THE SCIENTIFIC MEETING

GEOCHEM 2021 - Geochemical Society Meeting

GEOCHEM 2021

ABSTRACT BOOK

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ORGANIZERS:

RUĐER BOŠKOVIĆ INSTITUTE, ZAGREB, CROATIA

COMMITTEE FOR GEOCHEMISTRY
CROATIAN ACADEMY OF SCIENCES AND ARTS, ZAGREB, CROATIA

UNIVERSITY IN TROMSØ
THE ARCTIC UNIVERSITY OF NORWAY, NORWAY

WITH THE SUPPORT OF:

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DEPARTMENT OF GEOLOGY, FACULTY OF SCEINCE, ZAGREB, CROATIA

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MEETING PROGRAMME

Day 1	
09:00 – 09:15	Registration of participants
09:15 – 09:30	Welcome speech and opening
09:30 – 10:30	***Recent ore-forming processes – Insights from subaerial and submarine hydrothermal systems*** Assoc. prof. Sabina Strmić Palinkaš (UiT The Arctic University of Norway, Tromsø, Norway)
10:30 – 11:30	***St. Jakob (Croatia) Pb-Zn mineral deposit in the Dachstein dolomites, Loferitic facies, Medvednica Mts. - A connection between the Alps and the Dinarides*** Prof. Ladislav A. Palinkaš (University of Zagreb, Zagreb, Croatia)
11:30 – 12:00	Coffee break
12:00 – 13:00	***Precambrian ore deposits and the role of Great Oxidation Event*** Prof. Ferenc Molnar (Eötvös Loránd University, Budapest, Hungary)
13:00 – 14:00	Lunch break
14:00 – 14:15	***Petrogenesis of mafic pegmatites: An insight from gabbroic pegmatites at the Hamn in Senja locality, Northern Norway*** Paul Heckmann (UiT The Arctic University of Norway, Tromsø, Norway)
14:15 – 14:30	***Genetic model of Paleoproterozoic sediment-hosted copper deposits in Northern Norway: A case study from the Repparfjord Tectonic Window*** Yulia Mun (UiT The Arctic University of Norway, Tromsø, Norway)
14:30 – 14:45	***Evolution of Ore-Bearing Fluids in The Vršnik Ore Body, The Bučim Porphyry Copper Deposit, Republic of North Macedonia*** Iva Jurković (Prehnit d.o.o., Zagreb, Croatia)
14:45 – 15:00	***Hydrothermal alterations of Vrshnik ore body in Cu porphyry deposit of Buchim, Republic of North Macedonia*** Ivor Perković (Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Croatia)

Day 2	
09:15 – 10:15	***Methane hydrates and global warming*** Dr. Jasmina Obhođaš (Ruđer Bošković Institute, Zagreb, Croatia)
10:15 – 11:15	***Global carbon sequestration*** Andrija Vinković (Ruđer Bošković Institute, Zagreb, Croatia)
11:15 – 11:45	Coffee break
11:45 – 12:00	***Neotethyan rifting related peperitic basaltic occurrences in the Dinarides, Hellenides and in the displaced fragments of the Dinarides*** Gabriella B. Kiss (Eötvös Loránd University, Budapest, Hungary)
12:00 – 12:30	**Mawat ophiolite complex-orogen in progress Kurdistan, Iraq** Ladislav A. Palinkaš (Faculty of Science, University of Zagreb, Croatia) Tola Ahmed Mirza (Suleymania university, Kurdistan, Iraq)
12:30 – 13:30	Lunch break
13:30 – 13:45	***Volcano-Sedimentary group, Mawat area Iraqi Kurdistan Region*** Jabbar Qaradaghi (University of Sulaimani, NE Iraq)
13:45 – 14:00	***Mineralogy, Geochemistry, and Origin of Gallala oxide and sulfide Mineralization, Walash - Noepurdan Series Kurdistan Region-NE-Iraq*** Twana Ahmed Mustafa (University of Sulaimani, NE Iraq)
14:00 – 14:15	***The origin of Zn-Pb-Ag ore deposit Bashibos*** Aleš Šoster (University of Ljubljana, Slovenia)
14:15 – 14:30	***Ardennite and phengite from sulfide-free ores with chalcophile metals from Nežilovo, North Macedonia*** Marko Bermanec (Faculty of Science, University of Zagreb, Croatia)

Day 3	
09:15 – 10:15	***Source rock characteristics in Kurdistan Region, N Iraq: insights from organic geochemistry and petrology*** Prof. Ibrahim M. J. Mohialdeen (University of Sulaimani, Sulaimani, Kurdistan)
10:15 – 11:15	***Contribution of environmental pollutants to metabolic disorders*** Dr. Juan Pedro Arrebola (University of Granada, Granada, Spain)
11:15 – 11:45	Coffee break
11:45 – 12:00	***Air Dispersion Modelling*** Iris Rammelmüller (Alpen-Adria University Klagenfurt, Austria)
12:00 – 12:15	***Differences in the behaviour of trace and rare-earth elements in oxidizing and reducing soil environments*** Ivor Perković (Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Croatia)
12:15 – 12:30	***Trace elements as pollution and palaeoredox proxies and indicators of sediment provenance in marine lakes*** Nevenka Mikac (Ruđer Bošković Institute, Zagreb, Croatia)
12:30 – 13:30	Lunch break
13:30 – 13:45	***Bivalve Callista chione – archive of high resolution trace element data*** I Hana Uvanović (Institute of Oceanography and Fisheries, Split, Croatia)
13:45 – 14:00	***Serum phthalate levels and markers of inflammation*** Celia Pérez Díaz (University of Granada, Granada, Spain)
14:00 – 14:15	***Forensic study of gigapascal-scale explosive events in Earth history: evidence, methods of study and some results*** Marina Čalogović (ProGEO-Croatia, Zagreb, Croatia)
14:15 – 14:20	***Possible causes for geochemical characteristics of Međimurje county water? - poster presentation*** Laura Kozjak (Faculty of Science, Zagreb, Croatia)

ORE GEOLOGY & GEOCHEMISTRY

SECTION

CHAIR:
Dr. Željka Fiket

Invited talk

Recent ore-forming processes – Insights from subaerial and submarine hydrothermal systems

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Submarine hydrothermal systems represent one of the most spectacular examples of recent ore-forming environments. An increased geothermal gradient, associated with extensional tectonics along divergent plate boundaries, drives the subseafloor hydrothermal circulation. Seawater circulates to depths of several kilometres and undergoes progressive changes of its physicochemical properties, including temperature, density, pH and REDOX potential. The modified seawater, i.e. hot, acidic and reduced fluid, has a huge capacity to leach and transport metals (such as Cu, Zn, Au, Fe, Mn and Co) from the oceanic crust. The temperature of the fluid can exceed 400°C and at those temperatures, the fluid becomes buoyant and rises rapidly back to the seafloor. The mixing of upwelling hot, acidic, reduced and metal-bearing fluids with cold, alkaline, relatively oxidized and metal-depleted seawater results in rapid precipitation of new mineral species including metal-sulphides, Ca and Ba sulphates and silica polymorphs.

Geothermal fields formed along continental rift zones represent sites of ore-forming processes in recent subaerial systems. In these environments, an increased geothermal gradient, associated with extensional tectonics, promotes deep circulation of meteoric water. The modified meteoric water hydrothermally alters continental crust and leaches metals (in particular Pb, Zn, Au, and Ag). Like in the submarine hydrothermal systems, the hydrothermal fluid reach temperatures close to 400°C, become buoyant and rise back to the surface. The mixing of hot hydrothermal waters with cold groundwaters, changes in REDOX potential due to water-rock interactions and a phase separation in shallow parts of the geothermal systems have been recognized as efficient mechanisms for deposition of metal-sulphides, silica polymorphs and variable amounts of carbonates.

Invited talk

St. Jakob (Croatia) Pb-Zn mineral deposit in the Dachstein dolomites, Loferitic facies, Medvednica Mts. - A connection between the Alps and the Dinarides

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The Pb and Zn ore deposit of St. Jakob (ore paragenesis: galena, sphalerite, pyrite) is situated on Mt. Medvednica (Croatia), within the Dachstein dolomite, an aerially isolated block, overthrusted on the parautochthonous underlying Palaeozoic-Triassic magmatic-sedimentary complex, a unit overprinted by Early-Cretaceous middle-grade metamorphism. The age of carbonate host rock is Norian/Rheatian as determined by Megalodonts in the Lofer cyclothemes, with A,B,C,D, elements of the peritidal-lagoonal cyclicity, and erosional disconformities. This associates them with a series of Norian dolomites that are part of the Triassic clastics and platform carbonates nappe, situated several kilometers SW in the Podsused quarry (Fuček et al. 1995). The identification of the ore dolomites as a separate unit suggests that the Triassic carbonate nappe once covered a larger area, most of which is now eroded with the dolomites remaining as a klippe. The deposit has been studied by mapping, different geochemical methods, stable and radiogenic isotopes, fluid inclusion study (destructive and non-destructive methods, Raman spectrometry, organic geochemistry, microtectonics, ore microscopy) and XRD. The basics of the complex investigation achieved by a number of contributors, could be summarised in this short paragraph. The dolomites have enriched LREE and depleted HREE. Negative Eu and Ce anomalies indicate formation in an anoxic marine environment. Four types of fluid inclusions were identified in quartz veins syngenetic with the ore in the dolomites. Quartz veins from the adjacent sheeted marbles (part of the Palaeozoic-Triassic complex) contained only 3 fluid inclusion types. The primary ore fluid, present only in the ore dolomites, is represented by two-phase inclusions with a methane-rich vapor phase, and an H2O-NaCl-KCl-$CaCl_2$ liquid phase with a salinity of 5 wt. % NaCl eqv. The secondary fluid, present in quartz veins from both rocks, is represented by two-phase inclusions with a CO_2 rich vapor phase and H_2O liquid phase with a salinity of 4 wt. % NaCl eqv. Very high homogenization temperatures indicate leakage (and subsequent healing) of inclusions. X-ray diffraction revealed the secondary ore minerals: smithsonite, montmorillonite, chlorite and muscovite. Lead isotope patterns from St. Jakob showed anomalous lead characteristics, but they are in perfect accordance with the lead isotope values for Mežica, a member of the Alpine MVT, Pb-Zn ore deposits. The origins of lead are probably deep basement rocks, remains from a previous orogeny. The simple paragenesis, host rock type, epigenetic nature and anomalous lead values of the St. Jakob Pb-Zn deposit are strong evidence for its characterization as a Mississippi-valley type ore deposit. Both the Mežica and St. Jakob deposits were formed during a compressive regime, emplaced after advanced rifting stage of the Neotethys ocean, in Upper Triassic time. Incipient closure of the Neotethys, is related to intraoceanic subduction and obduction processes of ophiolites, on the passive platform margin, which classifies them as Bleiberg (Alpine) subtype of MVT deposits. Their numerous depositional similarities, placed in the Loferite facies, and age of

the host rocks of the Upper Triassic time, suggest a strong connection between the Southern Alps and the Dinarides, and is a step towards clarifying the evolution of the Neotethys Ocean in its early history in the tectonised Internal Dinarides. Acknowledgment goes to all those who participate in the research through classifying contributions (diploma works, master theses), or individual analytical works done in the Lausanne University with kindness of prof. J. Spangenberg and prof. W. Prochaska in the Montanuniversität Leoben, of prof. Neubauer in Salzburg University.

Oral presentation

Petrogenesis of mafic pegmatites: An insight from gabbroic pegmatites at the Hamn in Senja locality, Northern Norway

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Mafic pegmatites occur in various geological environments including ophiolites, layered magmatic intrusions, and volcanic arcs, but their petrogenesis has been poorly constrained. Mineralogically and texturally zoned as well as homogeneous gabbroic pegmatites from the Palaeoproterozoic mafic-ultramafic Hamn intrusion the Hamn in Senja locality, Northern Norway, were investigated to provide a better understanding of the main magmatic physicochemical factors that control the development of pegmatitic textures in mafic rocks. The homogeneous gabbroic pegmatites show the same rock-forming mineral assemblage and mineral chemistry of the major mineral phases compared with its associated host rock. However, the homogeneous pegmatite can be distinguished from its host rock by abundant epidotization and scapolitization, suggesting that H2O- and Cl-rich magmatic fluids played an important role in the evolution of this type of pegmatite. In contrast, the zoned pegmatites are internally differentiated in terms of grain size, and mineral composition. A characteristic comb-like diopside layering shows a change from numerous small to fewer larger grains from the rim towards the core of the pegmatite pocket, which suggests that the pegmatite-forming melt experienced a change from a high nucleation rate vs growth rate ratio to a low nucleation rate vs growth rate ratio, which can be explained by a decrease in the degree of undercooling with ongoing crystallization from rim to the core of the pockets. The zoned pegmatites do not show any pieces of evidence of involvement of H2O- and Cl-rich magmatic fluids but, in contrast to the homogenous type of pegmatites, fluid inclusions hosted by diopside and quartz record a presence of CO2.

Oral presentation

Genetic model of Paleoproterozoic sediment-hosted copper deposits in Northern Norway: A case study from the Repparfjord Tectonic Window

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Sediment-hosted copper deposits of Nussir and Ulveryggen occur within the Paleoproterozoic Repparfjord Tectonic Window (RTW) in Northern Norway. RTW represents a 2.1 Ga old volcano-sedimentary complex composed of mafic volcanic rocks interlayered with marine carbonates and siliciclastic rocks. The complex was subjected to the Svecofennian orogeny (1.92-1.75 Ga) resulting in extensive deformations and regional greenschist facies metamorphism. The mineralization of the Nussir was precipitated in brittle dolostones in forms of veins while the mineralization at the Ulveryggen deposit is disseminated within porous arkosic sandstones. Major ore minerals in both deposits are chalcopyrite, bornite, chalcocite, covellite, sphalerite, associated with minor amounts of pyrite, silver minerals, galena, tellurides and native Bi. The petrographic and microthermometric study of fluid inclusions combined with the sphalerite geothermometry revealed the temperature of mineralizing fluids in the range between 320 and 350°C at the pressure of 150-175 bars. Overlapping δ13C and δ18O values between hosting metadolostones and mineralized veins, and a wide range of salinities suggest that metals including Cu were leached by basinal brines from mafic volcanics under rock-buffered conditions in a closed system. The study revealed key factors that control the formation of sediment-hosted Cu deposits including: 1) presence of mafic volcanics as the main source of metals; 2) evaporites as a source of Cl- important for mobilization of base metals; 3) orogenic tectonics as a trigger for mobilization of basinal brines and 4) rheologic properties of host rocks leading to formation of diverse types of textures in different types of sedimentary host rocks.

Oral presentation

Evolution of Ore-Bearing Fluids in The Vršnik Ore Body, The Bučim Porphyry Copper Deposit, Republic of North Macedonia

Iva Jurković

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The Bučim porphyry Cu deposit is located in the contact zone between the Serbo-Macedonian Massif and the Vardar Zone approximately 90 km south-east from Skopje, Republic of North Macedonia. The total ore reserves have been estimated at 170 million metric tons with 0.3 wt.% Cu and 0.3-0.5 g/t Au. The mineralization is spatially and temporary associated with subvolcanic intrusions of the latitic and latitic-andesitic composition that intruded Precambrian gneisses and amphibolites of the Serbo-Macedonian Massif. Vršnik is one of four ore bodies at the Bučim Cu deposit. The mineralization occurs in forms of dissemination and stockworks. The main ore mineral is chalcopyrite accompanied with variable amounts of pyrite, magnetite, hematite, quartz and carbonates. This study brings an insight into the evolution of ore-bearing fluids at the Bučim Cu deposit recorded by fluid inclusions entrapped in syn-ore quartz of the Vršnik ore body. Seven types of fluid inclusions and four types of fluids have been identified. High-salinity (30 – 60 wt% NaCl) and high-temperature (Th=400°C - >660°C) fluid inclusions with ore daughter minerals represent the main ore-bearing fluid. Their coexistence with vapour-rich inclusions reflects boiling as the main depositional mechanism in the Vršnik ore body. Post-ore fluids are characterized by lower salinities and a decrease in temperatures reflectreflecting an increased contibution of meteoric water.

Oral presentation

Hydrothermal alterations of Vrshnik ore body in Cu porphyry deposit of Buchim, Republic of North Macedonia

Ivor Perković[1], Sabina Strmić-Palinkaš[2,3], Andrea Čobić[4], Goran Tasev[5], Todor Serafimovski[5]

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The Buchim Cu-porphyry deposit is an active copper mine, situated in the contact zone of Serbo-Macedonian Masiff and Vardar zone, approximately 80km SE from Skopje, capital of the Republic of North Macedonia. On the regional scale, it is in the central part of the Lece-Chalkidiki metallogenic zone. The genesis of the deposit is related to the intrusion of several dykes of latitic to latitic-andesitic composition into the basement rocks of the Serbo-Macedonian Masiff. Copper mineralization is deposited as disseminations and stockwerk veins, with principal ore minerals being chlacopyrite, bornite, cubanite, pyrite and magnetite. Hydrothermal alteration is associated with ore mineralization and was analyzed in the Vrshnik ore body, one out of four ore bodies which compose the Bučim Cu-porphyry deposit. Four alteration zones were determined: potassic, phyllic, argillic and chloritic. The potassic alteration is characterized with siderite and biotite deposition together with biotitization of mafic minerals. Kaolinization and sericitization of feldspars characterizes the phyllic alteration. Argillic alteration is represented with the replacement of sericite with illite and smectite. Replacement of mafic minerals with calcite and chlorite is typical for the chloritic alteration. The potassic alteration formed first, from high temperature hydrothermal fluids. The phyllic alteration zone formed from acidic fluids with the argillic alteration forming as a halo around the phyllic alteration. The chloritic alteration formed around the contact zone of the intrusion and gneisses, where water-rock interaction was the highest. The absence of the propylitic alteration zone, indicates the exposure of the shallower part of the porphyry system.

Oral presentation

Neotethyan rifting related peperitic basaltic occurrences in the Dinarides, Hellenides and in the displaced fragments of the Dinarides

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The presentation aims to provide a review of our detailed volcanological, mineralogical, petrological and geochemical studies performed at various Triassic submarine basaltic volcanic series. The studied locations represent the advanced rifting stage of the Neotethyan Ocean and are found in the Dinarides, Hellenides as well as in the displaced fragment of the Dinarides. Six different volcanological facies are composing the submarine basaltic lava flows, out of which the peperitic facies is of highest importance. Its occurrence is a clear evidence of rifting related origin, it can be used in the field to distinguish these associations from the Jurassic ophiolites occurring in the same mélange, it has effects on the fluid-rock interaction as well as it serves as a tool for geological correlation.

Oral presentation

Mawat ophiolite complex-orogen in progress Kurdistan, Iraq

Ladislav A. Palinkaš

(Faculty of Science, University of Zagreb, Croatia)

Tola Ahmed Mirza

(Suleymania university, Kurdistan, Iraq)

Tectonic analysis of the Mawat ophiolit complex registered system of rupture elements of variable intensity and strike directions. The first order E-W elements delineate the boundaries among three major tectono-stratigraphic units: i) Nothern Mawat Group (NMG), Cretaceous-Tertiary metavolcanics, metasediments and mélanges, roofed by Gimo metamorphosed formation, (ii) Median Intrusive complex (MIC), with basics and ultramafics, and (iii) Southern Waraz Group (SWG), Cretaceous-Tertiary meta-volcanics, metasediments with mélange elements.

SWG has fully developed sheeted dyke complex, while its existance in the former two is ambigues, what infers important anticipation on their genesis. In addition, NMG and MIC have significantly different mélange units.

The genesis and architecture of the mélanges reflect their disparate tectonic evolution even at the last stages of Mawat suturing, during obduction on the Arabian stable shallow shelf.

The the sea-floor meta-basic rocks of Waraz are a complex association of extrusives and intrusives. It consists of 600-1000 m of basalt intruded by layered and isotropic gabbros, diorites, dolerite dykes, and late stage plagiogranite differentiates.

The Waraz Mawat Group consists of: (i) Upper pillow lavas, (ii) Lower pillow lavas, (LPL), host of copper mineralisation (iii), Sheeted dyke formation (SDF) and (iv) Gabbro-diabase formation, (GDF). Sulphide mineralisation in the Mawat ophiolites is a part of the sub-sea floor alteration process. The mineralisation events in the Waraz meta-basalts are diachronous and not formed from the single fluid and under the same P/T conditions. Its polyphase character could be constrained, at least, into two major episods: 1) The low temperature (LTH) and 2) The high temperature hydrothermal episode (HTH).

Ore paragenesis includes primary sulfide minerals in decreasing order: pyrite, chalcopyrite, sphalerite, bornite, magnetite, as stains and void-fillings in the „stockwork“ or „stringer“ type ore body. The massive stratiform sulfphides , as well as ascertained feeder zones, have not been detected. It suggests low temperature diffusive upflow, exiting from cracks and crevices on the basalt floor.

A Plagiogranite intrusion in the Waraz prospect area plays active role in the ore forming process, but not exclusive as a shallow focus of heat and metals for genesis of the overlying massive sulfide deposit. It is responsible for the HTH episode. The Waraz plagiogranite intrusive is accomodated in the fault zone between the Southern Mawat Group and Median Intrusive Complex, in extension of the “Shear zone” along the western border of the Mawat trust-sheet nappe system, in NW-SE direction.

The low-temperature mineralisation with chlorite-rich stockwork is overprinted by the high temperature, epidote-dominated. The former is related to the ridge-axis hydrothermalism within fast-spreading rift, and the latter to the off-axis hydrothermal circulation. The temporal and spatial displacement of the latter was created by ridge propagation or supra-subduction initiation in the slow-spreading rift.

The major VMS deposit prospects and Cu-ore showings are situated within the „Shear Zone“. The „Shear zone“ (SZ) is a gently arcuated tecto-magmatic belt (SZ), 20-200 m wide, trending NW-SE, from Mawat village toward the Waraz area. It encountered basic and acidic intrusions, diorites, quartz dolerites and plagiogranites, with pervasive epidotisation, as a dominant alteration process.

Mawat prospect area, a part of the NMG, significantly differs from those in the MIC and SMG. It points to disparate tecto-magmatic history of the three lithostratigraphic units of the Mawat ophiolite complex, MIC, NMG and SMG.

The mélanges in the NMG engulf huge, exotic, deca-meter blocks of Hallstatt varigated marls and limestones, basalt flows and peperite facies. Triassic exotic formation in the Mawat mélange incorporates between lava flows and peperitic rocks thick layers of ochre, presumed to be SEDEX type mineralisation. Mawat suture complex offers a plethora of tecto-magmatic processes, applicable at other objects and events not only in the Zagros orogenic belt but along entire the Alpine-Himalayan orogenic system in the frame of Neo-Tethyan Wilsno cycle.

Oral presentation

Genesis and Tectonics of Basaltic pillow lava and Peperites within Walash Volcano-Sedimentary group, Mawat area Iraqi Kurdistan Region

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Iraqi Zagros Suture Zone (IZSZ) extends along the Northeastern part of Iraqi territory i.e Kurdistan Region. Geological investigations in this area are difficult and full of problems. Geologists face many obstacles in this area as it's a boundary between Iran and Iraq. Political and Geographical factors are major obstacles to geologists. Iran-Iraqi eight years war yield land mines along the Iraqi Zagros Suture Zone. Besides, the area is interested in the geological study, especially petrological study. Although the area represents the best outcrops of ophiolitic ranges, it is poorly investigated and need more mapping and petrological investigation. Acidic, intermediate, basic and ultrabasic igneous intrusions are dominants while lowgrade to amphibolite facies metamorphic rocks are recorded within IZSZ.

Basaltic magma erupted under high hydrostatic pressure produces non-explosive eruptions forming edifices built from lava flows. Repeated eruptions build extrusive edifices composed of pillow lavas with minor sheet lava flows. The intrusion of magma into the pelagic sediments on the seafloor produces a mixture of lava and wet sediment called peperite.

A heralding sign of the Neo-Tethyan birth is a unique appearance of two remarkable pieces of evidence, Triassic rift-type basalts and deep-water Hallstatt sediments, usually joint in the mélanges, within the footwalls or on the heads of the ophiolitic slabs. Triassic rift-type basalts associated with deep-water sediments are common constituents in the mélanges of the western zone of the Mawat complex. They form meter to kilometre-sized blocks in the mélanges. Pillow basalts are reddish or greenish in colour, usually amygdaloidal, with a characteristic" peperite facies", in which basalts are mixed with red, usually limy or muddy, water-soaked sediments, representing the unconsolidated stage of red, micritic limestone.

Oral presentation

Mineralogy, Geochemistry, and Origin of Gallala oxide and sulfide Mineralization, Walash - Noepurdan Series Kurdistan Region-NE-Iraq

Twana Ahmed Mustafa

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Pyrite, chalcopyrite, magnetite and hematite are the dominant ore minerals ,which are found of the Sulfide and Oxide mineralization's with in the Walash-Naopurdan series. Basaltic andesite rocks are the host rocks of the sulfide and oxide mineralization's. Different structure of the pillow lavas and peperitic facies are the most geological characterization of the study area. Red micritic mudy limestone ,and turbidities are the abundance sedimentary rocks in the study area.

Supervised by:

1- Dr. Tola A. Mirza/ Professor

2- Dr. Ladislav A. Palinkaš/ Professor

3- Dr. Stavros Kalaitzidis / Assistant Professor

Oral presentation

The origin of Zn-Pb-Ag ore deposit Bashibos

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The Bashibos exploration concession is located in the SE Republic of North Macedonia. The mineralization is hosted in an extremely heterogeneous sequence of interchanging metamorphosed and ductile deformed siliciclastic, volcanic and carbonate rocks. The sedimentation of the unit initially took place in a short-lived sedimentary basin of the Early Permian Variscan foreland. The basin was formed after the main phase of the Variscan orogeny when the final amalgamation of the Pelagonian and Serbomacedonian Massifs took place. During the Middle to Late Permian, the reversal of the tectonic regime, caused by the slab rollback of the subducting Paleotethys Ocean led to a rifting in the back-arc environment, forming a back-arc basin. The sediments deposited in the basin originated from the Serbomacedonian and Pelagonian Massifs. The sedimentation took place in a distal low-energy environment. The heated hydrothermal brine from the underlying layers migrated upwards along graben-limiting faults to the seafloor where it formed the deposit. The metal chloride complexes from the hydrothermal brine were sequestered by the reduced sulphur, which was mainly produced by the bacterial sulphate reduction of the Permian seawater sulphate, leading to the formation of syngenetic sedimentary-exhalative mineralisation. During the Early Cretaceous, the Bashibos formation underwent dynamic metamorphism under the conditions of the greenschist facies, which was related to the collision and obduction of the Middle Jurassic intra-oceanic arc onto the European plate. The metamorphism led to the formation of regional foliation, asymmetric folding and formation of ductile shear zones as well as to significant hydrothermal alteration of the host rock sequence. Highly dispersed and fine-grained sedimentary-exhalative sulfides were mobilised by metasomatic fluids and precipitated in weak structural zones such as foliation planes, quartz-carbonate veins and shear zones.

Oral presentation

Ardennite and phengite from sulfide-free ores with chalcophile metals from Nežilovo, North Macedonia

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Among numerous minerals determined at Nežilovo, Pelagonian Massif, North Macedonia, ardennite-(As) has been discovered and studied in two different mineral associations. Regularities of isomorphism in ardennite-related minerals are discussed. The presence of ardennite-(As) in association with 2M1 and 3T phengite polytypes provides evidence for three separate stages of formation. Conditions at which ardennite-(As) crystallized have been estimated based on compositional features of associated micas.

ENVIORONMENTAL GEOCHEMISTRY

SECTION

CHAIR:
Assoc. prof. Sabina Strmić Palinkaš

Invited talk

Methane Hydrates and Global Warming

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There is a growing understanding that methane hydrates (MHs) distributed globally in permafrost and deep-sea sediments present an enormous unconventional reservoir of methane (CH_4), however, there is also increasing concern about their role in global climate change. The first natural sites of MH were discovered in the 1960s in Siberian permafrost. Today we know that MHs are globally widespread in permafrost (5%) and in deep-sea sediments (95%) [1]. They are stable under high pressure and low temperatures. In the seas and oceans worldwide, MH deposits form in coastal sediments at depths 400-1200 m. The assumed amounts of MH range $2x10^{14}$-$3x10^{18}$ m^3 [2]. Although MH exploitation is currently considered too expensive, they are investigated as a potential future source of energy. Of particular interest are technologies that investigate CH_4 exploitation by pumping warm pressurized CO_2 into the sediment layers containing MH. The deposited CO_2 liberates the trapped CH_4 forming an even more stable form of a hydrate. In this way, the hydrate material does not melt and the stability of the geological formation remains intact, yet another greenhouse gas is sequestered. MH can be destabilized by a slight change in salinity, temperature (1-2°C), or pressure, thus instability of MH can be induced by climate changes and be their accelerator. This is exactly the situation in the deep-sea Adriatic Sea, where the MH reservoir shows boundary instability because of the recent Adriatic rapid deep-sea warming, which might be of importance for studying the role of MHs in climate change.

[1] Merey, Ş, & Longinos, SN (2018). Does the Mediterranean Sea have potential for producing gas hydrates? Journal of Natural Gas Science and Engineering, 55, 113–134. doi:10.1016/j.jngse.2018.04.029

[2] Mordis GJ, Collet TS, Boswell R, Kurihara M, Reagan MT, Koh C, Sloan ED (2009) Toward production from gas hydrates: current status, assessment of resources, and simulation based evaluation of technology and potential. SPE Reservoir Evaluation & Engineering, 12/5, 745-771.

Invited talk

Global carbon sequestration

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The Industrial Revolution began a long interval of fossil fuel exploitation and thus enabled humans to release huge quantities of previously buried carbon dioxide. Human-induced carbon dioxide emissions are visible as an increase in atmospheric concentrations which have grown rapidly and are nearly double the previous, natural concentrations. Natural carbon cycles have always been able to keep the carbon content in balance, but the additional anthropological emissions are tipping the scales. Those increased carbon concentrations have to be removed from the atmosphere by the multiple processes known as carbon sequestration. It is used to describe natural and anthropogenic processes by which carbon dioxide is either removed from the atmosphere or diverted from emission sources and stored in one of the carbon reservoirs, terrestrial environment (soils, sediments and vegetation), ocean (water and sediments) or geologic formations (rocks). The terrestrial environment can sequester (store) carbon by primary producers (plants) during photosynthesis, but the carbon is released back into the atmosphere through the respiration of consumers and decomposers. Oceans are capable of sequestering huge amounts of carbon, which can then be separated into organic (organic matter) and inorganic (dissolved molecules, ions and shell material). Many interactions happen between those two carbon forms and only a small part ends buried in the sediment and later, trapped in rocks. The carbon stored in rocks can be released through weathering or volcanic activity. The cycle of carbon is a complex synergy of all reservoirs, which is additionally complicated by their anthropogenic modifications.

Oral presentation

Air Dispersion Modelling

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Air dispersion modelling has become one of the main tools in the study of air quality whereby it is a key element in most environmental impact assessments. Almost every human activity and natural process leads to some form of air pollution. Therefore, air dispersion modelling is a powerful technique to evaluate whether if a source creates a problem. Considering climate change, sustainable design and planning of our cities is essential, but alpine regions and urban areas pose several problems to the correct investigation of air pollutant concentrations. In general, two different models will be considered, namely the Gaussian Plume Model and the Stochastic Lagrangian Particle Model. The first model assumes that the source emits a constant stream of pollution. Then it can be proven mathematically that the resulting plume will have a Gaussian concentration profile in the lateral and vertical directions. This Gaussian profile will fan out as the distance to the source increases. The second model assumes that each source emits a large number of particles, and each particle follows a random path around the mean wind vector. This path is updated with every time step. Predictions of pollutant concentration are obtained by counting the number of particles in a given volume of air. The goal is to extend the currently used models to alpine regions and urban areas respectively to different source types, deposition and reflection to predict a concentration profile.

Oral presentation

Differences in the behaviour of trace and rare-earth elements in oxidizing and reducing soil environments: Case study of Terra Rossa soils and Cretaceous palaeosols from the Istrian peninsula, Croatia

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This study compares the differences between the distribution of trace elements and rare-earth elements (REEs) formed under reducing and oxidizing soil conditions during pedogenesis on carbonate bedrock. Terra rossa (TR) soils, representing pedogenesis under oxic conditions, and Cretaceous palaeosols (CP), representing pedogenesis under reducing conditions, were sampled on the Istrian peninsula. They were studied by ICP-MS, ICP-OES, XRF, XRD, sequential extraction and statistical analyses. The differences in trace-element behaviour between the TR and CP stem from different redox conditions, but the most remarkable difference was observed in the behaviour of the REEs. Statistical analyses revealed that in TR soils all the REEs showed a very positive correlation, while in CPs the light REEs and heavy REEs showed an internal, very positive correlation. TR soils have almost twice as much REEs as CPs. This difference is pedogenetic, as both materials have a very similar amount of REEs in the residual fraction. While TR soils have the same amount of REEs in fractions other than the residual fraction, CPs have almost no REEs in these fractions. Different REE patterns obtained from sequential extraction, such as a middle-REE enrichment and a positive Ce anomaly in TR soils and light-REE depletion, heavy-REE enrichment, positive Ce and Eu anomalies in CPs, contributed to an understanding of the redox and pedogenetic processes. This study successfully emphasized the influence of different redox conditions on the behaviour of trace and rareearth elements during pedogenesis on a carbonate bedrock and the ability of the REEs to track pedogenetic processes.

Oral presentation

Trace elements as pollution and palaeoredox proxies and indicators of sediment provenance in marine lakes

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The Mljet National Park, founded in 1960, is one of the first established marine protected areas in the Mediterranean. Its most famous phenomenon are two karstic seawater lakes, known as Small and Great Lake. They are very unique for their geological formation, their hydrography and water dynamic, their particular water chemistry resulting in whiting events, and their very specific biological community including scyphozoans and corals. Thus, it is of great importance to study these lakes and to find a way to protect them from changes caused by anthropogenic pressures. It this work distributions of trace elements in sediment cores from the lakes were studied and used to investigate the origin of sediments, the diagenetic processes in recent sediments, the palleoredox history of the lakes and the anthropogenic influence. Typical fingerprint of trace elements in sediments suggested the surrounding soil as the main provenance of lake sediments, and indicated limited input of material from the open sea. Different trace elements were used as authigenic mineral formation, palaeoredox and pollution indicators. It was demonstrated that Sr could be used as a proxy indicating authigenic formation of aragonite mud sediments. Distributions of the redox sensitive elements Mo, Tl, U and Cd were used to identify changes in redox conditions in the investigated lakes caused by environmental changes in the system over the last 100 years. Elements which are typically of anthropogenic origin (Zn, Cu, Pb, Sn, Bi), including organotin compounds, were used to demonstrate increasing pollution over the last 40 years.

Oral presentation

Bivalve Callista chione – archive of high resolution trace element data

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Gigapascal-scale explosive events are primarily impacts of space bodies on planets and moons, Earth in particular, and may be atmospheric, marine or terrestrial. The energy of such an event is enough to vaporize impactor and target matherials, in most cases solid rock at very location of the impact event, cause crystal lattice deformation in a variety of hard minerals and complete or partial melting of target rocks, brecciation of solid rocks by spallation, and ejection of impactogenic rock debris from the impact crater which may form even planetary-wide impact ejecta layer(s). Impactors may be a variety of solid space bodies; comet nuclei, asteroids, or planetary fragments. Their properties and nature are usually unknown, since they are completely vaporized in large impacts. Impacts produce proximal and distal products which vary in degree of heat and pressure transformation, and range from completely melted rock to fractured and unshocked bed rocks. Impact products thus vary in physical and mineralogical composition and the degree of metamorphosis. The products are a variety of melted rocks such are impact glasses, incomplete melt-rocks, suevites and virtually unaffected rocks which nevertheless comprise shock-deformed minerals. The study of impactogenic products is based on a variety of analytical methods; XRD, XRF, TXRF, μPIXE, μRAMAN, SEM+EDS/WDS, ICP-MS, and optical microscopy. The result is chemical and mineralogical composition of target rocks and/or impactor. Our research was focused on the study of distal ejecta with the aim to decipher target rocks and provenance of impactogenic debris, and identify possible location(s) of the impact(s).

Oral presentation

Forensic study of gigapascal-scale explosive events in Earth history: evidence, methods of study and some results

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Gigapascal-scale explosive events are primarily impacts of space bodies on planets and moons, Earth in particular, and may be atmospheric, marine or terrestrial. The energy of such an event is enough to vaporize impactor and target matherials, in most cases solid rock at very location of the impact event, cause crystal lattice deformation in a variety of hard minerals and complete or partial melting of target rocks, brecciation of solid rocks by spallation, and ejection of impactogenic rock debris from the impact crater which may form even planetary-wide impact ejecta layer(s). Impactors may be a variety of solid space bodies; comet nuclei, asteroids, or planetary fragments. Their properties and nature are usually unknown, since they are completely vaporized in large impacts. Impacts produce proximal and distal products which vary in degree of heat and pressure transformation, and range from completely melted rock to fractured and unshocked bed rocks. Impact products thus vary in physical and mineralogical composition and the degree of metamorphosis. The products are a variety of melted rocks such are impact glasses, incomplete melt-rocks, suevites and virtually unaffected rocks which nevertheless comprise shock-deformed minerals. The study of impactogenic products is based on a variety of analytical methods; XRD, XRF, TXRF, μPIXE, μRAMAN, SEM+EDS/WDS, ICP-MS, and optical microscopy. The result is chemical and mineralogical composition of target rocks and/or impactor. Our research was focused on the study of distal ejecta with the aim to decipher target rocks and provenance of impactogenic debris, and identify possible location(s) of the impact(s).

Poster presentation

Possible causes for geochemical characteristics of Međimurje county water?

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The surface of Međimurje is covered with Paleogene and Quaternary sediments. Quaternary deposits are more significant as they extend over the half of the area, and are represented in clays, loess and Aeolian sands (fraction 0.06 mm 76.6-86.7%). Mineralogically, that means that the top layer of bedrock is made of quartz, feldspar, carbonate, amphibole and mica. Quartz is known for its resistance so weathering does not affect it the same rate as other minerals. Muscovite is also resistant, while biotite alters into chlorite, which wear to clay minerals. Feldspar, as well as amphiboles, alter into clay minerals, while potassium ions and silicate component remain in solution. Ca+ and HCO3- enter the solution by the wear of carbonates.

Data from the analysis of elements (As, Ca, Cd, Cl, Cr, Cu, Fe, K, Mg, Mn, N, Na, Ni, SO4 2-, Zn) from Mura and Drava rivers over a period of one year were compared with European data for the same area, water and sediment. Analysed data show lower actual concentrations of elements in water compared to European data, while the presence of the same elements in sediments is much higher.

Given the proven positive correlation in the size of the fraction of 0.06 mm with the elements mentioned above, it can be concluded that the bedrock does not affect greatly the concentrations of elements in surface water of rivers in Međimurje.

ORGANIC GEOCHEMISTRY

SECTION

CHAIR:
Dr. Jasmina Obhođaš

Invited talk

Source rock characteristics in Kurdistan Region, N Iraq: insights from organic geochemistry and petrography

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Kurdistan Region is located in N and NE parts of Iraq, which is geologically representing a part of the Western Zagros Fold-Thrust Belt. Most of the petroleum systems in Kurdistan Region are located within the Zagros Fold Belt; including the giant Kirkuk Oil Field, Kor Mor Gas Field, etc. The geochemical and petrographical studies proved the Jurassic-Early Cretaceous succession (e.g. Sargelu, Naokelekan, Chia Gara formations) is prolific source rocks and they generated and expelled hydrocarbons to Tertiary reservoirs, such as Kirkuk Group. The recent geochemical studies show that the source rocks are mainly organic matter-rich marine carbonates, deposited in dysoxic to anoxic environmental conditions. They are characterized by high TOC% content and kerogen of types II, III and IV. Recent molecular geochemical data for the sediments from these source rocks support an origin from marine organic matter with some minor admixture of terrigenous material. Although organic petrographical studies are not too much, they revealed the presence of different macerals, such as bituminite, alginite, vitrinite, as well as the solid bitumens also recorded. Few researches on organic matter-rich Paleogene rocks indicated to immature rocks. The Triassic rock units in the region, such as Baluti and Kurra Chine formations from many areas characterized by black to brown shale and organic matter-rich carbonates. These interested rocks need further detailed geochemical and petrographical analyses, which may represent another effective source rocks in the region.

Invited talk

Contribution of environmental pollutants to metabolic disorders

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Oral presentation

Serum phthalate levels and markers of inflammation

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Serum phthalate levels and markers of inflammation Phthalates are a group of emerging environmental pollutants found ubiquitously due to their widespread global production. Phthalates are used in plastics and personal care products among others. Continuous phthalate exposure is suspected to be related to several health disorders, such as cardio-metabolic conditions, and inflammation has been proposed as a potential mechanism of action. The present study, based on an adult cohort from southern Spain named GraMo, aims to explore cross-sectional associations between serum phthalate metabolites with set of subclinical inflammatory biomarkers.

The study population (n= 213) was intraoperatively recruited in 2003-4 in two public hospitals from Granada, Southern Spain. Phthalate metabolites were analyzed by means of online-TurboFlow-liquid chromatography coupled mass spectrometry in tandem mode, while inflammatory biomarkers were assessed by flow cytometry and Luminex®. Associations were explored by means of Spearman´s correlation and subsequent multivariate linear regression models focused on the most suggestive associations. Several phthalate metabolites (mono-n-butyl phthalate, mono-iso-butyl phthalate, mono-ethyl phthalate, mono-iso-decyl phthalate and mono-benzyl phthalate) were positively and significantly associated with two cytokines (interleukin 18 and monocyte chemoattractant protein 1), and two adipokines (plasminogen activator inhibitor 1 and leptin). These significant associations were maintained after adjusting for possible confounders in the regression models. Despite the inherent limitations of the cross-sectional design, our novel associations might point to relevant underlying subclinical immune mechanisms of action of these pollutants, that warrants further research.

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