TIRMEX Summer Field School
on Innovative Mineral Exploration
29 May – 02 June 2023, Bosnia and Herzegovina

Introduction

The objective of the school is to introduce innovative mineral exploration methods and techniques with special focus on metallic mineral commodities. The program is designed for earth science master students, primarily from the East-South-Eastern European (ESEE) region. Master students from field of mining engineering are also welcome.

Bosnia and Herzegovina (B&H) is currently in the focus of European mineral resource exploration due to its critical raw material potential, with over 120 critical raw materials deposits and occurrences known in B&H. During the summer field school students will have opportunity to visit three different and significant mineral regions in Bosnia and Hercegovina. First region to visit is Ljubija iron ore region with three open-cast pits: Omarska, Adamuša and Ciganuša. Second one is the Jajce bauxite-bearing region and the third one is polymetallic mining area of Vareš town.

Application

Students of the TIMREX Summer Field School will have the opportunity to investigate all this impressive raw material deposits from iron ores to bauxite and dimension stone and to learn importance of data collection, analysis, modelling and interpretation of results as the first major step in exploration and exploitation decision making.

The TIMREX project supports the participation of the students by a scholarship up to 400 € to cover the travel and subsistence costs during the summer school field programme. Arrival to and from Zagreb is not covered by the project. Eligibility for the scholarship will be defined by external evaluators based on the completed registration form:

https://forms.gle/bhKXYP6yrgfL9WWRA

Upon successful completion of the summer school a certificate on 3 ECTS is given to the students.

Application deadline: 2 May 2023, 24:00 (CET)

eit RawMaterials Connecting matters

Co-funded by the European Union

Detailed program of the school

Introductory Lectures (online)
Practical classes, demos
Field programs
Social programs

Introductory online lectures

23 May 2023

time	Topic	Leaders
4-5 PM	Regional Geology of the Western Balkans	Sibila Borojević Šoštarić, UNIZG-RGNF
5-6 PM	Overview of metallic mineral deposits of BIH	Sibila Borojević Šoštarić, UNIZG-RGNF

24 May 2023

time	Topic	Leaders
4-5 PM	Innovative analytical methodologies in exploration geochemistry	István Márton, Stockwork Ltd.
5-6 PM	Integration, interpretation and modelling of multielement geochemical and geophysical datasets	Tomislav Brenko, UNIZG-RGNF Jasna Orešković, UNIZG-RGNF

25 May 2023

time	Topic	Leaders
4-5 PM	Specific exploration methods of dimension stone deposits	Ana Maričić, UNIZG-RGNF
5-6 PM	Karst Bauxites - potential REE resources?	Andrea Mindszenty, Eötvös Loránd University, Budapest

Summer Field School programme

28 May 2023
15:00 – 16:00: meeting in Zagreb, Pierottijeva street 6
16:00 – 19:00 travel to Prijedor (BIH) and accommodation

29 May

Time	Location	Topic	Leaders
9 – 13	Prijedor	Omarska open-pit mine Topic: geochemistry of Iron and manganese Visit to the ore processing plant (gravity – magnetic separation)	Sibila Borojević Šoštarić, UNIZG-RGN Local geologist
13 – 14			
14-15		Lunch	

15-18		Cabinet work in groups: Link between geochemistry and field mineralogical data	Cabinet work in groups: Link between ore geochemistry before and after processing	Sibila Borojević Šoštarić, UNIZG-RGNF Tomislav Brenko, UNIZG-RGNF
19 –		Dinner		

30 May

time	Location	Topic	Leaders
9 – 13	Prijedor	Adamuša and Ciganuša – iron ore open-cast pit Topic: geological setting and main features of deposits influencing the exploitation	Sibila Borojević Šoštarić, UNIZG-RGNF Local geologists
13 – 14		Lunch	
14 – 16		Advanced geophysical methods in mineral exploration (Magnetometry, Electric resistivity tomography – ERT) – differences between methods and advantages of geophysical methods during exploration of deposits	Josipa Kapuralić, UNIZG-RGNF
16 – 18	Jajce	Travel to Jajce	
19 –		Dinner	

31 May

time	Location	Topic	Leaders
8 – 12	Jajce	Jajce underground bauxite mine Topic: observation of stratigraphical setting influencing exploitation	Sibila Borojević Šoštarić, UNIZG-RGNF Local head geologist at Rudnik boksita Jajce
12 – 15		REE geochemistry observations / profiling at open-pit Skakavac profile	Tomislav Brenko, UNIZG-RGNF
15 – 17		Dimension stone quarry: specific issues of dimension stone exploration and resource assessment	Ana Maričić, UNIZG-RGNF
17 – 20		Travel to Kakanj	
20 –		Dinner	

1 June

time	Location	Topic	Leaders
9 – 15	Kakanj / Vareš	Vareš mining area Topic: precious and base metal site development	Local geologists
15 – 16		Lunch	
16 – 18		Geochemistry and core analysis cabinet work Importance of data analysis and modelling of different data sets during exploration phase, and its influence on exploitation.	Sibila Borojević Šoštarić, UNIZG-RGNF Local geologists
19 –		Dinner	

2 June

time	Location	Topic	Leaders
8 – 12	Kakanj	Students' presentations – work in groups Students will present their results. Each group will present different sets of data that are connected to iron ores, bauxite and dimension stone deposits.	Sibila Borojević Šoštarić, UNIZG-RGNF Tomislav Brenko, UNIZG-RGNF Ana Maričić, UNIZG-RGNF
12 – 13		Closing event + Lunch	
13 – 18		Return to Zagreb / return home from Sarajevo	

Course leaders

Sibila Borojević Šoštarić is Professor at the University of Zagreb – Faculty of Mining, Geology and Petroleum Engineering. Her main scientific interest in detailed mineralogical, petrological, and geochemical analysis with emphasis on ore deposits, mineralization and metallogeny.

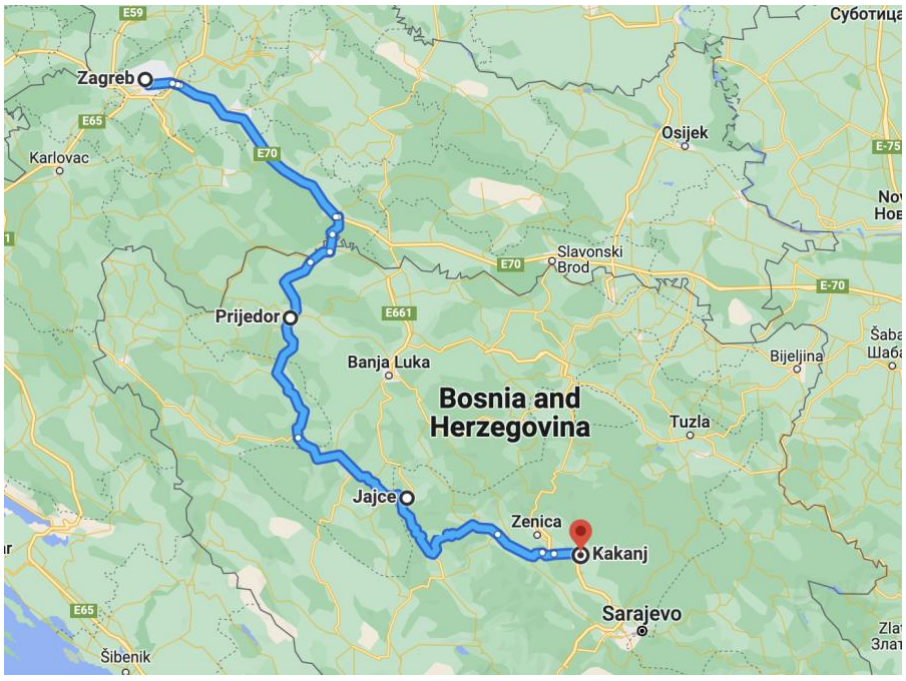
Ana Maričić is Associate Professor at the University of Zagreb – Faculty of Mining, Geology and Petroleum Engineering. Her main scientific interest is in assessment and qualification of natural building stone, aggregates, sand and gravel deposits and determination of its of properties and durability when used in civil engineering constructions.

Tomislav Brenko is a postdoctoral researcher at the University of Zagreb – Faculty of Mining, Geology and Petroleum Engineering. His main scientific interests include detailed geochemical and mineralogical analyses, statistical modelling of data and provenance studies in geoarchaeology, with an emphasis on iron ore.

István Márton has been working in the exploration and mining industry as an Exploration Geologist and Geochemist, 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 ha 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.

Andrea Mindszenty is a Professor Emeritus at the Department of Applied Geology of Eötvös Loránd University, Budapest. She has worked for 10 years as an exploration geologist in the aluminium industry in Hungary and abroad (Nigeria, Pakistan, VietNam, Cuba); visited and studied bauxite deposits of India and those of the Mediterranean countries like Italy, former Yugoslavia etc. She joined the University staff in 1981 and has worked in the education of students of geology ever since then. She was co-leader of IGCP Project 287 „Tethyan Bauxites" in 1989-1993. Her major research interest has been: Unconformity-related phenomena (Bauxites and Paleosols/Paleokarst, Travertines, Submarine hardgrounds), Carbonate diagenesis/porosity evolution, Urban Geology, and REE-enrichment in bauxites and Bayer-residue. Currently she is national correspondent of Hungary for the International Association of Sedimentologists (IAS).

Site information



Omarska, Adamuša and Ciganuša open-cast pits near Prijedor are part of the Ljubija siderite-ankerite-limonite ore region related to Early Permian intracontinental rifting containing 50 iron ore deposits and over 100 ore occurrences. Primary carbonate iron ores are siderite and ankerite while limonite is a secondary oxidised ore. Manganese content is several percent. Omarska is the most significant iron ore deposits with primary ore within Carboniferous clastic and carbonate rocks. Unlike Adamuša and Ciganuša pits, Omarska pit is still active where ore is processed in a modern gravity – magnetic separation processing plant. Siderite-limonite ore body in Adamuša pit, according to rough estimation, is 800 m in length, 500 m in width and with thickness up to 40 m while siderite-ankerite and limonite ore bodies in Ciganuša pit have dimension of 1,600 x 1,200 m and total area of 1.25 km^2.

In the Jajce bauxite-bearing area numerous high-quality karst bauxite deposits, with high Al_2O_3 and low SiO_2 content, are located. In Bešpelj, Crvene Stijene, and Poljane districts bauxite exploration and exploitation are done by underground methods while Skakavac

deposit is exploited by surface exploitation. Furthermore, two quarries of dimension stone are associated with bauxite deposits: Crvene Stijene, presented by reddish breccias, and polymict grey conglomerates in the hanging wall to bauxite deposits, and Poljane with light grey fossiliferous limestones from footwall of bauxite deposits.

The mining town and area of Vareš has a significant mining history dating back to Bronze Age. Several iron and polymetallic (lead, zinc, barite, silver, gold) deposits within a 30 km x 10 km sedimentary formation were discovered there. The polymetallic mineralization in the Vareš region is associated with Middle Triassic advanced rifting. Mineralisation includes siderite, manganese-rich hematite, barite, pyrite, marcasite, chalcopyrite, galena, sphalerite, tetrahedrite and Pb-sulphosalts.