochemistry and better instrumentation of industrial geochemical laboratories provide large and high-precision partial digestion multi-element datasets for mineral exploration projects. Additionally, the expansion of portable and benchtop XRF, SWIR and XRD devices deliver fast and reliable characterization of mineralogy and geochemistry of drill core, soil and rock samples. Furthermore, tripod- and UAV-based hyperspectral scanning and satellite-based remote sensing deliver high-resolution alteration and lithology maps for pits, underground galleries and surface outcrops. These exploration controlling aspects, about alteration footprint and optimal drill-spacing, about vectors to fertile host rocks and economic mineralization and on perspectives of geometallurgical domaining at any mineral exploration project.

The first part of the lesson will provide insights on the use of these exploration geochemical tools and interpretations. The second part of the lesson will assess various tools for 2D and 3D integration, geostatistical methodologies and interpretation of high-precision multielement and spectral datasets and the review of various geochemical vectors used in mineral exploration.

Thursday, 21st October (online lecture) 09:00 – 10:10 (Part 1) 10:20 – 11:30 (Part 2)

Lecture D2U2:

Part 1: Applications in modern geochemical exploration by using systematic sampling protocols, portable sensor-based devices and remote sensing datasets; Case study 1 - Targeting for Cu-Au epithermal system in remote areas











Part 2: Applications in modern geochemical exploration by using surface and drill hole multielement and spectral datasets. Case study 2 – 3D data integration and vectoring for high-grade ore zones in porphyry Cu-Au-Mo systems

The lesson aims to provide practical applications of modern geochemical exploration datasets thorough the review of real case studies focused on target generation and mineralization vectoring at various scales. The use of widely used and accepted software tools for data analysis and interpretation (i.e., ioGAS by Reflex) and 3D integration and modelling (i.e., Leapfrog Geo by Seequent) will be demonstrated during the workflows.

The first case study will present a target generation work at a greenfield remote area in the Caucasus, where field exploration season is very short and laboratory analysis of soil, sediment and rock samples have longer turnaround time, therefore using systematic sampling protocols, portable sensor-based devices, and remote sensing datasets provide critical aspect to support real-time decisions on drill target delineation.

The second case study will present a workflow on 3D data integration and modelling of prospect-scale surface and drill hole multielement and spectral datasets and vectoring for high-grade ore zones in a porphyry Cu-Au-Mo system from the Tertiary belt of the Balkans.

Thursday, 21st October (online lecture) 11:45 – 13:15 (Part 1) 14:15 – 15:25 (Part 2)











LECTURER

Name of the lecturer: Boglárka Anna Topa

She has received her MSc in Geology from the Eötvös Loránd University (ELTE), Budapest, Hungary in 2013. After graduation, she worked as an assistant lecturer at the Department of Mineralogy (ELTE), meanwhile, she was also the curator of the Collection of Mineral Raw Material Samples at the Hungarian Natural History Museum (Department of Mineralogy and Petrology).

During these years she gained experience with a wide range of instrumental analytical techniques related to different geological, environmental and archaeometrical investigations. Her ongoing PhD research is focusing on manganese ore deposits. She studies the behaviour and role of different manganese minerals with a complex analytical approach.

In 2021 she joined the staff of the Institute of Mineralogy and Geology at the University of Miskolc and participates in some of the currently running projects of the institute (e.g., UNEXUP) as an assistant research fellow.



Name: Boglárka Anna Topa Title: Assistant research fellow Institution: Institute of Mineralogy and Geology, University of Miskolc Relevant website: https://geology.uni-miskolc.hu/ Contact number: +36 46 565-111 / 18-05 E-mail: boglarka.topa@uni-miskolc.hu











Lecture D2U3 – Demonstration and case studies

Part 1: Demonstration of UAV-based remote sensing data acquisition and integration in 3D models

Part 2: Demonstration of portable geochemical devices

In the field of geology (especially mineral deposit related explorations) the application of remote sensing technology has undergone some significant development in the last several years. Building up 3D models with the help of drone-based photogrammetry provides a good basis for further geological interpretations. The demonstration will guide the audience step by step through the compilation of 3D models including real-life case studies with on-field videos and introduces the whole processing method from beginnings to final results.

Related to the everyday industrial needs - besides mapping - it is often desirable to get prompt preliminary geochemical information during the actual ongoing task to improve the chance of quick and precise decisions. Application of portable spectral data acquisition equipment such as XRF (X-ray fluorescence spectrometer) and LIBS (laser induced breakdown spectrometer) in on-site geochemical and mineralogical observations and judgements is a good practice to get deeper knowledge, increase efficiency and save time. The demonstration will show these types of equipment in operation with special attention dedicated to the analysis of core samples representing different types of ore deposits.

Thursday, 21st October (with Richárd Z. Papp) 15:40 – 16:40 (Part 1) 16:50 – 17:50 (Part 2)











LECTURER

Name of the lecturer: Prof. Dr. Norbert Péter Szabó

He obtained his M.Sc. degree in geophysical engineering in 1999 from Faculty of Mining Engineering, University of Miskolc. He has been continuously working from graduating at the University of Miskolc. He obtained his Ph.D. in 2005. Since 2019, he has been a full professor at the Department of Geophysics. He is currently the head of Geophysical Department and vice-dean for scientific affairs at the Faculty of Earth Science and Engineering. In addition, he is senior research fellow at the MTA-ME Geoengineering Research Group. In 2020, he defended his D.Sc. dissertation at the Hungarian Academy of Sciences. He conduct researches on geophysical inversion and exploratory (multivariate) statistical methods and their applications in earth sciences (mainly water and hydrocarbon prospecting). He delivers lectures on well logging, gravitational and magnetic exploration methods, engineering and environmental geophysics and geostatistics in the framework of BSc, MSc and PhD training programs.













Lecture D3U1: Advanced statistical analysis of multivariate (big) datasets

Introduction to basic univariate and multivariate statistical methods. The advantage of using robust statistical methods. The Most Frequent Value (MFV) method as robust statistical estimatior. Geostatistical approches; the theory of Kriging. Exploratory factor analysis of geospatial variables. Evolutionary computation-based factor analysis and its applications for improved lithological analysis and quantitative estimation of petrophysical properties. Cluster analysis of multidimensional data objects and its applications for improved lithological analysis and quantitative estimation of petrophysical analysis and hyperparameter estimation tools as an aid for a more relaible interpretation of geophysical data. Well logging applications and examples. Duration of presentation is 2 h.



Friday, 22nd October, 09:00 – 10:30

Lecture D3U3: Shallow geophysical investigations by combining seismic, geoelectric and direct-push logging methods. Near-surface structures

Shallow geophysical methods in brief: seismic refraction, multi-electrode direct current geoelectric method, direct-push logging (borehole engineering sounding) methods. Environmental investigations made by combining seismic, geoelectric and direct-push logging methods. The workflow of single inverse modeling methods. The problem of estimating the layer boundaries in joint inversion of surface geophysical data. Joint inversion of different direct-push logging datasets. Evolutionary meta-algorithmic inversion method; the genetic algorithm. Estimating the petrophysical and zone parameters











of near-surface structures as input for soil mapping and mining (e.g., gravel) applications. Duration of presentation is 2 h.



Friday, 22nd October, 13:00 – 14:30











LECTURER

Name of the lecturer: Endre Nádasi

He graduated from the University of Miskolc in 2012 as an Earth Science Engineer BSc. He obtained his MSc degree in Geological and Geophysical Engineering (major in Geophysical Engineering) in 2014. The same year, he started his PhD program in electromagnetic (EM) geophysics at the Mikoviny Sámuel Doctoral School of Earth Sciences, University of Miskolc. He has spent seven months as a Visiting Scholar during 2018 and 2019 at the Consortium for Electromangetic Modeling and Inversion (CEMI), University of Utah, USA. He is currently an assistant lecturer and PhD candidate at the Department of Geophysics, University of Miskolc. He is going to receive his PhD title in 2021. His research interests focus on EM geophysical techniques, especially magnetotelluric (MT) and ground penetrating radar (GPR) methods. He delivers lectures on geoelectric, EM geophysical methods and data processing related subjects in the framework of BSc and MSc training programs.



Name: Endre Nádasi Title: Assistant lecturer Institution: University of Miskolc Relevant website: <u>https://www.uni-miskolc.hu/~geofiz/index_en.html</u> Contact number: +3646565111 / 11-38 E-mail: <u>gfne@uni-miskolc.hu</u>











Lecture D3U2: Inversion-based modelling for the interpretation of gravity, magnetic and geoelectric datasets

The brief theory of discrete inverse theory, the types of inverse problems. The workflow of inverse modeling. Potential field datasets and basic physics. Inversion based modeling for the interpretation of gravity, magnetic and geoelectric datasets. The solution of forward problem and the discretization of Earth structures. Estimation of petrophysical characteristics by multidimensional inversion methods. Quality check possibilities, the calculation of estimation error of model parameters. Applications to prospecting ores and non-metallic mineral resources. Duration of presentation is 2 h.



Friday, 22nd October, 10:45 – 12:15











WEDNESDAY (20.10.2021.) – DAY 1st

Main challenges and needs in innovative mineral exploration and robotization

Morning session		
7:30- 8:30	Breakfast	
9:00- 10:00	Check-in and registration	
10:00 – 10:30	Welcome drink and snacks	
10:30 – 11:00	Opening ceremony	
11:00- 11:45	Lecture D1U1 General (EU) policy framework for need of innovative methods in mineral exploration Lecturer: Assoc. Prof. Ferenc Madai Affiliation: University of Miskolc - Faculty of Earth Science and Engineering, Institute of Mineralogy and Petrology	
	Coffee break (11:45-12:00)	
12:00- 13:10	Lecture D1U2, Part 1 st Innovative solutions for and challenges in underwater spaces: sensor development, robotization <i>Lecturer name</i> : Richárd Z. Papp <i>Affiliation</i> : University of Miskolc / UNEXMIN Georobotics Ltd.	
	Lunch break (13:10-14:10)	
	Afternoon session	
14:10- 15:30	Lecture D1U2, Part 2 nd Innovative solutions for and challenges in underwater spaces: sensor development, robotization Lecturer name: Richárd Z. Papp Affiliation: University of Miskolc / UNEXMIN Georobotics Ltd.	
Coffee break (15:30 -15:45)		
15:45- 17:15	Lecture D1U3 Case studies: exploration of flooded underground spaces, the UNEXMIN-UNEXUP story, sea- floor exploration Lecturer name: Assoc. Prof. Norbert Zajzon Affiliation: University of Miskolc - Faculty of Earth Science and Engineering, Institute of Mineralogy and Petrology	
17:30- 19:00	City tour	
19:00	Welcome Dinner	









	THURSDAY (21.10.2021.) – DAY 2 nd		
Remote-sensing- and sensor-based techniques and their application in the			
construction of 3D models			
	Mornina session		
7:30-	Proved facet		
8:30	Breaktast		
9:00- 10:10	Lecture D2U1, Part 1 st Review of new analytical methodologies in exploration geochemistry Lecturer name: PhD. István Márton Affiliation: Stockwork Geoconsulting Ltd / Babeş–Bolyai University		
	Coffee break (10:10-10:20)		
10:20- 11:30	Lecture D2U1, Part 2 nd Geochemical vectors in mineral exploration: integration, interpretation and modelling of high- precision multielement and hyperspectral datasets Lecturer name: PhD. István Márton Affiliation: Stockwork Geoconsulting Ltd / Babeş–Bolyai University		
	Coffee break (11:30-11:45)		
11:45- 13:15	Lecture D2U2, Part 1 st Applications in modern geochemical exploration by using systematic sampling protocols, portable sensor-based devices, and remote sensing datasets; case study 1: targeting for Cu-Au epithermal system in remote areas <i>Lecturer name: PhD. István Márton</i> <i>Affiliation: Stockwork Geoconsulting Ltd / Babeş–Bolyai University</i>		
	Lunch break (13:15-14:15)		
	Afternoon session		
14:15- 15:25	Lecture D2U2, Part 2 nd Applications in modern geochemical exploration by using surface and drill hole multielement and spectral datasets; case study 2: 3D data integration and vectoring for high-grade ore zones in porphyry Cu-Au-Mo systems. Lecturer name: PhD. István Márton Affiliation: Stockwork Geoconsulting Ltd / Babeş–Bolyai University		
Coffee break (15:25-15:40)			
15:40- 16:40	Practical demo D2U3, Part 1 st Demonstration on portable geochemical devices and UAV-based remote sensing data acquisition and integration in 3D models <i>Lecturer name:</i> Boglárka Anna Topa, Richárd Z. Papp Affiliation: University of Miskolc / UNEXMIN Georobotics Ltd.		
	Coffee break (16:40-16:50)		
16:50- 17:50	Practical demo D2U3, Part 2 ^{na} Demonstration on portable geochemical devices and UAV-based remote sensing data acquisition and integration in 3D models Lecturer name: Boglárka Anna Topa, Richárd Z. Papp Affiliation: University of Miskolc / UNEXMIN Georobotics Ltd.		









FRIDAY (22.10.2021.) – DAY 3 rd		
Advanced geophysical data processing and geostatistical methods and their		
innovative applications for mineral exploration		
Morning session		
7:30- 8:30	Breakfast	
9:00- 10:30	Lecture D3U1 Advanced statistical analysis of multivariate (big) datasets Lecturer name: Prof. Norbert Szabo Affiliation: University of Miskolc, Faculty of Earth Science and Engineering, Institute of Geophysics and Geoinformatics	
Coffee break (10:30-10:45)		
10:45- 12:15	Lecture D3U2 Inversion-based modelling for the interpretation of gravity, magnetic and geoelectric datasets Lecturer name: Endre Nádasi Affiliation: University of Miskolc	
Lunch break (12:15-13:00) (Shorter)		
	Afternoon session	
13:00- 14:30	Lecture D3U3 Shallow geophysical investigations by combining seismic, geoelectric and direct-push logging methods. Near-surface structures Lecturer name: Prof. Norbert Szabo Affiliation: University of Miskolc, Faculty of Earth Science and Engineering, Institute of Geophysics and Geoinformatics	
	Coffee break (14:30 – 14:40)	
14:40- 15:00	EIT RawMaterials activities in other regions	
15:00- 15:30	Closing Ceremony	
	18:00 Dinner	

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