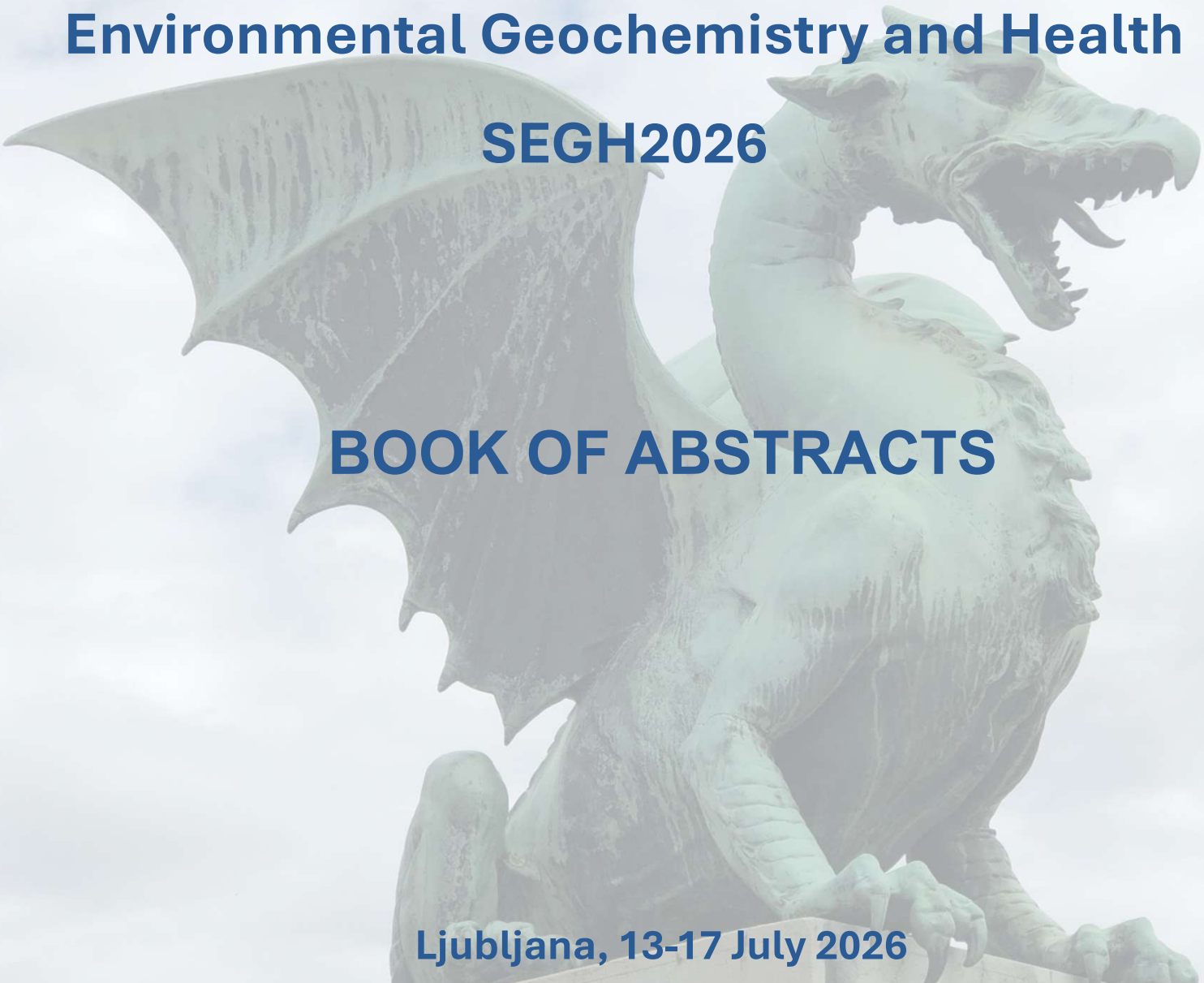
SEGH2026

41st International Conference on Environmental Geochemistry and Health

SEGH2026

BOOK OF ABSTRACTS



Ljubljana, 13-17 July 2026

GeoZS Geološki zavod Slovenije 80 years
NTF UNIVERSITY OF LJUBLJANA Faculty of Natural Sciences and Engineering | Department of Geology
SLOVENIAN GEOLOGICAL SOCIETY

SEGH2026

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Organisers

Geological Survey of Slovenia (GeoZS), University of Ljubljana, Faculty of Natural Sciences and Engineering (UL NTF), Slovenian Geological Society (SGD).

Organising Committee

Dr Martin Gaberšek, Conference Chair (GeoZS)

Prof Nastja Rogan Šmuc, Co-Chair of the Conference (UL NTF)

Dr Mateja Gosar (GeoZS)

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Acknowledgements

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PROGRAMME

Day 1: Monday July 13

Time	Event	Location
All day	Conference Workshops	Various locations around Ljubljana: 1) Microplastics in sediment, groundwater and wastewater: Geological Survey of Slovenia & Institut Jožef Stefan 2) IUGS-IFG Forensic Geoscience - Soil Sampling Workshop: Geological Survey of Slovenia 3) From the Field to the Map: Applied Methods for Measuring and Mapping Environmental Radioactivity: Faculty of Natural Sciences and Engineering
Networking event		
19:00–22:00	Ice-breaker event	Bistro Švicarija, Pod turnom 4, 1000 Ljubljana

Day 2: Tuesday July 14

Time	Event	Location
08:00–09:00	Registration	Lobby (ground floor)
09:00–09:30	**Opening ceremony:** Prof Andrej Šmuc, dean of the Faculty of Natural Sciences and Engineering Dr Miloš Bavec, director of the Geological Survey of Slovenia Dr Marko Komac, vice president of International Union of Geological Sciences	P5 (ground floor)

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THEME: Environmental geochemistry and human health in the context of extreme weather events (Chairs: Nastja Rogan Šmuc & Elena Pavoni)		
09:30–10:00	**Keynote Presentation**: Dr Mateja Gosar, Geological Survey of Slovenia **FROM GEOCHEMICAL BASELINES TO ANTHROPOGENIC INFLUENCES AND EXTREME WEATHER EVENT EFFECTS: A CASE STUDY FROM SLOVENIA**	P5 (ground floor)
10:00–11:00	Marine Casetta, Université de Nantes, France **IMPACT OF REPEATED REDOX CYCLES ON METAL REMOBILIZATION AND ECOTOXICITY IN WETLANDS**	P5 (ground floor)
	Federico Floreani, University of Trieste, Italy **RESPONSE OF GASEOUS MERCURY FLUXES FROM SOILS IMPACTED BY PAST MINING ACTIVITIES (IDRIJA, SLOVENIA) TO VARIABLE WEATHER CONDITIONS**	
	Farah Tasneem Ahmed, The University of Manchester, United Kingdom **SOURCE APPRAISAL AND PRELIMINARY HEALTH RISK ASSESSMENT OF TRACE ELEMENTS IN URBAN COMMUNITY GARDEN SOILS: A CASE STUDY FOR FOREVER FIELDS, MANCHESTER, UK**	
	Annika Parviainen, Andalusian Earth Sciences Institute, Spain **THE IMPACT OF MINERALIZATIONS OF THE IBERIAN PYRITE BELT ON EXPOSURE LEVELS AND HEALTH EFFECTS IN THE GENERAL POPULATION**	
11:00–11:30	Coffee Break	P209 (2nd floor)
	Poster Session	P106 (1st floor)
THEME: Environmental radioactivity (Chairs: Quentin Crowley & Anita Erőss)		
11:30–12:30	Quentin Crowley, Trinity College Dublin, Ireland **EXPLORING SOIL GEOCHEMISTRY AS A PROXY FOR RADON ANOMALIES**	P5 (ground floor)

	Anita Erőss, Eötvös Loránd University, Hungary **ENVIRONMENTAL RADIOISOTOPES: NATURAL TRACERS IN HYDROGEOLOGICAL STUDIES AND DRINKING WATER QUALITY PARAMETERS**	
	Reyana Dawn Garcia, Eötvös Loránd University, Hungary **NATURAL RADIOACTIVITY IN DRINKING WATER: APPLICATION OF ENVIRONMENTAL TRACERS AND REGIONAL GROUNDWATER FLOW ANALYSIS IN NORTHWESTERN HUNGARY**	
	Saeed Bidar Kahnamuei, Eötvös Loránd University, Hungary **COMPREHENSIVE HYDROGEOCHEMICAL EVALUATION AND MEDICINAL RADIOACTIVITY OF LAKE HÉVÍZ, HUNGARY**	
12:30–14:00	Lunch	P209 (2nd floor)
	Fellows lunch	P210 (2nd floor)
THEME: Forensic geology – environmental crimes and the application of geochemical methods in criminal investigations (Chairs: Mateja Gosar & Andrew Hursthouse)		
14:00–14:30	**Keynote Presentation**: Prof Duncan Pirrie, University of South Wales, United Kingdom **ADVANCES IN FORENSIC GEOSCIENCE; THE ROLE OF GEOLOGY IN THE INVESTIGATION OF SERIOUS CRIME**	P5 (ground floor)
14:30–15:30	Andrew Hursthouse, University of the West of Scotland, United Kingdom **FLY TIPPING – A GLOBAL CRIME THAT NEEDS LOCAL SOLUTIONS**	P5 (ground floor)
	Martin Gaberšek, Geological Survey of Slovenia **EVERY PARTICLE TELLS A STORY: MICROSCOPIC CLUES FROM THE ENVIRONMENT**	

	Panagiotis Papazotos, Hellenic Survey for Geology & Mining Research, Greece **HYDROCHEMICAL FOOTPRINT OF ACID MINE DRAINAGE FROM THE ABANDONED KIRKI MINES, EVROS, NE GREECE**	
	Jadran Faganeli, National Institute of Biology, Slovenia **ORIGIN OF Pb IN THE Pb MINE-DRAINING MEŽA RIVER (N SLOVENIA)**	
15:30–16:00	Coffee Break	P209 (2nd floor)
	Poster Session	P106 (1st floor)
16:00–17:30	SEGH AGM & World Caffe	P5 (ground floor)
Networking event		
17:45–21:00	Geological tour of Ljubljana & Slovenian Wine Tasting	

Day 3: Wednesday July 15

Time	Event	Location
08:30–09:00	Registration	Lobby (ground floor)
THEME: Inorganic and organic contaminants in the geosphere (Chairs: Nina Mali & Ariadne Argyraki)		
09:00–09:30	**Keynote Presentation**: Dr Manca Kovač Viršek, National Institute of Biology & Geological Survey of Slovenia **MICROPLASTICS IN GROUNDWATER: A CRITICAL SUBSURFACE SINK AT THE GEOSPHERE–HYDROSPHERE INTERFACE**	P5 (ground floor)

09:30–10:45	Nina Mali, Geological Survey of Slovenia **PATHWAYS OF MICROPLASTICS TO GROUNDWATER: FIELD EXPERIMENTS IN THE UNSATURATED ZONE**	P5 (ground floor)
	Elena Pavoni, University of Trieste, Italy **POST-FLOTATION MINE SLUDGES AS A SOURCE OF THALLIUM AND OTHER POTENTIALLY TOXIC ELEMENTS (Zn-Pb RAIBL MINING DISTRICT, NORTHEASTERN ITALY): INSIGHTS FROM SPECIATION AND BIOCHAR MITIGATION EXPERIMENTS**	
	Ray Scanlon, Geological Survey Ireland **AN INVESTIGATION OF URBAN SOIL GEOCHEMISTRY ACROSS FIVE CITIES IN IRELAND**	
	Janja Svetina, Geological Survey of Slovenia **FIELD-SCALE RETARDATION OF CR(VI) IN A HIGHLY PRODUCTIVE ALLUVIAL AQUIFER: AN ANALYTICAL MODELLING APPROACH**	
	Stefano Tomat, University of Trieste, Italy **EFFECTS OF SALINITY AND SOIL IMPROVERS ON MERCURY MOBILISATION FROM POLLUTED SOILS**	
10:45–11:15	Coffee Break	P209 (2nd floor)
	Poster Session	P106 (1st floor)
11:15–11:50	**Poster flash presentations (Chair: Martin Gaberšek)**	P5 (ground floor)
11:50–12:50	Barbara Čeplak, Geological Survey of Slovenia **TECHNOLOGY-CRITICAL ELEMENTS IN MURA RIVER SEDIMENTS WITH A PARTICULAR FOCUS ON YREE LEVELS**	P5 (ground floor)
	Ariadne Argyraki, National and Kapodistrian University of Athens, Greece **ESTIMATING TOTAL MEASUREMENT UNCERTAINTY IN SEAWATER TRACE ELEMENTS: EVIDENCE FOR THE DOMINANT ROLE OF SAMPLING**	

	Elena Alvareda Migliaro, Universidad de la República, Salto, Uruguay **HYDROGEOCHEMICAL CONSTRAINTS ON GROUNDWATER AVAILABILITY IN FRACTURED COASTAL AQUIFERS UNDER EXTREME DROUGHT: INSIGHTS FROM CANELONES, URUGUAY**	
	Jochen Weh (LUMEX ANALYTICS, PLATINUM SPONSOR) **A UNIVERSAL TOOL FOR MONITORING OF MERCURY**	
12:50–14:00	Lunch	P209 (2nd floor)
	ECR Lunch	P210 (2nd floor)
THEME: Emerging technologies and latest challenges in environmental geochemistry, biogeochemistry, medical geology, and toxicology (Chairs: Anna Augustsson & Gillian Gibson)		
14:00–14:30	**Keynote Presentation**: Dr Ines Tomašek, Université Clermont Auvergne, France **RESPIRATORY HEALTH HAZARD POSED BY GEOGENIC POLLUTANTS IN URBAN AMBIENT AIR**	P5 (ground floor)
14:30–15:30	Alicja Kicińska, AGH University of Krakow, Poland **COMBUSTION OF PLASTICS IN DOMESTIC FURNACES – A THREAT TO PUBLIC HEALTH AND THE ENVIRONMENT**	P5 (ground floor)
	Ivana Perović, Geological Survey of Slovenia **SLOVENIA'S HIDDEN PHARMACY: A DECADE OF TRACKING PHARMACEUTICALS IN OUR GROUNDWATER**	
	Mouataz T. Mostafa, Arish University, Egypt **MACHINE LEARNING–BASED GEOCHEMICAL FINGERPRINTING OF URBAN SEDIMENTS ACROSS INDUSTRIAL, URBAN CORE, RURAL, AND PERI-URBAN ENVIRONMENTS**	

	Quan Zhang, Zhejiang University of Technology, China **S-DINOTEFURAN EXHIBITS HIGHER TOXICITY THAN *R*-DINOTEFURAN IN EARTHWORM–SOIL SYSTEM VIA ENANTIOSELECTIVE PERSISTENCE, BIOACCUMULATION AND METABOLIC STRESS**	
15:30–16:00	Coffee Break	P209 (2nd floor)
	Poster Session	P106 (1st floor)
16:00–17:00	Jamie-Leigh Abrahams, University of the Western Cape, South Africa **PREDICTION OF HEAVY METAL CONTENT IN COALFIELD SEDIMENTS USING GROUND AND AIRBORNE HYPERSPECTRAL DATA**	P5 (ground floor)
	Christiana Mystrioti, National Technical University of Athens, Greece **STABILIZATION OF ANTIMONY IN CONTAMINATED SOILS**	
	Maria Clara Zuluaga, National University of Colombia, Colombia **BIOGEOCHEMICAL CYCLE OF LEAD, CASE STUDY OF THE PROVINCE OF HUELVA, SPAIN**	
	Maria Clara Zuluaga, National University of Colombia, Colombia **BIOGEOCHEMICAL CYCLE OF CADMIUM AND LEAD IN CACAO CROPS IN THE MUNICIPALITY OF SAN VICENTE DE CHUCURÍ, COLOMBIA**	
Networking event		
19:00–22:00	Conference dinner	Vivo catering, Dunajska cesta 125, Ljubljana

Day 4: Thursday July 16

Time	Event	Location
08:30–09:00	Registration	Lobby (ground floor)

THEME: Impacts of living environment on human health **Dedicated to the memory of Professor Iain Thornton,** **Emeritus Professor of Environmental Geochemistry, Imperial College London and** **President, Society for Environmental Geochemistry and Health (1985–1987)** **(Chairs: Jane Entwistle & Andreja Kukec)**		
09:00–09:30	**Keynote Presentation**: Dr Lucija Perharič, National Institute of Public Health, Slovenia **GEOCHEMICAL RISK ASSESSMENT FOR HUMAN HEALTH**	P5 (ground floor)
09:30–10:45	Rita Bonfiglio, University of Rome, Italy **EXPOSOMIC AGENTS IN CHOLANGIOCARCINOMA: IMPACT OF TISSUE TOXIC METAL BIOACCUMULATION ON CANCER PROGRESSION AND IMMUNE ESCAPE**	P5 (ground floor)
	Tanja Rejc, University of Ljubljana, Slovenia **ENVIRONMENTAL RISK FACTORS AND ASTHMA IN SLOVENIAN CHILDREN AND ADOLESCENTS**	
	Xia Huo, Jinan University, China **EXPOSURE TO POLLUTANTS AFFECTS CHILDREN'S GUT MICROBIOTA AND INTESTINAL MUCOSAL BARRIER FUNCTION**	
	Valeria Palumbo, University of Rome, Italy **IMPACT OF BIOACCUMULATION OF TOXIC METALS ON PLAQUE INSTABILITY AND CEREBROVASCULAR EVENTS**	
	Janusz Janeczek, University of Silesia in Katowice, Poland **UNEXPECTED HEALTH EFFECTS OF INHALABLE AMBIENT AIR MINERAL DUST**	
10:45–11:15	Coffee Break	P209 (2nd floor)
	Poster Session	P106 (1st floor)

THEME: Impacts of living environment on human health (Chairs: Teja Čeru & Xia Huo)		
11:15–12:45	Paula Marinho-Reis, University of Minho, Portugal **REVISITING INDOOR DUST METRICS: IMPLICATIONS OF METAL LOADINGS FOR CHILDREN'S EXPOSURE AND HEALTH RISK IN KINDERGARTENS**	P5 (ground floor)
	Miguel Izquierdo-Díaz, Universidad Politécnica de Madrid, Spain **LEGACY AND BIOAVAILABILITY OF TRACE ELEMENTS IN URBAN RIVER SEDIMENTS**	
	Teja Čeru, Geological Survey of Slovenia **CHILDREN'S LEAD EXPOSURE IN A LEGACY Pb–Zn MINING REGION (UPPER MEŽA VALLEY, SLOVENIA): IEUBK MODELLING VALIDATED BY BIOMONITORING**	
	Lindsay Bramwell, Northumbria University, United Kingdom **INDOOR AIR QUALITY, HEALTH, AND WELLBEING FOLLOWING ENERGY EFFICIENCY RETROFITS IN SOCIAL HOUSING: THE IN2AIR STUDY**	
	Angela Bayona-Valderrama, Northumbria University, United Kingdom **PROTOCOL DEVELOPMENT AND FEASIBILITY STUDY FOR THE ELEVATED CHILDHOOD LEAD INTERAGENCY PREVALENCE STUDY (ECLIPS)**	
	Bo Xie, University of Groningen, Netherlands **ONE HEALTH PERSPECTIVE ON E-WASTE CHALLENGE: A CALL FOR INTERDISCIPLINARY RESEARCH AND POLICY**	
12:45–14:00	Lunch	P209 (2nd floor)
THEME: Impacts of living environment on human health (Chairs: Jamie-Leigh Abrahams & Nastja Rogan Šmuc)		

14:00–15:15	Misozi Makangila, The Copperbelt University, Zambia **RISK ASSESSMENT OF INHALABLE BIOACCESSIBLE POTENTIALLY TOXIC ELEMENTS IN AIRBORNE PARTICLES FROM A ZAMBIAN COPPER MINE SITE**	P5 (ground floor)
	Zacharenia Kypritidou, National and Kapodistrian University of Athens, Greece **ASSESSMENT OF GRAIN SIZE EFFECTS ON LEAD CONCENTRATIONS IN CONTAMINATED SOILS: IMPLICATIONS FOR CITIZEN-BASED SCREENING IN LAVRION, GREECE**	
	Wilfried Dathe, Heck Bio-Pharma GmbH, Germany **NATURAL CUBAN ZEOLITE — STRUCTURAL PROPERTIES, BINDING AFFINITIES AND BENEFIT FOR HUMAN HEALTH**	
	David Polya, The University of Manchester, United Kingdom **INEQUALITIES AND (IN)ADEQUACIES OF DRINKING WATER ARSENIC REGULATION – REVISITING THE USEPA (2000) COST BENEFIT ANALYSIS**	
	Mariola Jabłońska, University of Silesia in Katowice, Poland **AIR POLLUTION CAUSED BY FIRES OF COAL WASTE HEAPS**	
15:15–16:00	Closing Ceremony	P5 (ground floor)

Day 5: Friday July 17

Time	Event	Location
08:00 – 17:00	Field trip to the Idrija UNESCO Global Geopark	Idrija

LIST OF POSTERS (posters are exhibited in Lecture Room P106 on 1st floor).

Presenter	Affiliation	Title
COVELLI	University of Trieste, Italy	EFFECTS OF SALINISATION ON MERCURY MOBILITY IN PHREATIC GROUNDWATER OF CONTAMINATED ALLUVIAL SOILS: PRELIMINARY RESULTS
ČERU	Geological Survey of Slovenia	POTENTIALLY TOXIC ELEMENTS IN HOUSEHOLD VACUUM DUST: SOURCE APPORTIONMENT AND HEALTH RISK ASSESSMENT IN A MINING- AND INDUSTRY-IMPACTED REGION
DENG	Peking University, Beijing, China	SHORT-TERM EFFECTS OF SIZE-FRACTIONED PARTICULATE MATTER ON BLOOD PRESSURE IN COPD PATIENTS: THE KEY ROLE OF INFLAMMATORY PHENOTYPES
FERRI-MORENO	Universidad Complutense de Madrid, Spain	ORAL RISK ASSESSMENT IN ABANDONED MINES BASED ON BIOACCESSIBLE VALUES
GABERŠEK	Geological Survey of Slovenia	MINERALOGICAL, PEDOLOGICAL AND GEOCHEMICAL CHARACTERISATION OF VINEYARD SOILS AS A KEY FACTOR IN THE CONCEPT OF TERROIR – PRELIMINARY RESULTS
GABERŠEK	Geological Survey of Slovenia	SULFUR-FUNCTIONALIZED NATURAL ZEOLITE CLINOPTILOLITE AS A SELECTIVE SORBENT FOR MERCURY IMMOBILIZATION IN THE IDRIJA MINE AREA, SLOVENIA
GOISLOT	Nantes Université, France	EXTREME EVENT-DRIVEN REMOBILIZATION OF TRACE METALS IN WETLANDS OF THE LOWER LOIRE RIVER HYDROSYSTEM (FRANCE)
HRIBLJAN	Geological Survey of Slovenia	ASSESSMENT OF SANDBOX SANDS AND SOILS IN THE CELJE BASIN THROUGH LEAD, ZINC, STRONTIUM, AND IRON STABLE ISOTOPE ANALYSIS
HU	Zhejiang University of Technology, China	COCKTAIL EFFECTS OF PESTICIDE MIXTURE EXPOSURE AMPLIFYING MITOCHONDRIAL DNA DAMAGE FOLLOWED BY HONEYBEE COLONY COLLAPSE
HUDOPISK	National Institute of Public Health, Slovenia	PREDICTIVE RISK FACTORS FOR BLOOD LEAD LEVELS IN CHILDREN: A LITERATURE REVIEW
HUMDI	Newcastle University, United Kingdom	ENVIRONMENTAL LEAD EXPOSURE: EVALUATING SOIL CONTAMINATION AND THE TRANSFER OF LEAD INTO DOMESTIC HEN EGGS IN NORTHERN ENGLAND, UK
KICINSKA	AGH University of Krakow, Poland	THE USE OF URBAN SOILS FOR AGRICULTURAL PRODUCTION: THE EXAMPLE OF KRAKÓW (POLAND)
KNEZ	AGH University of Krakow, Poland	CHARACTERISATION OF DEVONIAN SANDSTONE CORE SAMPLES USING SCHMIDT HAMMER AND GEOMECHANICAL PROPERTIES TESTING

Presenter	Affiliation	Title
KOS	Jožef Stefan Institute, Slovenia	GEOCHEMICAL AND PEDOLOGICAL CONTROLS ON Pb, Zn, AND Fe ORE MINERAL WEATHERING: INSIGHTS FROM SOIL COLUMN LEACHING EXPERIMENTS WITH PARTICLE-SCALE VALIDATION
LIAKOPOULOS	Hellenic Survey for Geology & Mining Research, Greece	OCCURRENCE AND EVALUATION OF POTENTIALLY TOXIC ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBONS IN POST-FIRE SOILS: A CASE STUDY FROM NE ATTICA, GREECE
LIM	Korea Atomic Energy Republic of Korea	EVALUATION OF UNDERGROUND DISPOSAL STABILITY AND ENVIRONMENTAL SAFETY OF CEMENT WASTE FORMS CONTAINING CARBONIZED SPENT ION-EXCHANGE RESINS
LIM	Korea Atomic Energy Republic of Korea	SUBSURFACE ENVIRONMENTAL STABILITY AND MIGRATION INHIBITION OF RADIOACTIVE CONTAMINANTS THROUGH IMMOBILIZATION OF CARBONIZED SPENT RESINS USING GEOPOLYMER
LIU	Florida International University, USA	PHOTOCHEMICAL, DARK ABIOTIC, AND MICROBIAL MERCURY REDUCTION IN AQUATIC ENVIRONMENTS
LOVRENČIĆ MIKELIĆ	Ruđer Bošković Institute, Croatia	ASSESSMENT OF RADIOLOGICAL HEALTH HAZARDS FROM ^{40}K, ^{226}Ra, AND ^{232}Th IN ROCKS AND SEDIMENTS OF THE KAŠTELA BAY COASTAL AREA (ADRIATIC SEA, CROATIA)
MALENŠEK ANDOLŠEK	Geological Survey of Slovenia	PERSISTENT MERCURY CONTAMINATION IN IDRIJCA RIVER ALLUVIAL SEDIMENTS: LONG TERM MONITORING AND THE ROLE OF EXTREME WEATHER EVENTS
MALI	Geological Survey of Slovenia	GWMicroPlast: MICROPLASTICS IN GROUNDWATER – FROM METHOD DEVELOPMENT TO FIELD EVIDENCE
MARINHO-REIS	University of Minho, Portugal	MICROPLASTIC CONTAMINATION IN URBAN GARDEN SOILS OF THE CÁVADO REGION: OCCURRENCE, CHARACTERIZATION AND ENVIRONMENTAL IMPLICATIONS
MARINOVIĆ	INA – Industrija nafte Plc., Croatia	GEOCHEMICAL INVESTIGATION AND BIOMARKER FINGERPRINTING OF TAR BALLS IN THE MLJET NATIONAL PARK ISLAND (CROATIA)
MILER	Geological Survey of Slovenia	PHYSICOCHEMICAL MICROPROPERTIES OF PARTICLES AS POLLUTION SOURCE INDICATORS - PROBLEMATICS
OLABODE	Adam Mickiewicz University, Poland	THE ROLE OF SOIL PROPERTIES IN MODULATING ARSENIC BIOACCESSIBILITY AND MOBILITY IN URBAN GARDENS
PAPAZOTOS	Hellenic Survey for Geology & Mining Research, Greece	MONITORING POTENTIALLY TOXIC ELEMENTS IN SOILS, SEDIMENTS, AND FLOATATION TAILINGS USING FPXRF MEASUREMENTS AROUND THE ABANDONED KIRKI MINE, NE GREECE
PENTARI	Technical University of Crete, Greece	SUSTAINABLE EXTRACTION OF LITHIUM FROM COAL FLY ASH USING CARBOXYLIC ACIDS

Presenter	Affiliation	Title
PISONI	University of Trieste, Italy	EFFECT OF EXTREME WEATHER EVENTS ON THE CONTRIBUTION OF MERCURY AND POTENTIALLY TOXIC ELEMENTS ASSOCIATED WITH FLUVIAL SUSPENDED PARTICULATE MATTER IN THE ISONZO RIVER (NE ITALY)
PLACENCIA-GÓMEZ	Geological survey of Slovenia	LABORATORY AND FIELD SCALE GEOPHYSICAL MEASUREMENTS IN SEDIMENTS IMPACTED BY INORGANIC POTENTIALLY TOXIC ELEMENTS (PTE)
PODLOGAR	Jožef Stefan Institute, Slovenia	MICROFIBER RELEASE FROM SYNTHETIC TEXTILES DURING DOMESTIC WASHING AS A SOURCE OF WASTEWATER POLLUTION
POGHOSYAN	Center for Ecological-Noosphere Studies, Armenia	GEOSTATISTICAL AND GEOCHEMICAL INSIGHTS INTO CHROMIUM IN SOILS OF LORI, ARMENIA
SVETINA	Geological Survey of Slovenia	EXTREME RAINFALL AS A DRIVER OF CONTAMINANT REDISTRIBUTION IN THE URBAN WATER CYCLE
YI	South China University of Technology, China	THE EFFECTS OF DOM-COUPLED FNPs ON THE MIGRATION OF Cu(II) THROUGH DIFFERENT TYPES OF POROUS MEDIA
YI	South China University of Technology, China	COMPOSITIONAL DIFFERENCES OF VARIOUS SORPTION STATES OF Cu AND Cd ON GOETHITE IN THE PRESENCE OF OXYANIONS: A QUANTITATIVE STUDY
ZULUAGA	Universidad Nacional de Colombia, Colombia	UNDERSTANDING THE SOURCES OF Pb AND Cc IN CACAO IN THE EASTERN CORDILLERA OF COLOMBIA

KEYNOTE LECTURES

DR MATEJA GOSAR

Mateja Gosar is a leading expert in environmental geochemistry at the Geological Survey of Slovenia. Her early research explored the environmental impacts of active, closed, and abandoned metal mines, and over time, her work expanded to geochemical baselines, contaminated sites, geochemical mapping, and urban geochemistry. In the past decade, she has focused on mining waste deposits as persistent global pollution sources, and her recent work examines how climate-related extreme weather events affect contaminated sites, particularly through changes in contaminant distribution and physico-chemical behaviour. Mateja has published over 150 scientific papers, holds an h-index of 27, serves on the editorial boards of four scientific journals, has supervised five PhD students, and is proud to see their important contribution to the development of environmental geochemistry.

Geological Survey of Slovenia, Ljubljana, Slovenia, Email: mateja.gosar@geo-zs.si

FROM GEOCHEMICAL BASELINES TO ANTHROPOGENIC INFLUENCES AND EXTREME WEATHER EVENT EFFECTS: A CASE STUDY FROM SLOVENIA

Slovenia's geochemistry is characterized by both natural geological conditions and significant anthropogenic influences. It is situated in a region where four tectonic units — the Dinarides, the Southern and the Eastern Alps and the Pannonian Basin — meet. The first two, the Dinarides and the Southern Alps, are composed mainly of carbonates, and they host a widely developed karst landscape that is well known worldwide. The Eastern Alps consist predominantly of metamorphic and magmatic rocks, and the Pannonian Basin is filled with a thick sedimentary sequence. While a long history of human activity has influenced the geochemical characteristics of Slovenia, the natural features determine the baseline geochemistry. Centuries of intensive mining, industry, and urban development have left regional and local signatures of potentially toxic element (PTE) pollution.

The influence of the long history of mining and ore-processing industries on PTE accumulation in various environmental media has been studied for more than 30 years by the geochemistry research group of the Geological Survey of Slovenia, and key findings will be briefly presented in the lecture. It has been established that, in Slovenia, mining and ore processing are the most important anthropogenic sources of PTEs in the environment. Two of the most affected locations are the areas around the closed Mežica and Idrija mines.

Interactions between chemical elements and their compounds in urban environments represent another key research focus. Furthermore, the consequences of climate change—especially extreme weather events such as intense precipitation, flooding, and strong winds—pose additional challenges. These events can mobilize contaminants, reshape their spatial distribution, and modify their physico-chemical properties. Understanding these mechanisms and their environmental implications is a key objective of our current research.

Acknowledgements: The preparation and delivery of the keynote lecture were funded by the Slovenian Research and Innovation Agency (ARIS) through the project ExtremEarth (J7-60124), CityDust (N1-0440) and the research programme Groundwater and Geochemistry (P1-0020).

DR MANCA KOVAČ VIRŠEK

Manca Kovač Viršek, PhD is specialized in environmental microplastics research, with a strong focus on developing harmonized methodologies for their monitoring in marine, freshwater, and groundwater systems in different matrices (water, sediments, organisms). She contributed to the development of one of rare filtration sampling systems used for microplastic sampling in groundwater (https://www.jove.com/t/68652/sampling-and-identification-of-microplastics-in-groundwater). Within the implementation of Marine Strategy Framework Direction, she contributed to the development of nationally adopted monitoring methodologies for microplastics in marine environment. Her strong research interests include also the impacts of microplastics on microbial communities' diversity, biofilm formation on microplastic particles, and the potential transfer of pathogenic microorganisms across ecosystems.

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MICROPLASTICS IN GROUNDWATER: A CRITICAL SUBSURFACE SINK AT THE GEOSPHERE–HYDROSPHERE INTERFACE

Microplastics have emerged as a pervasive pollutant across all environmental compartments of the Earth system. This invited lecture will offer a comprehensive overview of the pathways and transport mechanisms through which microplastics enter and migrate within groundwater systems, as well as the key methodological and conceptual challenges that currently hinder robust data collection and interpretation in this field. The presentation will summarize the current knowledge on the environmental fate of microplastics in groundwater and highlight critical uncertainties that limit our understanding of their long-term behaviour in subsurface environments.

In the final part, the lecture will outline emerging research questions at the interface of hydrogeology, environmental chemistry, and microbiology—particularly those related to interactions between microplastic particles, chemicals and microorganisms. By connecting these themes, the talk will emphasize the urgent need for integrated, interdisciplinary approaches to accurately assess the risks posed by microplastics in groundwater and other subsurface systems.

DR LUCIJA PERHARIČ

Lucija Perharič, a consultant physician, graduated at the Medical Faculty of Ljubljana in 1985. After obtaining her MSc in toxicology at the University of Surrey (UK), she trained in clinical toxicology, clinical pharmacology, and internal medicine. Since 1999, she has been working at the National Institute of Public Health, where she established and developed risk assessment of chemicals and national chemical risk assessors' network, introduced toxicovigilance of endocrine disrupting chemicals, and co-authored the initial national human biomonitoring programme. Her specific interests include plant toxins, which were also the subject of her PhD. Since 2003, she has maintained the title European Registered Toxicologist. In 2022, she was elected a Fellow of the Royal College of Physicians (UK). Currently, she is intensely involved in the EU project, Partnership for the Assessment of Risks from Chemicals. She is a founding member of the Slovenian Society of Toxicology, its former president and since 2024 its honorary member for her fostering of toxicology and for chairing the EUROTOX2023 congress.

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GEOCHEMICAL RISK ASSESSMENT FOR HUMAN HEALTH

Geochemicals occur in soil, water, sediment, foods, thus contributing to exposure of living organisms to a range of chemicals, which may exert effects on health. The aim of this presentation is to illustrate the role of toxicology, exposure science and epidemiology in environmental geoscience by using local examples of risk assessment for human health from exposure to metals.

Arsenic (As) in soil from natural bedrock weathering, mining, and agricultural irrigation is a global environmental hazard. In 2013, the NIJZ assessed a mildly increased risk in toddlers chronically exposed to arsenic (As) through food, based on concentrations of arsenic in home-grown vegetables in Central Slovenia, an area of previous antimony mining. Subsequently, an epidemiological cross-sectional study using concentrations of inorganic As in urine refuted the association between soil contamination with arsenic from past antimony mining and exposure of

children to arsenic (Perharič et al, 2018). Neither was an increased risk from exposure to total As found in Slovenian general adult population (Ahačič et al, 2023).

Environmental exposure to lead (Pb), even at low levels, i.e. ≤ 50 µg/L of blood, may be associated with neurotoxic effects in children. Human biomonitoring (HBM) of Pb in blood of children in the Upper Meža Valley (UMV), a former Pb mining area in N Slovenia, has been used for over 20 years as a tool to assess risk from exposure to Pb and to evaluate the risk mitigation measures. Exposure to Pb in UMV decreased rapidly in the early years of implementing the remediation measures indicating the appropriateness of the introduced measures (Ivartnik et al, 2021; Martinčič et al, 2023).

In Slovenia, copper-based fungicides are among the most frequently used plant protection products. The NIJZ assessed risk from exposure to copper (Cu) in general adult population based on the HBM data. The blood Cu concentrations were within the clinical reference values, suggesting an unlikely risk to health from exposure to Cu (Bolčič Tavčar et al., 2024).

Hopefully, this presentation will contribute to further collaboration and exchange between scientists, health professionals and regulators in illuminating the path towards the sustainable health protection and disease prevention.

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PROF DUNCAN PIRRIE

Duncan Pirrie is Secretary of the IUGS Initiative on Forensic Geology and Chair of the Geological Society of London Forensic Geoscience Group. His research career started as a sedimentologist working on the Cretaceous of Antarctica. Subsequent field research has been carried out world-wide. He has pioneered applications of automated scanning electron microscopy. In forensic geoscience he has worked on trace evidence analysis in over 100 homicide investigations and also developed techniques for soil "predictive geolocation". Current research includes work on conflict soils – areas affected by warfare, in-situ soil analysis, illegal mining, and geoarchaeology, with over 150 published papers to date. He is currently Professor of Applied Mineralogy at the University of South Wales, UK and Visiting Professor in Geology at the University of Plymouth.

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ADVANCES IN FORENSIC GEOSCIENCE; THE ROLE OF GEOLOGY IN THE INVESTIGATION OF SERIOUS CRIME

We can define forensic geoscience, as the application of geoscience to aid criminal or civil legal proceedings. There are key areas: (a) search - identifying the location of individuals or items, lost or hidden in the environment, (b) trace evidence – using geoscience materials to establish an evidential association between items related to an enquiry and (c) more recently, geoscience applied to the detection and disruption of the illegal trade in geological commodities. All three pillars of forensic geoscience may require the integration of "field"-based observation and sampling with detailed analytical and evaluative geoscience, ideally based on a conjunctive suite of analytical tools. As such, geoscience has become an important part of an overall forensic toolbox, in for example, the investigation of and provision of evidence in homicide cases worldwide. Geochemical analysis, when integrated with mineralogical and soil organic data, can provide valuable data layers in many investigations. Currently under-explored areas where geochemistry may aid forensic investigations include, but are not limited to: (1) characterising contaminants in urban soils, to allow greater sample differentiation for comparative purposes;

(2) establishing geochemical signatures associated with human decomposition; (3) understanding the long-term impact of warfare on the geochemistry of near surface environments and (4) in developing traceability tools to aid in the detection and disruption of the illegal trade in geological commodities. In addition, the rigorous approach required in forensic geoscience investigations to sampling, sample management / analysis, evaluation and reporting are equally relevant across the geosciences.

Co-authors of the presentation are Laurance Donnelly[1] & Lorna Dawson[2]

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DR INES TOMAŠEK

Ines Tomašek is a scientist at CNRS (Centre national de la recherche scientifique) based at Université Clermont Auvergne, France. She is an interdisciplinary researcher with expertise in volcanology, particle toxicology, and environmental chemistry, and has more than thirteen years of experience in multidisciplinary projects.

Following initial training as a medical laboratory technician, Ines studied geology at the University of Zagreb (Faculty of Mining, Geology and Petroleum Engineering), Croatia. She subsequently completed a PhD in Earth Sciences at Durham University, United Kingdom. Her doctoral project (funded by Marie Skłodowska-Curie ITN) enabled her to develop and apply multidisciplinary approaches to assess the health hazards of volcanic ash. She further expanded this work during postdoctoral appointments at Vrije Universiteit Brussel (Belgium) and Université Clermont Auvergne (France).

Her research focuses on health risks for populations exposed to volcanic emissions, particularly in polluted urban environments. Current research themes include: (1) human exposure to potentially toxic elements; (2) biological effects of co-exposure to volcanic and urban air pollutants; (3) interactions between volcanic emissions and urban atmospheres; and (4) urban air quality and exposure to diverse geogenic pollutants.

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RESPIRATORY HEALTH HAZARD POSED BY GEOGENIC POLLUTANTS IN URBAN AMBIENT AIR

Airborne particulate matter (PM) is a major environmental health concern linked to the onset and exacerbation of respiratory and cardiovascular disease. While research has traditionally focused on anthropogenic emissions from traffic and industry, geogenic (earth-derived) particles from natural sources such as desert dust storms and volcanic eruptions can contribute substantially to urban air pollution, often over large geographic areas and extended timescales.

Despite their widespread occurrence, the health impacts of geogenic pollutants remain insufficiently understood. These particles are highly heterogeneous in composition and surface properties, and their characteristics can change during atmospheric transport through physical and chemical interactions with other pollutants. As climate change, desertification, and land-use change increase the frequency and intensity of geogenic emissions, understanding the

respiratory health hazard associated with exposure to geogenic PM is becoming increasingly important.

This keynote will highlight multidisciplinary approaches used to characterise the physicochemical properties and biological reactivity of geogenic particles, with a particular focus on respiratory health. It will also explore the challenges of assessing hazard posed by combined exposures to multiple ambient pollutants in urban environments.

ORAL PRESENTATIONS

SEGH2026

PREDICTION OF HEAVY METAL CONTENT IN COALFIELD SEDIMENTS USING GROUND AND AIRBORNE HYPERSPECTRAL DATA

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Conventional geochemical methods of analyzing heavy metal (HM) content in soils and sediments are often arduous, especially when conducted at large scales. Thus, there is a need for a more efficient technique. Hyperspectral (HS) sensors rapidly capture hundreds of spectral bands, some of which can be used to indirectly detect HM content in soils and sediments based on their distinct spectral absorption features (SAFs) exhibited when bound to minerals, such as iron-oxides and clays. This study endeavored to (i) derive SAF parameters (SAFPs) from ground- and airborne HS data collected from coalfield sediments in Witbank, South Africa, (ii) predict Cu and As content in sediments using regression modeling and, (iii) evaluate the models' predictive capacities using the root mean squared error of prediction (RMSEP). Derived SAFPs (Depth, Width and Asymmetry) were linked to goethite (433^{a}–500^{b}) and kaolinite (1366^{a}–1448^{b} and 2208^{a}) in sediments (the numbers indicate the wavelength [in nm] consistent with the lowest reflectance value across the wavelength range of the SAF, in ^{a}ground HS data and ^{b}airborne HS data). Derived SAFPs were most agreeable at Depth433^{a}–500^{b} (R^2 = 0.85). Copper was best predicted using Depth500^{b} (R^2 = 0.77, RMSEP = 2.1) while As was best predicted using Asym2208^{a} (R^2 = 0.70, RMSEP = 1.7). Finally, Kruskal-Wallis and Dunn-Bonferroni tests showed that differences between measured-, ground HS-predicted- and airborne HS-predicted HM content in sediments were not statistically significant. The results suggest that HS data may compliment traditional geochemical methods of analyzing HM content in coalfield sediments

SOURCE APPRAISAL AND PRELIMINARY HEALTH RISK ASSESSMENT OF TRACE ELEMENTS IN URBAN COMMUNITY GARDEN SOILS: A CASE STUDY FOR FOREVER FIELDS, MANCHESTER, UK

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Exposure to trace elements (TE) is a concern for individuals who consume or cultivate produce in urban community gardens. Forever Fields (FF) is a community-based garden in Manchester, UK, managed by Manchester Urban Diggers (MUD), who grow vegetables year-round. Soil samples (*n = 90*) were collected from FF in 2024/25 and analysed using portable XRF. The method was validated by analysing Certified Reference Materials (CRMs), with recoveries of 100 ± 20% for all elements in soils. Mean soil concentrations found were: Pb (120±40 mg/kg), As (20±8 mg/kg), Hg (8±2 mg/kg), Ni (30±10 mg/kg), Cr (55±27 mg/kg), and Sb (15±4 mg/kg), amongst other TEs. Based on calculated Enrichment Factors (EF) and Geoaccumulation Indices (Igeo), anthropogenic sources contributed materially to Pb, As, Sb, or Hg concentrations in some of the soils but not to those of Cr. Notwithstanding some soil TEs concentrations exceeded UK soil guideline values, a preliminary health risk assessment using plausible exposure and receptor parameters indicated minimal non-carcinogenic and carcinogenic health risks arising from exposure to any of Pb, As, Sb, Cr, Ni or Hg in the community garden soils. The calculated health risks do not account for exposure to other agents (e.g. biological agents, organic chemicals) in the soils or via food grown at the site – the latter will be addressed in future research.

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HYDROGEOCHEMICAL CONSTRAINTS ON GROUNDWATER AVAILABILITY IN FRACTURED COASTAL AQUIFERS UNDER EXTREME DROUGHT: INSIGHTS FROM CANELONES, URUGUAY

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Extreme drought conditions between 2020 and 2023 critically affected groundwater availability in southern Uruguay, particularly within fractured coastal aquifers where structural controls govern recharge, flow, and water quality. This study evaluates the hydrogeochemical dynamics of the Costa Azul, Canelones aquifer system under severe hydrological stress, integrating geological mapping, photointerpretation, field surveys, and chemical characterization of 14 wells, complemented with a historical dataset of 25 additional wells. Two fracture systems were identified as the primary structural controls on groundwater flow: NW–SE lineaments, associated with the highest well flows (up to 28 m^3/h), and NE–SW structures with more moderate productivity (up to 12 m^3/h). Hydrochemical analyses revealed notable increases in sodium (Na) and chloride (Cl^-) concentrations during the drought period, with several wells showing Na up to 385 mg/L and Cl^- up to 381 mg/L, suggesting salinization processes likely exacerbated by reduced recharge, evapoconcentration, and potential marine influence. Complementary parameters, including pH, electrical conductivity, alkalinity, major ions, and redox conditions, highlight significant spatial variability and reflect the combined effects of geology, fracture connectivity, and climatic stress on groundwater composition.

Overall, results demonstrate the heightened vulnerability of fractured coastal aquifers to extreme climatic events, emphasizing the urgency of strengthening groundwater monitoring networks, establishing spatial hydrochemical baselines, and implementing sustainable extraction and drought-adaptation strategies. These findings provide essential scientific support for water management planning and improving resilience in regions increasingly threatened by prolonged droughts.

ESTIMATING TOTAL MEASUREMENT UNCERTAINTY IN SEAWATER TRACE ELEMENTS: EVIDENCE FOR THE DOMINANT ROLE OF SAMPLING

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Reliable assessment of human and ecosystem exposure to trace elements in marine environments depends on robust and validated measurement procedures, including a clear understanding of total measurement uncertainty. This is particularly critical for elements with known or potential toxicological significance, where uncertainty directly affects risk assessment. In this study, the Eurachem/CITAC guidance on validation of measurement procedures including sampling is applied to the determination of trace elements in seawater. Measurement uncertainty was estimated using the duplicate method with a simplified balanced design, based on single analyses of duplicate samples. External analytical uncertainty enabled separation of sampling component. Sampling was conducted at eight locations in the Aegean Sea from a sailing vessel, at depths between 0.2 and 500 m. Primary samples were collected using trace-metal clean protocols, while independent duplicate samples were obtained using a Niskin bottle. All samples were filtered, acidified, and stored at 4 °C prior to analysis. Concentrations of Li, B, Al, V, Mn, Fe, As, Sr, Mo, and Ba were determined under repeatability conditions using ICP-MS (Agilent 7700). Analytical bias was evaluated by three certified reference materials. Expanded relative measurement uncertainty (95% confidence) ranged from 6.07% (Sr) to 87.2% (Fe). The sampling component of uncertainty was greater than the analytical for seven out of ten examined elements while for As, an element of environmental and health concern, the analytical contribution was negligible, demonstrating that sampling is the dominant source of uncertainty. These results underscore the need to prioritize sampling design and harmonization to ensure reliable exposure assessment and support environmental health protection.

PROTOCOL DEVELOPMENT AND FEASIBILITY STUDY FOR THE ELEVATED CHILDHOOD LEAD INTERAGENCY PREVALENCE STUDY (ECLIPS)

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Lead (Pb) is a persistent environmental contaminant with no known safe threshold for adverse health effects. It poses a risk to neurodevelopment in young children. Current surveillance systems in the UK rely on clinician-initiated testing, meaning many cases are likely to go undetected. There is therefore an urgent need for a population-level Pb screening programme. To address this need, ECLIPS set out to develop and test, initially in Leeds, England, a home-based blood Pb biomonitoring protocol. Children aged 1-6 years who did not have a bleeding disorder and were not taking blood-thinning medication were eligible for inclusion. Recruitment started in November 2025. A mailer campaign testing three types of messaging was sent to 150,000 households to obtain consent from interested residents. From consenting households, 500 participants were randomly selected. A further 100 participants are planned to be recruited via poster and flyer placement in community paediatric clinics and special inclusion schools. Parents/carers receive a blood sampling kit by post with instructions to collect capillary blood from a finger prick at home and to return the samples for testing by post. The sampling kit includes a novel sampling card that collects 10 µl of blood via a microfluidic channel, enabling quantitative Pb measurement. The dried blood spot samples are digested and Pb measured by ICP-MS, to obtain capillary blood lead concentration (CBLC). Participants who submit a valid blood sample are invited to collect household dust and garden soil samples for environmental Pb analysis by ED-XRF. Three online questionnaires capture demographic, behavioural, and experiential data throughout the study. The overall response rate of the mailer campaign was 0.6%, representing an estimated 3% of households with children aged under 9 years in Leeds. Approximately 30% of participants who received a kit at home to collect blood returned sampling cards for analysis. The CBLC results, survey findings and Pb analysis in dust and soil samples

will be presented. ECLIPS integrates blood, dust, and soil sampling with survey tools to collect data on participant background and experiences within a single protocol. This study will provide evidence on the feasibility of home-based Pb screening, data on exposures and domestic sources of Pb, and insights to inform future UK prevention strategies.

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COMPREHENSIVE HYDROGEOCHEMICAL EVALUATION AND MEDICINAL RADIOACTIVITY OF LAKE HÉVÍZ, HUNGARY

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Lake Hévíz, located in western Hungary, is one of the largest thermal lakes in the world, known as a regional discharge zone of the Transdanubian Range karst system. The lake's slightly radioactive water originates from springs within an underwater cave in the lakebed, where waters at different temperatures and varied radium/uranium composition interact and contribute to the formation of the therapeutic water and healing mud. In this study, a comprehensive geochemical analysis of waters from the lake's cathchment area, including springs, observation wells, thermal, and drinking water wells, was conducted. ICP-MS and ion chromatography were applied for hydrochemical analysis to measure major ion concentrations. A similar dissolved solid content was detectable, while substitution of Ca^{2+} with Mg^{2+} occurred in the cation facies of some thermal wells and one of the cave samples, alongside disparate temperature regimes with variations in redox conditions. Alpha spectrometry on selectively adsorbing NucFilm discs was used to measure uranium and radium isotopes. Radon was measured by the liquid scintillation technique. Low radium, uranium, and radon levels were detected in the thermal wells with the highest temperature, while the highest radionuclide concentrations occurred inside the cave, related to mixing of different fluids. The stable isotope (δ^2H and $\delta^{18}O$) composition suggests a meteoric origin with different subsurface residence times. The integrated geochemistry framework revealed that the lake receives different reduced sulphuric and radioactive waters via distinct flow paths, which influenced by climate change and anthropogenic activities in the long term.

EXPOSOMIC AGENTS IN CHOLANGIOCARCINOMA: IMPACT OF TISSUE TOXIC METAL BIOACCUMULATION ON CANCER PROGRESSION AND IMMUNE ESCAPE

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Cholangiocarcinoma (CCA) is a highly aggressive and rare malignancy with rising incidence and limited biomarkers for patient stratification. The pathogenesis of CCA is still largely unknown, and environmental factors, including toxic metals, may contribute to its occurrence and progression.

Fifty-one tumor samples were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) to quantify aluminum (Al), lead (Pb), cadmium (Cd), mercury (Hg), and arsenic (As). Results were integrated with tissue microarray-based immunophenotyping to assess immune infiltrates (CD3, CD4, CD8, CD68, CD163), immune checkpoints (PD-L1, CTLA-4), cell cycle markers (p53, p63) and epithelial-mesenchymal transition (EMT) markers (vimentin, β-catenin).

Lead, Al, and Cd were consistently detected across all cases, supporting a widespread exposure signature and suggesting that toxic metal bioaccumulation is a pervasive and biologically relevant feature of CCA. Notably, metal accumulation patterns were largely independent, indicating distinct biological routes of uptake. High Pb levels were significantly associated with loss of p53 expression, linking metal exposure to genomic instability. Moreover, tumors with high metal burden exhibited increased PD-L1 expression, defining an immune-evasive phenotype. Unsupervised clustering further identified distinct metal-driven tumor subgroups characterized by divergent immune microenvironments.

Collectively, these findings highlight toxic metals as previously underappreciated modulators of tumor evolution in CCA, bridging environmental exposure with genomic alterations and immune escape. While causality cannot be inferred, our data introduce metal burden as a novel dimension of tumor stratification, with implications for risk assessment, patient selection, and the development of precision oncology strategies informed by environmental exposures.

INDOOR AIR QUALITY, HEALTH, AND WELLBEING FOLLOWING ENERGY EFFICIENCY RETROFITS IN SOCIAL HOUSING: THE IN2AIR STUDY

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Fabric-first energy efficiency retrofits, e.g. window upgrades, external cladding, and cavity wall and loft insulation, reduce fuel poverty but may compromise indoor air quality (IAQ) by limiting natural ventilation, increasing risks of mould, and respiratory and allergic disease. Evidence quantifying these trade-offs across real world housing typologies is limited. We provide evidence on IAQ, health and everyday impacts of fabric-first works for residents. We aim to inform practical decarbonisation designs protecting residents alongside supporting climate goals.

We measure IAQ, energy use, and health outcomes for residents of terraced bungalows, tower block flats, and semi-detached homes in Northeast England. Air quality monitors capture $PM_{2.5}$, CO_2, temperature, and humidity at one-minute intervals over three-week periods before retrofit and one year post-intervention. Monitoring takes place during November to March when IAQ is usually poorest. Residents complete health and wellbeing surveys (SF-36, ICECAP-A, Use of Services) and share energy consumption data. Control participants in neighbouring non-retrofitted properties provide comparison data. Investigation protocols were co-developed with social housing providers and industry professionals. Personalised results feedback letters were co-developed with public health specialists and participants.

Baseline monitoring is complete for 80 homes with 43 post-retrofit assessments also complete. Baseline 24-hour mean $PM_{2.5}$ ranged from 3–25 μg/m^3 in bungalows and 2–70 μg/m^3 in tower blocks (smoking households excluded). Post-retrofit bungalow $PM_{2.5}$ ranged from 2–78 μg/m^3, pending adjustment for weather conditions. Health measures remain similar across baseline and post retrofit. To understand post retrofit changes, IAQ will be adjusted for occupancy rate and behaviour.

IMPACT OF REPEATED REDOX CYCLES ON METAL REMOBILIZATION AND ECOTOXICITY IN WETLANDS

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Wetlands are critical ecosystems considered as sinks for trace metals (TM), through their interactions with iron oxides (Fe) and Organic Matter (OM). However, climate change is increasing the frequency and intensity of extreme hydrological events, inducing faster redox variations in these environments. These fluctuations can destabilize Fe-OM phases of soil and led to the remobilization of sinked TM such as cadmium (Cd) and copper (Cu), that behave differently according to their redox properties and bearing phases. This study aims to simulate how these weather events, i.e., redox alternance, influence TM release in wetlands, and to what extent the resulting soluble fraction becomes ecotoxic.

The methodology involves two contrasting wetland scenarios in well controlled reactors (batch experiments): peatlands (pH 4.5, humic acid, lepidocrocite) and rivers (pH 7, fulvic acid, goethite). The Fe reduction under anoxic condition is notably catalyzed by the iron-reducing bacteria *Shewanella putrefaciens*, during eight successive oxic/anoxic cycles (56 days). Metal concentrations in the soluble fractions is measured continuously, as well as Fe dissolved. The evolution of ecotoxicity during the cycles is quantified through bioluminescence inhibition assays using the marine bacterium *Aliivibrio fischeri*, following the ISO 21338 standard.

The objective is to correlate the metal remobilization dynamics in a redox sensitive environment with an ecotoxicological response. Whereas the toxicity of Cu depends closely on its speciation, the biological response of Cd is assessable even at low remobilization levels. This approach will help identify in which situations wetlands promote an increase in ecotoxicity in the context of climate change.

EXPLORING SOIL GEOCHEMISTRY AS A PROXY FOR RADON ANOMALIES

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Radon, a Class 1 carcinogen, is the leading cause of lung cancer among non-smokers. Identifying primary sources of radon is vital for effective mitigation and health protection. As soil-gas radon is the main contributor to indoor radon, soil geochemistry may serve as a proxy for radon emanation potential and geogenic radon classification. This study examines the relationship between topsoil geochemistry and radon distribution across 17,983 km^2 covering varied geology in Ireland. Both univariate analyses (r^2, Pearson r, heatmaps) and multivariate approaches (principal component analysis and machine learning) were applied to test the capacity of soil geochemistry to predict radon anomalies. Among the models tested—Gaussian process regression, logistic regression, and random forest—the Gaussian process model achieved the highest performance (accuracy 74%, f1-score 0.74). Key predictive elements include Y, Tl, Mn, Cr, Co, Be, Sc, and Rb, which cluster with higher geogenic radon categories in PCA biplots. These elements, termed “radon-prone elements”, exhibit spatial covariance within topsoil samples, suggesting that their distribution reflects areas of elevated geogenic radon potential. The results demonstrate that multivariate analysis of soil geochemistry provides a robust framework for predicting geogenic radon classes. This geostatistical approach highlights the diagnostic potential of legacy soil datasets for radon risk assessment and supports the integration of soil geochemistry into radon detection and mitigation strategies.

SEGH2026

TECHNOLOGY-CRITICAL ELEMENTS IN MURA RIVER SEDIMENTS WITH A PARTICULAR FOCUS ON YREE LEVELS

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The technology-critical element (TCE) levels in stream sediments (STS), alluvial sediments (AS), and suspended particulate matter (SPM; average and low water regimes) from 66 locations (main channel and tributaries) were determined in an Alpine river system, the Mura River (Austria, Slovenia, EU). TCEs (Ga, In, Te, Nb, Sb, Ta, Tl, YREE (yttrium and rare earth elements)) have become essential components in modern technologies. Given the anticipated increase in their use and environmental impact in the coming decades, this study establishes baseline levels in sediments to distinguish anthropogenically introduced TCEs from natural ones. The study concluded that no significant enrichment of TCEs was detected in STS and AS samples that can be directly associated with anthropogenic activities. Contrary, levels of Ga and YREE in SPM were higher in urban environments and at sites downstream of cities, suggesting the potential impact of industrialisation. The YREE-normalized values generally decrease from upstream to downstream in STS samples and increase in the same direction in SPM samples under both water regimes. The increase in YREE levels in SPM samples suggests the importance of erosion, fluvial transportation and deposition of YREE minerals in the lower reaches and their accumulation in secondary minerals. Graz was identified as an important source of SPM, and enrichment in YREE, together with a positive Gd anomaly in the middle reaches, may be explained by anthropogenic influences. The study additionally concludes that STS and AS primarily reflect the geogenic distribution of elements, while SPM is a more sensitive indicator of anthropogenic activities.

CHILDREN'S LEAD EXPOSURE IN A LEGACY Pb–Zn MINING REGION (UPPER MEŽA VALLEY, SLOVENIA): IEUBK MODELLING VALIDATED BY BIOMONITORING

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Legacy Pb–Zn mining has left lasting impacts on several communities in the Upper Meža Valley (Slovenia), where elevated lead levels in soil, house dust and locally produced food continue to pose risks to young children. To better understand exposure patterns in this historically contaminated region, we assessed children's lead uptake in three mining-impacted residential areas (Črna, Mežica and Žerjav) using the Integrated Exposure Uptake Biokinetic (IEUBK) model. Locally specific environmental and dietary inputs were compiled, including detailed data on Pb concentrations in soil, household dust, tap water, air, market foods and locally produced foods. For two age groups (24–36 and 36–48 months), geometric mean blood lead levels (BLLs) were modelled under multiple dietary exposure scenarios and verified using available biomonitoring data. Soil, dust and local food showed consistently elevated Pb concentrations, whereas tap water and ambient air were within acceptable limits. Modelled dietary exposure ranged from 0.7 to 3.3 µg/kg bw/day and exceeded the benchmark dose level associated with developmental neurotoxicity in children. Agreement between measured and predicted BLLs was generally good in Črna and Mežica and partially consistent in Žerjav, where the model overestimated BLLs in younger children (24–36 months). Exposure apportionment highlighted pronounced spatial differences: soil and dust dominated Pb intake in Žerjav (55–85%), while in Črna and Mežica dietary exposure became the primary pathway when local foods were included. These findings demonstrate that consumption of locally produced food can substantially contribute to children's lead exposure in mining-affected regions and should be explicitly considered in future monitoring, risk assessment and mitigation strategies.

NATURAL CUBAN ZEOLITE — STRUCTURAL PROPERTIES, BINDING AFFINITIES AND BENEFIT FOR HUMAN HEALTH

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The natural Cuban zeolite has undergone intensive mineralogical, chemical and physical testing to ensure that it is suitable for human use. The distinctive feature of Cuban zeolite, a crystalline aluminosilicate, is that it consists of two components: the large-pored mordenite and the medium-pored clinoptilolite. Both components possess the remarkable zeolite properties of ion exchange, water adsorption, and the irreversible fixation of pollutants.

In addition to the physical and chemical properties of this zeolite we determined its adsorption and desorption capacities for biogenic amines. The histamine uptake capacity of this zeolite is high and depends from the particle size, smaller particles adsorb significantly more than larger ones. A similar adsorption capacity applies to serotonin.

Based on the results obtained it can be assumed that the irreversible binding of biogenic amines occurs at the surface of the particles, which may also be true for larger molecules such as cytokines. Thus, we investigated the protective role of natural Cuban zeolite and its combination with magnesium aspartate, administered through diet in mouse of model of colitis using 2,4,6-trinitrobenzene sulfonic acid (TNBS) by evaluating its anti-inflammatory potential, alone and in combination with magnesium aspartate. It was shown for the first time that administration of zeolite is capable of suppressing proinflammatory cytokines in colonic mucosa and improving colon histopathology in murine TNBS-induced colitis. These findings suggest that zeolite combined with magnesium aspartate may be of therapeutic value for patients with inflammatory bowel disease.

ENVIRONMENTAL RADIOISOTOPES: NATURAL TRACERS IN HYDROGEOLOGICAL STUDIES AND DRINKING WATER QUALITY PARAMETERS

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In groundwater mostly uranium, radium and radon can be found. Depending on the measured activity concentrations, radiation exposure through the consumption of groundwater-derived drinking water can have a significant impact on human health. To find the most appropriate risk management methods, understanding groundwater flow systems is a key issue, as it helps to explain the origin of radioisotopes. Thanks to the mandatory measurements of gross alpha, gross beta and radon activity of drinking waters in Hungary, a basic knowledge on radioactivity of groundwater is available. These measurements highlight where combined radionuclide-specific measurements and hydrogeological studies are essential further steps for safe drinking water supply. These radioisotopes, however, can be used as natural tracers in hydrogeological studies, due to their different physical and chemical behaviour in the subsurface environment. Elevated uranium values are either associated with recharge areas of groundwater flow systems or can be found in local flow systems, where oxidising conditions prevail. In the surroundings of the Velence Hills dissolved uranium in groundwater is mobilized and transported by local flow systems. Beside groundwater resources, relatively high uranium concentrations were measured in Lake Velence proving that the lake is integral parts of groundwater flow systems and receive uranium-containing groundwater. Radium is mobile under reducing conditions; therefore, it can be often found in thermal waters, which are associated with regional flow systems. In their discharge areas iron- and manganese oxyhydroxides may develop due to the change in redox conditions, which efficiently adsorb radium and hence act as a source of radon.

ORIGIN OF Pb IN THE Pb MINE-DRAINING MEŽA RIVER (N SLOVENIA)

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The Meža River (N Slovenia) remains heavily contaminated with Pb particularly from past Pb mining and smelting activity in the upper Mežica Valley. The Pb istotope, stable ^{204}Pb and products of radioactive decay ^{206}Pb, ^{207}Pb and ^{208}Pb, analyses revealed two sources of riverine Pb: the present industrial input and mine tailings from the past local mining and smelting activities. Mine residues vary between 15 % (industrial area Žerjav) and 100 % (upstream) of Pb in the Meža River. Pb sources are reflected in local soil, vegetables and residents.

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RESPONSE OF GASEOUS MERCURY FLUXES FROM SOILS IMPACTED BY PAST MINING ACTIVITIES (IDRIJA, SLOVENIA) TO VARIABLE WEATHER CONDITIONS

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Gaseous elemental mercury (GEM) volatilisation at the soil-air interface represents a key aspect of mercury (Hg) biogeochemical cycle and can be notably high from Hg-enriched soils such as those within former mining districts, deeply affecting the dispersion and fate of Hg released in the environment. This study is focused on the evaluation of GEM fluxes from soils at four locations within the Idrija urban area (Slovenia) characterised by a different Hg enrichment due to past Hg mining and roasting processes. To evaluate seasonal and diurnal variation of GEM fluxes, at each site, several replicate measurements with a non-steady state flux chamber were taken under different environmental conditions. Overall, notable GEM fluxes were observed during summer and daytime, tracking the diurnal pattern of incident radiation and confirming its role in promoting Hg reduction in soil. Conversely, despite high Hg concentrations in soils, GEM fluxes in winter were notably reduced under snow cover compared to bare soil surfaces. Increased emissions were observed after a heavy rainfall event and under extremely high temperatures, mostly at sites characterised by less developed vegetation and thus more subject to soil heating. Due to favoured Hg reduction and diffusion, relatively high soil temperatures may also explain the substantial GEM emissions observed mostly in summer during night. These results suggest that an increase in frequency and intensity of extreme weather events (e.g. intense rainfalls, heatwaves and prolonged drought) may play a crucial but extremely site-specific role in influencing the legacy GEM re-emissions from soils at contaminated sites.

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EVERY PARTICLE TELLS A STORY: MICROSCOPIC CLUES FROM THE ENVIRONMENT

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Microscopic solid particles are all around us. They originate from numerous geogenic sources (weathering and erosion of rocks and soil, volcanic eruptions, and forest fires) as well as anthropogenic sources (e.g., industry, traffic, combustion of fossil fuels). The determination of the morphological, chemical, and mineralogical characteristics of individual solid particles can result in the identification of their sources, which is important not only from a human health aspect but also investigating environmental and other crimes. Such studies involve various media, including street dust and household dust, and often combine several analytical methods, among which scanning electron microscope techniques are particularly powerful. The aim of this presentation is to showcase several interesting examples of the successful identification of solid particles from Slovenia. Using a holistic approach, we identified characteristic particles originating from a foundry in Maribor. We identified specific types of solid particles originating from several rather unexpected sources, such as dentistry and the use of cigarette lighters. The final example demonstrates the application of forensic principles in environmental investigations related to the improper use of renovation materials.

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NATURAL RADIOACTIVITY IN DRINKING WATER: APPLICATION OF ENVIRONMENTAL TRACERS AND REGIONAL GROUNDWATER FLOW ANALYSIS IN NORTHWESTERN HUNGARY

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Groundwater accounts for 92% of drinking water supply in Hungary, making natural radioactivity in aquifers a major concern for drinking water quality. This study investigates the causes of gross alpha activity exceeding EU parametric value of 0.1 Bq/L in northwestern Hungary using a regional groundwater flow system approach. Geochemical sampling of springs, drinking water wells and thermal wells was carried out in 2021 and 2024. In-situ physicochemical parameters such as pH, redox potential, temperature, and electrical conductivity were measured. Laboratory analyses were carried out wher also the activity concentrations of total U, ^{226}Ra, and ^{222}Rn were measured. Pressure–elevation profiles were used to characterize local and regional groundwater flow conditions. In drinking water samples, total U activity reached up to 540 mBq/L, which can be linked to the local geogenic sources of the Sopron Mountains and adjacent Pannonian sediments. Radionuclide-specific measurements indicated that elevated gross alpha activity in several drinking water wells is primarily due to dissolved uranium under oxidizing conditions in local flow systems and recharge areas. Activity concentrations of ^{226}Ra and ^{222}Rn

were generally low, with one sample showing 301 mBq/L of ^{226}Ra and 219 Bq/L of ^{222}Rn. The presence of radium may be attributed to regional flow systems, whereas the high radon activity cannot be explained solely by in-situ decay of radium and warrants further investigation. The results demonstrate that the integration of hydrochemistry, environmental isotopes, and groundwater flow system analysis is a powerful tool for understanding the causes of natural radioactivity in groundwater-derived drinking water.

EXPOSURE TO POLLUTANTS AFFECTS CHILDREN'S GUT MICROBIOTA AND INTESTINAL MUCOSAL BARRIER FUNCTION

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The composition and metabolites of the gut microbiota can be altered by environmental pollutants. However, the effect of co-exposure to multiple pollutants on the human gut microbiota has not been sufficiently studied. In this study, gut microorganisms and their metabolites were compared between 33 children from Guiyu, an e-waste dismantling and recycling area, and 34 children from Haojiang, a reference environment without e-waste recycling. The exposure level was assessed by estimating the daily intake (EDI) of polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), 6PPD-quinone (6PPDQ), and metal(loid)s in kindergarten dust. Significant correlations were found between the EDIs of 6PPDQ, BDE28, PCB52, Ni, Cu, and the composition of gut microbiota and specific metabolites. The Bayesian kernel machine regression model showed negative correlations between the EDIs of five pollutants (6PPDQ, BDE28, PCB52, Ni, and Cu) and the composition of gut microbiota. The EDIs of these five pollutants were positively correlated with the levels of the metabolite 2,4-diaminobutyric acid, while negatively correlated with the levels of d-erythro-sphingosine and d-threitol. Our study suggests that exposure to 6PPDQ, BDE28, PCB52, Ni, and Cu in kindergarten dust is associated with alterations in the composition and metabolites of the gut microbiota. These alterations may be associated with children's health. Pollutants have been implicated in intestinal barrier dysfunction, through mechanisms such as cellular damage, epigenetic alterations, inflammation, microbiota changes, and metabolic disruptions.

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FLY TIPPING – A GLOBAL CRIME THAT NEEDS LOCAL SOLUTIONS

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Fly-tipping is the illegal disposal of waste onto land and in our waterways. It is a global phenomenon which manifests heterogeneously dependent on availability of waste management services. Developed countries experience fly-tipping as a leak from the circular economy whereby items are dumped in the environment before collection can occur whereas developing countries experience mass open dumpsites due to a lack of waste management services. Fly-tipping is a pollution-based environmental crime, and it is an act of human behaviour. It is a serious source of pollution and can be hazardous to human health given that the materials disposed of can be difficult to dispose of and/or contain substances that are destructive to land and the habitats of wildlife. Our research studies the fly-tipping of bulky items as they are the most encountered materials in fly-tipping incidents across Scotland with economic costs for litter and fly-tipping reaching £280.8 million annually. Scotland provides a unique case study to consider the nexus of waste management systems and communities given the connected nature of the waste landscape and close-knit web of stakeholders. We report on preliminary findings from a study of local authority website disclosures, Freedom of Information (FOI) requests, and a household survey (n=143). It is clear that fly-tipping is not an individual behavioural issue but an outcome of system design misalignment, fragmented governance, and an implementation gap between policy ambition and lived experience. Across all datasets, affordability emerges as the decisive mechanism shaping disposal behaviours. Website disclosures reveal the structural access barriers that shape bulky waste disposal choices across Scotland. Charges and discount provisions vary widely between authorities, producing a clear ‘rural premium’ in many regions, while high density urban areas face acute storage constraints that amplify pressure for rapid disposal.

LEGACY AND BIOAVAILABILITY OF TRACE ELEMENTS IN URBAN RIVER SEDIMENTS

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Fluvial sediments act as long-term environmental reservoirs, integrating both natural geochemical signals and anthropogenic inputs. This study evaluates the current concentration, spatial distribution, and bioavailability of trace metals and metalloids in sediments of the Manzanares River (Madrid, Spain), updating and comparing results with data obtained more than two decades ago. A longitudinal sampling design was implemented from the headwaters located within a protected natural park to downstream urban areas. Sediments (<63 µm) were analyzed using pseudo-total digestion (aqua regia) and weak-acid extraction (sodium acetate) to distinguish total concentrations from potentially bioavailable fractions. Elemental quantification was performed by ICP-MS.

Results reveal a clear spatial gradient. Headwater sediments reflect natural geochemical background conditions and generally fall below international sediment quality guidelines. In contrast, concentrations increase significantly along the urban stretch, with several elements exceeding Canadian ISQG (interim sediment quality guidelines) thresholds and occasionally approaching or surpassing PEL (probable effect levels) values, indicating potential ecotoxicological risk. Temporal comparison suggests partial improvement for some elements, likely associated with wastewater treatment upgrades and river restoration measures. However, the overall urban geochemical signature persists in the sediment compartment.

Bioavailability results indicate that most elements are largely immobilized, although some of them (such as Cd and Pb), display relatively higher labile fractions, implying greater mobility under changing physicochemical conditions. The findings underscore the importance of integrating total and bioavailable fractions in sediment quality assessments and confirm that legacy contamination remains a key factor in the long-term environmental dynamics of urban rivers.

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AIR POLLUTION CAUSED BY FIRES OF COAL WASTE HEAPS

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Air pollution from uncontrolled fires and smoldering of coal-waste dumps is a serious global environmental and health issue. Results of a five-year geochemical and mineralogical study of gaseous and particulate pollutants emitted from a self-igniting and currently burning large coal-waste heap in Upper Silesia, S Poland, are presented. Airborne fine particles ($PM_{2.5}$) concentration over high emission areas of the waste heap ranges from 63 to 570 µg/m^3. Concentrations (µg/m^3) of combustion gases are as follow: NO_2 <90-483>, SO_2 <64-873>, HCN <198-4843>, NH_3 <35-1624>, Cl <30-8658>, and H_2S <87-1701>. Major minerals and mineral phases in the suspended dust include: quartz, feldspars, aluminosilicate glass spherules, Fe oxides, calcium carbonates, and Ca, Na- and Ba sulphates. Rare earth phosphate, Fe sulphides, ZnS, and $PbCl_2$ occur less frequently. Sb, Bi, Cd, Ag, and Au-containing particles were occasionally observed. High emissions of fine particulate matter and toxic combustion gases, namely HCN, ammonia, chlorine, and hydrogen sulphide pose a serious threat to the nearby living people and have a negative impact on the local environment. The difficulty in extinguishing fires of self-heating coal-waste dumps worsens the problem and increases health risks for the local population.

UNEXPECTED HEALTH EFFECTS OF INHALABLE AMBIENT AIR MINERAL DUST

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The adverse health effects of inhaling large quantities of respirable particulate matter, including mineral dust, are well known. Other, rather unexpected result of environmental exposure to airborne dust was revealed in a study of mineral composition of dust particles deposited in the lower respiratory tract of individuals who lived in the industrialized and urbanized conurbation of Upper Silesia, Poland. Dust particles induced calcification of lungs tissues as a result of frustrated phagocythosis. The increased CO_2 fugacity at pH>7 in the lung's lower lobe enabled precipitation of amorphous calcium carbonate and its subsequent recrystallization into Mg-calcite ($Ca_{1-x}Mg_xCO_3$), and/or calcite. Carbonates enveloped inhaled insoluble dust particles, including uranium oxides, quartz, aluminosilicates, and metal sulfides. Recently, airborne microcrystals of mimetite, $Pb_5(AsO_4)_3Cl$, were observed in ambient air in one of the cities of Upper Silesia. Mimetite microcrystals became airborne due to aeolian entrainment of dust particles most probably from the disturbed waste dumps related to the historic Zn and Pb mining and smelting in the region. Calculated health hazard indices suggest a high carcinogenic risk due to prolonged exposure to mimetite in resuspended dust. There is a need for mineralogical analyses of inhalable dust in ambient air of regions affected by past and present non-ferrous metals smelting to determine the bioavailability of potentially toxic elements.

COMBUSTION OF PLASTICS IN DOMESTIC FURNACES – A THREAT TO PUBLIC HEALTH AND THE ENVIRONMENT

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Over the last ten years, technological progress has brought a vast array of new substances and materials to the consumer market, many of which have a highly complex chemical composition. The quantity of plastics produced and used for commercial purposes has been rapidly increasing year by year (https://plasticseurope.org). Consequently, plastics have become the dominant fraction within the mass of municipal waste, collected selectively and in mixed streams. Regrettably, part of this mass is burnt in domestic furnaces, constituting a hazardous addition to the traditionally employed fuels. There is a clear absence of adequate identification and legal regulations concerning the effects of burning such materials on: *i*) pollutants emitted into the atmosphere through the chimneys of individual households, *ii*) emissions onto soils and vegetation cover, and *iii*) possibilities for further management of ashes, i.e., residues remaining at the bottom of the furnace after combustion.

Based on the analyses conducted (water leaching, aqua regia and BCR extractions, and XRF), the following parameters were determined: chemical composition (total and pseudo-total) of the ashes and the proportion of readily and poorly mobile fractions of potentially toxic elements (PTEs) in their composition. This allowed for calculating the environmental risk (RAC) and the health risk associated with the presence of inorganic contaminants, namely selected PTEs (As, Cd, Cr, Pb, and Zn), in the material studied.

The highest pseudo-total concentrations of PTEs (mean values): Zn > Pb > Cr > Cd > As, were identified in selected fractions of municipal waste, i.e., rubber (Zn, Pb) >> artificial leather (Cd, Cr) >> furniture plywood (Pb) > textiles (As). The highest calculated environmental risk (very high risk, RAC = 55) was associated with readily leachable Cr compounds present in ashes derived from the combustion of mixed municipal waste. A medium risk (RAC = 23) was determined for As and Zn, occurring in ashes obtained from the burning of plastic-coated paper cartons and mineral oil containers, respectively. Finally, a low risk (RAC = 10) was identified for Cd in ashes obtained from the combustion of rubber.

Acknowledgement

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ASSESSMENT OF GRAIN SIZE EFFECTS ON LEAD CONCENTRATIONS IN CONTAMINATED SOILS: IMPLICATIONS FOR CITIZEN-BASED SCREENING IN LAVRION, GREECE

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Exposure to Pb-contaminated soils in historically impacted areas has led to the development of simplified screening tools, such as colorimetric tests, suitable for citizen use. However, uncertainties remain regarding the influence of soil properties on the reliability of these approaches. This study evaluates the effect of grain size on total Pb concentration estimates in contaminated urban soils. A subset of 24 soil samples was randomly selected from a 140-sample dataset collected in Lavrion (Attica, Greece), an area impacted by legacy mining and metallurgical activities, as part of a high-school science initiative to raise awareness of current conditions in their broader historical context. Field samples were initially analysed using portable XRF directly in collection bags, then air-dried, sieved into <2 mm (coarse) and <100 µm (fine) fractions, and re-analysed. Lead concentrations ranged from 421–24,979 mg/kg (field), 356–16,192 mg/kg (coarse), and 981–22,740 mg/kg (fine). Overall, no statistically significant differences were observed among fractions (one-way ANOVA, $p<0.05$), suggesting that bulk measurements provide comparable Pb estimates despite expected enrichment in finer particles and variability is some sieved samples. Colorimetric tests were conducted in the field and on coarse fractions in the laboratory. Extract pH exceeded 3 in 16 field and 7 coarse-lab samples due to carbonate buffering. Colour responses indicated that 1:3 field samples and 1:2 lab-samples exceeded the 200 ppm bioaccessible-Pb threshold. Future work will quantify bioaccessible Pb in fine fractions using USEPA Method 1340 and evaluate the reliability of colorimetric tests against standardized in vitro methods.

RISK ASSESSMENT OF INHALABLE BIOACCESSIBLE POTENTIALLY TOXIC ELEMENTS IN AIRBORNE PARTICLES FROM A ZAMBIAN COPPER MINE SITE

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Mining and mineral processing activities generate airborne particulate matter, which can transport potentially toxic elements (PTEs) to nearby communities. This study evaluates inhalation risks associated with bioaccessible PTEs in respirable particles collected from a copper slag dump in the Copperbelt Province, Zambia. Airborne dust was sampled over a one-year period using polyurethane foam passive air samplers (PUF–PAS). Bioaccessibility was determined using Artificial Lung Fluid (ALF) to estimate the fraction of each element available under pulmonary conditions. The hot dry season exhibited the highest bioaccessible concentrations of Cu (12,500 ng/m^3), Co (442 ng/m^3), Mn (204 ng/m^3), and Zn (132 ng/m^3). This was likely due to increased dust generation and re-suspension of the smelter slag. The bioaccessible fractions for Cu (16–24%) and Co (20–25%) remained consistent across all seasons, suggesting that intrinsic particle properties, rather than environmental factors, controlled their availability. In contrast, the fractions for Zn (26–46%), Fe (5–31%), Mn (29–46%), Pb (40–68%), and As (39–69%) varied seasonally. This variation reflects changing contributions from non-mining sources such as vehicle emissions and soil dust. The average airborne concentrations of Pb remained below the Zambian ambient air quality standard. In contrast, Mn and As exceeded the U.S. EPA reference concentration (Rfc) limits, indicating a potential health risks. The quantified bioaccessible concentrations will inform human health risk assessments using U.S. EPA-recommended models for carcinogenic and non-carcinogenic pathways. This study provides a comprehensive evaluation of the potential health implications of exposure to bioavailable element fractions in mining environments.

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PATHWAYS OF MICROPLASTICS TO GROUNDWATER: FIELD EXPERIMENTS IN THE UNSATURATED ZONE

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Microplastics (MPs) are increasingly recognised as emerging contaminants in groundwater resources; however, their transport processes in the unsaturated zone (UZ) remain poorly understood. Most existing knowledge comes from laboratory column experiments, which often do not represent the complex hydraulic and geochemical conditions of real aquifer systems. This knowledge gap limits realistic assessments of aquifer vulnerability, particularly in highly permeable gravel aquifers used for drinking water supply.

We present an ongoing field-based lysimeter experiment designed to investigate MP transport under natural boundary conditions. Four outdoor lysimeters were constructed using well-characterised sand and gravel sediments representative of intergranular aquifers. Polypropylene MPs of different morphologies (spheres, fragments, and fibres) were applied as particulate tracers, together with deuterated water (δ^2H) as a conservative hydraulic tracer. This dual-tracer approach enables direct comparison between water flow dynamics and particle-specific transport behaviour.

The experimental design allows time-resolved monitoring of seepage water and provides a basis for quantifying MP mobility, retention, and delayed breakthrough relative to water flow. By explicitly comparing different particle shapes under identical hydraulic conditions, the setup enables differentiation between advective transport and particle–sediment interactions that control microplastic migration in the UZ.

Rather than focusing on final breakthrough curves, this contribution demonstrates the feasibility and relevance of a field-based experimental framework for generating transport data directly applicable to real aquifer systems. The resulting dataset will support the derivation of field-relevant transport parameters and improve conceptual and numerical models of microplastic migration, contributing to more robust groundwater monitoring and protection strategies.

REVISITING INDOOR DUST METRICS: IMPLICATIONS OF METAL LOADINGS FOR CHILDREN'S EXPOSURE AND HEALTH RISK IN KINDERGARTENS

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Young children are especially vulnerable to exposure to potentially harmful elements (PHEs) in indoor dust because of frequent hand-to-mouth behaviour, high dust ingestion rates, and increased physiological susceptibility during early development. In kindergarten settings, where children spend a substantial part of the day, characterising dust contamination using metrics that better reflect exposure potential is essential for health risk assessment. Although metal(loid) concentrations in dust (μg g^{-1}) are commonly reported, surface dust loadings (μg m^{-2}) may provide a more exposure-relevant metric because they account for both contaminant concentration and the amount of dust available for contact, ingestion, and resuspension. Indoor settled dust was collected from five kindergartens in the industrial city of Estarreja. Total concentrations of Cr, Co, Ni, Cd, As, and Pb were measured by ICP-MS in the <63 μm and <250 μm fractions, which are particularly relevant for children's exposure. Dust mass loadings and corresponding elemental loadings were also quantified. Elemental loadings varied markedly among kindergartens and were consistently higher in the finer fraction. Strong and highly significant correlations (p < 0.001) were observed between total dust loading and elemental loadings, whereas concentration–loading relationships were generally weaker and statistically significant only for Ni and Pb. The strong correlation between Pb concentration and Pb loading (r_s = 0.73) indicates that dust accumulation is a major driver of Pb surface burden and potential exposure risk. These findings show that dust loading is a critical determinant of children's exposure to PHEs and should be incorporated alongside concentration data in health risk assessment of kindergarten environments.

STABILIZATION OF ANTIMONY IN CONTAMINATED SOILS

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Antimony (Sb) is a toxic metalloid of increasing environmental concern, primarily released into the environment through mining and metallurgical activities. The extraction and processing of Sb-bearing ores, along with the disposal of associated wastes, often result in elevated Sb concentrations in surrounding soils. Such contamination poses significant risks to ecosystems and human health due to the mobility and bioavailability of Sb species. Therefore, developing effective and sustainable remediation strategies for Sb-contaminated soils is of critical importance. In this study, three amendments, ferrous iron (Fe(II)), aluminum salts (Al^{3+}), and biochar, were investigated for the stabilization of Sb in contaminated soils. Two contamination levels were examined, 25 and 100 mg/kg, with the higher level representing typical conditions found in mining-impacted areas. Artificial soil contamination was achieved using Sb(III) in the form of potassium antimony tartrate. Ferrous sulfate and aluminum sulfate were applied as soluble amendments at the dose of 6 mmol/kg while biochar was used as a solid stabilizing agent at the application rate of 6% (w/w). Stabilizing agents were added one month after contamination to allow equilibration between Sb and soil components. The progress of stabilization as a function of time was evaluated by taking samples after 1, 2 and 3 months. The effectiveness of treatment was assessed using the EN12457-2 leaching test, while selected samples were further analyzed through sequential extraction to evaluate Sb fractionation and mobility. The results demonstrated that iron amendment exhibited the highest stabilization efficiency, significantly reducing antimony mobility compared to aluminum salts and biochar.

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IMPACT OF BIOACCUMULATION OF TOXIC METALS ON PLAQUE INSTABILITY AND CEREBROVASCULAR EVENTS

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Environmental pollutants, particularly toxic metals, are recognized as major contributors to cardiovascular and cerebrovascular diseases. Lead (Pb), nickel (Ni), cadmium (Cd), arsenic (As), and mercury (Hg) are well-established environmental contaminants with documented cardiotoxic and pro-atherogenic effects. In contrast, other metals such as aluminium (Al), despite their widespread presence in the environment and implication in various human pathologies, have a yet unclear role in atherogenesis. In this study, we investigated toxic metals bioaccumulation in human carotid atherosclerotic plaques using inductively coupled plasma mass spectrometry (ICP-MS), along with scanning and transmission electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM/TEM-EDX). Aluminium was detected in all 50 analyzed samples, without preferential localization within specific plaque regions and with no significant association with plaque instability. Furthermore, Al accumulation did not modify the impact of established cardiovascular risk factors on plaque vulnerability. These findings suggest that Al deposition within the vascular wall is a diffuse and likely passive process, independent of acute thrombotic events. Although not predictive of plaque instability, Al accumulation may serve as an indicator of cumulative environmental metal exposure. In contrast, the concomitant bioaccumulation of heavy metals including Pb, Ni, Cd, As and Hg, significantly impact the plaque instability represents a possible independent risk factor for cerebrovascular events. In conclusion, this study provides evidence that the bioaccumulation of toxic metals could be an important risk factor for acute cerebrovascular complications associated with carotid instability. These findings also lay the foundation for developing new therapeutic opportunities, for reducing the vascular burden of toxic metals

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HYDROCHEMICAL FOOTPRINT OF ACID MINE DRAINAGE FROM THE ABANDONED KIRKI MINES, EVROS, NE GREECE

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The extraction of mineral resources often generates Acid Mine Drainage (AMD), a geochemically driven process from the oxidation of sulfide minerals exposed to atmospheric conditions. This process releases acidity and hazardous levels of Potentially Toxic Elements (PTEs), threatening aquatic ecosystems, soil integrity, water quality, and human health. This study assesses the hydrogeochemical characteristics, environmental impact, and ecological risks within the abandoned Kirki mine (Evros, NE Greece), located 22 km from Alexandroupolis. A comprehensive monitoring program of surface and groundwater focuses on physicochemical parameters and trace element concentrations, including PTEs. After dataset quality control, ArcGIS Pro 3.6.0 is utilised to create thematic/spatial distribution maps of pollutants. Statistical techniques include descriptive analysis, correlation analysis in SPSS, hydrogeochemical diagrams (e.g., Piper, Ficklin, Gibbs, Gaillardet, Pourbaix, etc.), bivariate plots, calculation of geo-environmental and saturation indices, and the speciation of PTEs using geochemical modelling tools such as PHREEQC. The results indicate acidic (pH≈3) and oxidizing (Eh>700 mV) geochemical conditions. This environment enhances the dissolution of PTE-bearing phases and favours the mobility of PTEs, which are observed at elevated concentrations of Fe (>59.0 mg/L), Mn (>1000.0 mg/L), Pb (>8.0 mg/L), Zn (>98.0 mg/L), Ni (>3.0 mg/L), and Cd (>2.7 mg/L). AMD from both the open pit lake and the flotation tailings exhibits similarly low pH values (≈ 3.5) and high PTE concentrations, confirming these processes. The findings suggest that surface runoff and the transport of fine-grained tailings from legacy disposal sites have caused substantial degradation of the Kirkalon and Erini stream network and their hydraulically connected aquifers. Consequently, the Kirki mine remains a major source of pollution to regional water resources and agricultural lands. This study provides a framework for developing targeted remediation strategies to protect groundwater quality and safeguard the health of local communities.

THE IMPACT OF MINERALIZATIONS OF THE IBERIAN PYRITE BELT ON EXPOSURE LEVELS AND HEALTH EFFECTS IN THE GENERAL POPULATION

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The Iberian Pyrite Belt (IPB) in the SW Iberian Peninsula hosts one of the world's largest polymetallic massive sulfide deposits, exceeding 2000 Mt of original ore reserves. The Riotinto region (Huelva, Spain) in IPB has been mined since Roman times. The natural geochemical background shows anomalously high concentrations of potentially toxic elements (PTE), particularly As, Cu and Pb, in soils, sediments, air and river systems affected by acid drainage. Historical mining has further contributed to PTE dispersion. Our previous studies indicate that elevated As and Pb levels in urban soils may pose carcinogenic and toxic risks. The Riotinto mining district spans more than 25 km^2, and several towns lie nearby, increasing chronic exposure risks through inhalation, ingestion and dermal contact.

This study examines the non-occupational population of the Riotinto area (n=200). Urinary PTE levels, assessed oxidative stress and blood biochemistry were measured. Urinary concentrations (creatinine-corrected) ranged from 3.73–2287 $\mu g/g_{creat.}$ for As (median 56.7 $\mu g/g_{creat}$), 3.62–66.1 $\mu g/g_{creat.}$ for Cu (8.04 $\mu g/g_{creat}$), and 0.11–4.84 $\mu g/g_{creat.}$ for Pb (0.60 $\mu g/g_{creat}$). Women showed higher median As and Cu values, though only Cu differences were statistically significant, whereas Pb was significantly higher in men. Furthermore, among the subjects living in the study area, women showed higher oxidative stress than men. No intercorrelations were found among elements, nor between PTE levels and oxidative stress or biochemical markers. Further assessment of demographic variables and lifestyle factors is needed to better understand how environmental conditions contribute to PTE body burden in areas with naturally high geochemical backgrounds.

POST-FLOTATION MINE SLUDGES AS A SOURCE OF THALLIUM AND OTHER POTENTIALLY TOXIC ELEMENTS (Zn-Pb RAIBL MINING DISTRICT, NORTHEASTERN ITALY): INSIGHTS FROM SPECIATION AND BIOCHAR MITIGATION EXPERIMENTS

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Decommissioned mining areas may notably affect environmental quality and local communities, posing risks to water resources and human health. At the decommissioned Zn-Pb mining district of Raibl (Cave del Predil, northeastern Italy), post-flotation mine sludges stored in tailings impoundments represent the main source of potentially toxic elements (PTEs), and especially thallium (Tl), in the local river drainage system, which is hydraulically connected to the aquifer underlying the tailings impoundments. This study aims to assess the mobility of Tl and other PTEs from post-flotation mine sludges and to evaluate the effectiveness of biochar in mitigating their release into solution.

To achieve these objectives, preliminary *in situ* investigations were performed and representative sub-samples were collected from boreholes showing the highest Tl concentrations or corresponding to the water table oscillation depth, based on portable X-Ray Fluorescence (pXRF) measurements.

The chemical speciation of Tl and other PTEs was investigated using the BCR sequential extraction procedure to identify the fractions regulating their mobility. Moreover, column leaching experiments were carried out simulating groundwater rise within the mine sludges, comparing biochar-amended and untreated material. Supernatant water was periodically sampled over a one-month experiment. Results suggest that Tl mobility is primarily governed by its speciation, with samples characterised by a predominance of Tl in the water-leachable fraction, as identified by BCR analysis, exhibiting the highest release in column tests, despite similar total concentrations. Biochar amendment effectively reduced Tl mobility by up to 98%, demonstrating its potential as a remediation tool to immobilise Tl and limit its environmental dispersion.

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SLOVENIA'S HIDDEN PHARMACY: A DECADE OF TRACKING PHARMACEUTICALS IN OUR GROUNDWATER

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Pharmaceuticals are recognized as persistent environmental contaminants with the potential to compromise both groundwater integrity and public health. In Slovenia, where groundwater serves as the primary source of drinking water, understanding the long-term behavior of these compounds is critical. This study presents a comprehensive, national-scale assessment of pharmaceutical occurrence, distribution and temporal trends over a ten-year period (2014-2024). The study utilized data from over 100 monitoring sites across urban, industrial and agricultural regions. The sampling network encompassed diverse hydrogeological settings, specifically comparing the vulnerability of intergranular aquifers against the high-velocity flow systems of karst aquifers. Monitoring protocols were followed to ensure the detection of trace-level concentrations across a broad suite of compounds. The analysis revealed that caffeine, carbamazepine and sulfamethoxazole exhibit the highest detection frequencies, serving as consistent indicators of anthropogenic pressure. The findings demonstrate that contaminant transport is significantly influenced by both land-use patterns and aquifer typology, with karst systems showing distinct susceptibility to rapid infiltration. Furthermore, a human health risk assessment was conducted to quantify the potential chronic effects of consuming pharmaceutical-laden groundwater. The results underscore the necessity of integrating pharmaceutical monitoring into national water management frameworks in order to follow the evolving chemical footprint of modern medicine.

INEQUALITIES AND (IN)ADEQUACIES OF DRINKING WATER ARSENIC REGULATION – REVISITING THE USEPA (2000) COST BENEFIT ANALYSIS

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Arsenic is widely known to be the inorganic groundwater contaminant with the most substantial negative impacts on human health (Polya and Middleton, 2017; Mukherjee et al., 2024). Yet, twenty five years on from the publication of the extensively critiqued (e.g. Balazs et al., 2012) US EPA cost benefit analysis (CBA) of the optimal drinking water regulatory value for arsenic in the USA (USEPA, 2000), the maximum contaminant level (MCL) in the USA remains the same, viz. 10 µg/L, a figure that is also the most commonly adopted regulatory value across the world. We summarise the limitations of the USEPA (2000) CBA approach in terms of both model and parameter errors and uncertainties. We further highlight inequalities in exposure to drinking water arsenic (cf. Balazs et al., 2012; Polya et al., 2022) and inequities that are inherent in the USEPA (2000) approach. Notwithstanding these limitations, drinking water arsenic concentrations in the USA have broadly decreased since the adoption of the USEPA (2000) recommendations (Petrusevic et al., 2025). This, together with a revised cost benefit analysis based upon more recent epidemiological data, suggests that, whilst not demonstrably optimal, implementation of the USEPA (2000) recommendations have likely been of net positive cost-benefit.

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ENVIRONMENTAL RISK FACTORS AND ASTHMA IN SLOVENIAN CHILDREN AND ADOLESCENTS

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Introduction: asthma is a chronic respiratory disease affecting more than 350 million people worldwide and represents a substantial public health burden due to increased premature mortality and reduced quality of life. The estimated prevalence of asthma is approximately 9% among children aged 6–7 years and 11% among adolescents aged 13–14 years. Asthma results from complex interactions between genetic, immunological, and environmental factors. Children living in polluted environments are at significantly higher risk of developing asthma and experiencing exacerbations. This study aimed to assess the impact of environmental factors on asthma in Slovenian children and adolescents.

Methods: a national cross-sectional study was conducted using a validated questionnaire. The study population included 2,170 Slovenian children aged 6–7 years and adolescents aged 12–13 years from primary schools across 12 regions. Data were collected between September 2023 and May 2024. Associations between asthma symptoms and environmental and sociodemographic factors were analysed using univariate and multivariate logistic regression. An environmental indicator was constructed, incorporating indoor air factors (mould, dampness, pollutants from building materials and furnishings) and outdoor air pollution (traffic- and heating-related exposure).

Results: the environmental indicator showed a statistically significant association on asthma symptoms in children and adolescents in univariate logistic regression. In the multivariate model, it was not statistically significant.

Conclusion: environmental risk factors remain an important and modifiable component in the development of asthma symptoms in children and adolescents. These findings reinforce the critical role of improving indoor and outdoor air quality as a key public health priority and support the need for targeted environmental interventions alongside broader prevention strategies to reduce the burden of asthma in young populations.

AN INVESTIGATION OF URBAN SOIL GEOCHEMISTRY ACROSS FIVE CITIES IN IRELAND

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Five cites in Ireland (Dublin, Cork, Galway, Limerick and Waterford) have recently been sampled as part of the national Tellus soil geochemical campaign with a density of four samples per km^2. Soil samples were collected from 1,960 sites across the five cites at two depths representing shallow (5-20cm) and deeper (35-50cm) topsoil.

A previous study in Ireland created Geologically Appropriate Levels (GAL) of harmful elements for urban soil waste which were destined to be stored in Soil Recovery Facilities (i.e. unlined landfills) in rural areas. Seven geologically based Domains were defined nationally, and trigger levels (98th percentile) were determined for soils using a low-density rural geochemical dataset.

GAL trigger values were applied to shallow samples to examine patterns and extent of exceedances. Each city covers two to four Domains while one Domain is not represented. Of the eight elements for which GAL trigger values exist, the dominant exceedances across all cities relate to Pb (34.4% of all samples), Hg (22.5%), Zn (14.9%) and Cu (11.36%). Less dominant exceedances are Ni (8.57%), As (6.73%), Cd (2.47%) and Cr (0.11%).

Spatial patterns of the elements suggest a mix of geogenic and diffuse anthropogenic sources. Pb concentrations shows a distinct linear relationship with the population of each city, and both Pb and Zn concentrations tend to be higher in shallower topsoil than deeper topsoil. The high number of exceedances above GAL trigger values, notably in Dublin, suggest that alternative urban geochemical baseline and trigger values should be developed for managing urban contaminated land.

FIELD-SCALE RETARDATION OF CR(VI) IN A HIGHLY PRODUCTIVE ALLUVIAL AQUIFER: AN ANALYTICAL MODELLING APPROACH

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Hexavalent chromium [Cr(VI)] is an inorganic contaminant classified as a human carcinogen. The new EU Directive (2020/2184) lowers the permissible limit for total chromium in drinking water from 50 to 25 µg/L by 2036. Reported transport parameters for Cr(VI) in the literature span several orders of magnitude, and field-scale estimates of retardation over distances greater than 10 km remain extremely rare, making site-specific quantification essential for reliable risk assessment. In the highly productive intergranular aquifer of Ljubljansko polje, Cr(VI) was first detected in 1985, leading to a temporary halt of water extraction at the Kleče pumping station. Although concentrations at Kleče declined below the limit of quantification within a decade, elevated concentrations and rising trends later emerged at the Hrastje pumping station, located downgradient. This study examines whether these trends reflect the impact of legacy contamination or ongoing sources. With well-defined hydrogeological characteristics and over 35 years of groundwater quality records, Ljubljansko polje serves as a valuable field-scale natural laboratory for contaminant transport analysis. Predominantly oxidising redox conditions strongly inhibit the natural reduction of Cr(VI) to the less mobile trivalent chromium [Cr(III)]. An analytical dispersion model was therefore applied to reconstruct historical contamination by calibrating calculated data to observed time delays between peak Cr(VI) concentrations at successive monitoring wells along the groundwater flow path. The field-scale retardation factor was estimated at approximately 9.5, corresponding to a soil partition coefficient of 1.06–1.33 L/kg, confirming that Cr(VI) transport is significantly delayed relative to groundwater flow despite its generally assumed high mobility.

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MACHINE LEARNING–BASED GEOCHEMICAL FINGERPRINTING OF URBAN SEDIMENTS ACROSS INDUSTRIAL, URBAN CORE, RURAL, AND PERI-URBAN ENVIRONMENTS

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Despite growing concern over potentially toxic element (PTE) contamination in rapidly expanding cities, the application of machine learning (ML) to classify urban sediments and determine their geochemical fingerprints remains underdeveloped. Therefore, this study addresses this gap by establishing an ML-based framework for discriminating urban sediment types and deciphering PTE-driven signatures across diverse environmental settings. A total of 180 samples were collected from four urban categories across Cairo megacity, Egypt: road-deposited dust from the urban core, industrial fallout dust, rural dust, and peri-urban sediments, and analyzed for PTEs using ICP-AES. Five supervised machine learning models, including Support Vector Machine (SVM), Multinomial Logistic Regression (MLR), Decision Tree Classifier (DTC), Partial Least Squares–Discriminant Analysis (PLS-DA), and k-Nearest Neighbors (k-NN), were optimized and validated to achieve high-precision classification, unravel complex nonlinear geochemical interactions, and extract elemental fingerprints for each sediment category. MLR yielded the strongest discriminatory performance (96.5% accuracy), whereas PLS-DA exhibited the lowest classification capability, with accuracy declining to approximately 58.8%. Variable Importance in Projection (VIP) analysis highlighted As, Zn, Pb, Cu, and Cr as the most influential elemental predictors. The demonstrated performance of these machine learning models underscores their broader applicability, offering a transferable analytical framework that can be adapted to other environmental matrices and urban contexts, strengthening future environmental assessments and data-driven pollution management strategies.

EFFECTS OF SALINITY AND SOIL IMPROVERS ON MERCURY MOBILISATION FROM POLLUTED SOILS

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Coastal soils in North-East Italy have a widespread mercury (Hg) contamination, due to past mining activity. These soils could become hotspots of Hg re-mobilisation, because of flooding and salinization caused by the sea level rise expected as a consequence of climate change.

The aim of the present work was to assess changes in Hg solubility in contaminated coastal soils, after exposure to increasing salinity, flooding and soil improvers.

A microcosm simulations of different salinity levels, flood events and soil improvers were carried out using soil columns filled with soil and the addition of 1% of biochar, gypsum and their mix. The soils were kept submerged with 25 mL of solutions of different salt concentrations ranging from 0 to 32.8 g L^{-1} for 30 days. After the flooding treatment, leached solutions were collected and the solubilized mercury was quantified.

Mercury concentration in coastal soils was 34±6 µg g^{-1}. Hg mobility increased with increasing salinity. With salt concentrations of 0 and 4.1 g L^{-1}, the amount of solubilised Hg was negligible, but with 8.2 and 16.4 g L^{-1} soluble Hg increased significantly. The effect of salt concentration was more pronounced in the most concentrated solution (32.8 g L^{-1}) reaching about 30 µg Hg L^{-1}. The mobility of the contaminant do not change with the application of soil improvers.

Our results show a potential risk of mercury re-mobilization from contaminated coastal soils as a consequence of sea level rise and an ineffectiveness of soil improvers in reducing its mobility.

ONE HEALTH PERSPECTIVE ON E-WASTE CHALLENGE: A CALL FOR INTERDISCIPLINARY RESEARCH AND POLICY

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The rapid generation of electronic waste (e-waste) and reliance on informal recycling has led to the widespread release of hazardous contaminants into ecosystems that impact the health of all organisms. However, regulatory responses remain fragmented across environmental and health sectors, limiting the ability to holistically address the effects of e-waste on human health and ecosystems. As the One Health perspective recognizes interdependence of humans, animals, plants and the environment to achieve optimal health outcomes, it offers a comprehensive framework to address the multifaceted risks posed by e-waste. This speech will review current knowledge on global e-waste generation, transboundary flows, recycling practices, and the effects of e-waste on planetary health, and emphasize the importance of adopting the One Health approach. It will also examine international conventions and regional regulatory frameworks, highlighting persistent gaps in enforcement, health protection, and social considerations, particularly in regions where informal e-waste recycling sustains local livelihoods. Drawing on the One Health framework, we emphasize that e-waste related risks arise through interconnected exposure pathways and socio-environmental vulnerabilities. Addressing the global e-waste challenge requires a shift from fragmented, sector-specific approaches toward integrated, health-centered strategies. Future research and policy should enhance the alignment of environmental protection, public health, and social considerations based on the One Health perspective via interdisciplinary collaboration and policy integration to mitigate the effects of e-waste and to promote a more sustainable and equitable future.

S-DINOTEFURAN EXHIBITS HIGHER TOXICITY THAN *R*-DINOTEFURAN IN EARTHWORM–SOIL SYSTEM VIA ENANTIOSELECTIVE PERSISTENCE, BIOACCUMULATION AND METABOLIC STRESS

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Earthworms are key organisms in soil ecosystems, but their populations are increasingly threatened by the widespread application of agricultural chemicals. Dinotefuran, a chiral third-generation neonicotinoid, is extensively used as a seed treatment and shows high persistence in soil. However, the connections between environmental fate, multiple toxic endpoints, underlying mechanisms, and microbial community responses remain unclear. Herein, we comprehensively investigated the degradation, bioaccumulation, toxicity, and underlying mechanisms of chiral dinotefuran at an environmentally relevant concentration (0.5 mg/kg) in Eisenia fetida. Compared with *R*-dinotefuran, *S*-dinotefuran persisted 1.5-fold longer in soil and accumulated up to 6.0-fold more in earthworms. It also exhibited markedly higher toxicity, increasing lethality by 9.9-fold in 48h filter paper assays and 13.3-fold in 14d soil exposure tests, coupled with 18.0-fold higher avoidance behavior. Additionally, sub-chronic 28d exposure caused significant weight loss, reduced survival, and pronounced disturbances in CYP450, GST, and CarE activities. Transcriptomic profiling showed that *S*-dinotefuran induced stronger metabolic stress by activating cytochrome P450–mediated and glutathione pathways while suppressing cellular homeostasis and immune defense pathways, with qRT-PCR confirming upregulation of CYP3A4, CYP2, and GPx. Notably, earthworm activity reshaped soil microbial communities and partially buffered chiral dinotefuran-induced disturbances at the community level. These findings support enantiomer-specific regulation and suggest that chirally resolved formulations may help safeguard soil ecosystem function.

BIOGEOCHEMICAL CYCLE OF LEAD, CASE STUDY OF THE PROVINCE OF HUELVA, SPAIN

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Environmental geochemistry has gained increasing relevance in recent decades due to growing concern about anthropogenic impacts on natural systems and human health. The geochemical characterization of potentially toxic elements provides information on their origin, spatial distribution, mobility, and potential bioavailability. Lead is one of the most widespread environmental contaminants, with a long history of anthropogenic use and well-documented adverse effects on ecosystems and human health. This study presents a geochemical characterization of lead in soils from the province of Huelva (southwest Spain), a region with contrasting geological environments and land-use histories. A total of 229 soil samples and 26 human hair samples were collected from three areas: (1) Aroche, located in the Ossa-Morena Zone, characterized by metamorphic rocks and agricultural land use; (2) El Campillo, within the Iberian Pyrite Belt, impacted by mining activities; and (3) the city of Huelva, developed on Neogene sediments of the Guadalquivir basin, with an industrial footprint. The analytical approach integrates geochemistry, geostatistical analysis, lead isotope ratios, and bioaccessibility assessments. This multiproxy framework allows for the identification of Pb sources, differentiation between geogenic and anthropogenic contributions, and the evaluation of potential pathways for human exposure. The results highlight spatial variability in Pb concentrations and isotopic signatures, reflecting the influence of the geological context, mining legacy, and industrial emissions. Bioaccessibility data constrain the fraction of Pb that may be available for human uptake, providing a realistic assessment of environmental risk. This study contributes to a better understanding of the Pb cycle in complex environmental systems.

BIOGEOCHEMICAL CYCLE OF CADMIUM AND LEAD IN CACAO CROPS IN THE MUNICIPALITY OF SAN VICENTE DE CHUCURÍ, COLOMBIA

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Cacao cultivation in Colombia has been promoted as a sustainable alternative to coca cultivation and as a strategy to improve rural livelihoods. However, cacao plants can absorb potentially toxic elements such as lead (Pb) and cadmium (Cd), which can accumulate in the beans and enter the food chain, raising concerns about food security. The study area, located in San Vicente de Chucurí (Santander, Colombia), is characterized by intensive agricultural activity and a complex geological environment dominated by Cretaceous marine sedimentary rocks, including shales, sandstones, limestones, and interbedded local coal seams. These conditions can influence soil composition. This study evaluates the origin, distribution, and concentration of Pb and Cd in cacao-producing areas using an integrated geochemical approach. Rock, soil, and cacao bean samples were analyzed using ICP-MS, combined with multivariate statistical analysis and spatial distribution mapping. Lead isotopic signatures were applied to identify Pb sources and differentiate between geogenic and anthropogenic inputs. The results show significant spatial variability in Pb and Cd concentrations, reflecting both lithological controls and land-use influences. While Cd appears to be primarily controlled by geological factors, Pb has mixed sources, as indicated by the isotopic signatures. The presence of these elements in cacao systems highlights the importance of understanding soil-plant transfer processes in tropical environments. These findings provide a basis for assessing potential risks to cacao production and support the development of specific management strategies and sustainable agricultural practices in Colombia.

POSTER PRESENTATIONS

EFFECTS OF SALINISATION ON MERCURY MOBILITY IN PHREATIC GROUNDWATER OF CONTAMINATED ALLUVIAL SOILS: PRELIMINARY RESULTS

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The intrusion of seawater into coastal plains and the resulting salinisation of the aquifer can be a significant factor influencing the mobility of mercury (Hg) in contaminated soils. Groundwater samples taken from several piezometers located near the mouth of the Isonzo River (Gulf of Trieste, north-eastern Italy) have shown that concentrations of dissolved mercury (DHg) follow a trend very similar to that of electrical conductivity, with maximum DHg values in seawater. However, groundwater salinity does not appear to be the only parameter affecting the remobilisation of Hg from the soil, as redox potential (Eh) and groundwater depth also play an important role. Indeed, very negative Eh values correlate with high concentrations of DHg in groundwater, suggesting strongly reducing conditions and severe anoxia especially where the release of DHg is promoted. Under these conditions, the reduction of sulphates by anaerobic microorganisms also takes on particular importance, as it is often associated with the production of methylmercury (MeHg), the most toxic and bioavailable form of Hg. However, although concentrations in the soil may be high (up to 60 mg/kg), there is no correlation with high contents of DHg in groundwater. This could be linked to a different speciation of Hg, with a potentially greater abundance of forms such as cinnabar or metacinnabar, which are poorly mobile, especially under conditions where the Eh is not particularly negative. Future studies should address the availability of DHg and MeHg for bioaccumulation in plants and organisms as a result of increased soil salinity.

POTENTIALLY TOXIC ELEMENTS IN HOUSEHOLD VACUUM DUST: SOURCE APPORTIONMENT AND HEALTH RISK ASSESSMENT IN A MINING- AND INDUSTRY-IMPACTED REGION

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Household dust is increasingly recognised as an important exposure medium for potentially toxic elements (PTEs), especially in communities with a legacy of intensive industrial activity. The Meža Valley (Slovenia), historically affected by Pb–Zn mining, smelting and metal-processing industries, represents one such setting where children may face elevated exposure risks within their living environment. In this study, we conducted the first large-scale assessment of PTEs in household vacuum dust collected from homes of children taking part in annual biomonitoring campaigns across the Upper and Lower Meža Valley. Fourteen metal(loid)s were quantified, and their spatial patterns were evaluated in relation to dominant historical and contemporary emission sources. Multivariate statistical approaches consistently revealed three characteristic pollutant groups linked to specific industrial origins, showing that indoor dust retains a strong signature of long-term metallurgical emissions rather than reflecting local geology or indoor inputs. This persistent contamination pattern underscores the influence of ambient pollution on indoor environments in affected communities. Health risk assessment indicated that ingestion is the principal exposure route, with children exhibiting substantially higher non-carcinogenic risks than adults—by a factor of seven to twelve. Lead concentrations in household dust were also identified as a significant predictor of variation in children's blood lead levels, highlighting the relevance of indoor exposure pathways for public health. Although cumulative carcinogenic risks remained within acceptable limits, the continued presence of elevated PTE concentrations despite remediation measures points to the need for area-wide mitigation strategies and sustained environmental and health monitoring.

SHORT-TERM EFFECTS OF SIZE-FRACTIONED PARTICULATE MATTER ON BLOOD PRESSURE IN COPD PATIENTS: THE KEY ROLE OF INFLAMMATORY PHENOTYPES

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Objectives: To evaluate associations between size-fractionated particulate matter and blood pressure and identify susceptible individuals by smoking and inflammatory phenotypes.

Results: UFPs and $PM_{2.5}$, rather than PM_{10}, were significantly associated with increased systolic blood pressure (SBP), whereas diastolic blood pressure (DBP) and pulse pressure showed non-significant changes. The effects appeared earlier after UFPs exposure (lag 03d) than $PM_{2.5}$ exposure (lag 06d), with central responses exceeding brachial responses. Notably, hypertensive individuals exhibited stronger responses to UFPs and $PM_{2.5}$ exposure, in whom significant elevations were observed in both SBP and DBP. Stratification by smoking status revealed no evidence of effect modification. Comparatively, individuals with an eosinophilic, instead of neutrophilic, phenotype showed heightened susceptibility to $PM_{2.5}$- and UFPs-related blood pressure increases, particularly in those with hypertension.

Conclusion: Small-sized particulate matter is an important risk factor for blood pressure elevations in COPD patients, especially among those with hypertension and an eosinophilic inflammatory phenotype.

ORAL RISK ASSESSMENT IN ABANDONED MINES BASED ON BIOACCESSIBLE VALUES

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During the last century, extensive mining operations occurred in vast regions of Spain. After the cease of the exploitation activities, hundreds of tons of waste were abandoned without physical or chemical stabilisation, resulting in the severe contamination of large areas. Currently, the proximity of residues to settlements enhances the direct contact of potentially toxic elements (PTEs) with population. The study of oral bioaccessible data of two abandoned sulphide mines in Spain was carried out in order to determine the potential risks associated with the exposure of children and adults to mining waste. *In vitro* tests were performed based on the Unified Barge Method (UBM) for samples from two Pb-Zn mines: San Quintín (Ciudad Real) and San Francisco Javier (Murcia). The most bioaccessible element was Zn, followed by Pb and Cd. Tailings and dumps revealed concerning oral bioaccessible values in both areas and contaminated soils from San Francisco Javier mine exhibited high potential bioaccessible values. Most samples were classified as risky for non-carcinogenic effects and in many cases as potentially carcinogenic. The results revealed that children were especially vulnerable to the studied materials, particularly during the gastric phase. The higher PTEs bioaccessibility of contaminated soil samples from San Francisco Javier highlighted the necessity for chemical stabilisation measures to mitigate the contamination of the surrounding soils.

SULFUR-FUNCTIONALIZED NATURAL ZEOLITE CLINOPTILOLITE AS A SELECTIVE SORBENT FOR MERCURY IMMOBILIZATION IN THE IDRIJA MINE AREA, SLOVENIA

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Addressing mercury-contaminated soils in the Idrija mine area in Slovenia is critical for controlling mercury spread and mitigating environmental impacts, including methylmercury formation. Mercury leaching can be reduced through the application of suitable green and environmentally friendly sorbent-based materials such as natural zeolites. Considering the well-established affinity of mercury for sulfur, the natural zeolite (NZ) from the Vranjska Banja deposit, Serbia was chemically modified using a 1.0 mol/L Na_2S solution at 25 °C for 2 h. Successful sulfidation of natural zeolite was confirmed by a 2.7-fold increase in sulfur content. The selectivity of sulfur-functionalized natural zeolite (SZ) was evaluated using single-component, two-component, and multi-component solutions containing individual concentrations of 2 mmol/L of Hg, Pb, Cd, Zn, Cu, Ni, Co, and Mn. The selectivity of SZ toward divalent heavy metal cations in all systems follows the same order: Hg > Pb > Cd > Zn > Cu > Ni > Co > Mn. Overall, it is evident that the achieved sorption capacities, as well as the Hg removal efficiency on SZ, are consistently higher in all investigated systems than those obtained for other metal cations. For example, the removal efficiency in the most complex multi-component system follows the order: Hg (76.16%) > Pb (64.98%) > Cd (3.39%) > Zn (1.17%) > Cu (0.91%) > Ni (0.81%) > Co (0.75%) > Mn (0.51%). Ultimately, SZ exhibits absolute selectivity toward Hg, along with a pronounced affinity of Hg for SZ, making this material an excellent choice for the remediation of mercury-contaminated areas.

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MINERALOGICAL, PEDOLOGICAL AND GEOCHEMICAL CHARACTERISATION OF VINEYARD SOILS AS A KEY FACTOR IN THE CONCEPT OF TERROIR – PRELIMINARY RESULTS

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The concept of terroir can be described as the interaction of geogenic and anthropogenic factors that influence the typicality and quality of a wine from a given geographical area. The geogenic parameters of terroir are bedrock lithology, hydrogeological and geomorphic characteristics of the terrain, pedological characteristics and climate, while anthropogenic factors include specific vineyard management techniques and vinification processes. Pedological and geochemical characteristics of vineyard soils are among the key factors within the terroir concept. To gain a comprehensive understanding of the influence of pedological and soil geochemical characteristics on wine properties, we focused on seven vineyards planted with Blaufrankich grapevines in Slovenia. In each vineyard, five soil profiles were excavated to a depth of 65 cm. Soil samples were collected from three depth intervals: 0–20 cm, 20–40 cm, and 40–60 cm, resulting in a total of 105 samples. Mineralogical composition, pedological characteristics (e.g., pH, texture, plant-available phosphorous and potassium, organic matter and carbonate contents), and levels of 63 chemical elements were determined. The results revealed statistically significant differences among vineyard soils for several parameters, reflecting the combined influence of natural (geogenic) and anthropogenic factors associated with vineyard cultivation. For example, the geochemical composition of soils developed on similar lithologies does not differ significantly; soils developed on marlstone, calcareous sandstone, and limestone breccia at two different locations differed statistically only in Ba levels. In future work, the geochemical and pedological data will be integrated with lithogeochemical, morphological, and climatic characteristics, as well as with sensoric and chemical analyses of grapes and vines.

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EXTREME EVENT-DRIVEN REMOBILIZATION OF TRACE METALS IN WETLANDS OF THE LOWER LOIRE RIVER HYDROSYSTEM (FRANCE)

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Increasing extreme rainfall is expected to destabilize trace metal storage in hydrosystems. River-connected wetlands are efficient metal sinks due to abundant reactive phases such as Fe oxyhydroxides and organic matter. They become transient sources during intense events, when shifting redox conditions and physical erosion enhance metal reactivity and remobilization.

This study investigates the remobilization of Cd, Cu and Zn in hydrosystems along the lower Loire River (Montjean-sur-Loire, France). Two sediment cores were collected from a riverbank and a semi-active channel, where past flood episodes were identified. Water and suspended particulate matter were collected during the February 2026 flood, which reached high water levels comparable to those of the 1995 event.

Preliminary results indicate that, in the semi-active channel, Cd, Cu and Zn distribution patterns are similar to those of Fe and TOC (Total Organic Carbon). Strong metal–Fe correlations (up to r = 0.90) suggest an association with these reactive phases. However, sediment from the less frequently flooded riverbank shows lower variability and preserves a record of historical metal contamination, with Cd enrichment factors indicating moderately severe enrichment.

We use (i) isotopic Cu and Zn systematics to understand remobilization processes and trace contaminant sources, and (ii) a DGT (Diffusive Gradients in Thin Films) device combined with LA-ICP-MS analysis. The latter approach will provide micrometer-scale resolution of the labile dissolved fraction of metals, as well as Fe and Mn at the sediment–water interface, and will help to constrain the role of redox-sensitive carrier phases in metal remobilization during intense events.

ASSESSMENT OF SANDBOX SANDS AND SOILS IN THE CELJE BASIN THROUGH LEAD, ZINC, STRONTIUM, AND IRON STABLE ISOTOPE ANALYSIS

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Elevated concentrations of potentially toxic elements (PTEs) have previously been reported in several kindergarten sandboxes in the Celje Basin, an area historically affected by industrial emissions, mainly due to Zn-ore smelting. To identify potential contamination sources, we performed analyses of Pb, Zn, Sr, and Fe stable isotopes at selected sandbox sites where previous research has already confirmed contamination with As, Cd, Pb and Zn. Soil samples still contain elevated contents of PTEs. In some sandboxes, critical and warning values for Ba, Cd, Cr, Pb, and Zn are exceeded, as well as limit values for As and Mo. The isotopic ratios of strontium ($^{87}Sr/^{86}Sr$), zinc ($\delta^{66}Zn_{JMC}$, $\delta^{68}Zn$), and iron ($\delta^{56}Fe$ and $\delta^{57}/^{54}Fe$), indicate that the isotopic composition of sandbox sand and adjacent soil samples partially overlaps with that of the mine waste originating from the former Pb-Zn mine in Mežica and slag material produced by the historical zinc smelting operations in Celje (the old Cinkarna Celje). This isotopic correspondence suggests that both materials may have contributed to the geochemical signature observed in the investigated samples. Lead isotope ratios ($^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$, $^{208}Pb/^{207}Pb$, $^{207}Pb/^{206}Pb$) show a stronger affinity with the isotopic composition of the Mežica mine waste, indicating that this source likely represents a significant contributor to the lead inventory in the studied sands and soils. However, the overlap between isotopic signatures of the investigated materials and the potential source materials is not sufficiently distinct to attribute contamination exclusively to a single source.

Overall, the isotopic evidence suggests that the potentially toxic element (PTE) contamination of sandbox sands and surrounding soils is the result of multiple anthropogenic inputs. These likely include mine waste from the Mežica Pb–Zn mining district, metallurgical slag from Celje, and additional, presently unidentified sources. The combined influence of these sources reflects the complex environmental history of the Celje Basin and highlights the importance of using a multi-isotope approach for source apportionment in contaminated urban environments.

COCKTAIL EFFECTS OF PESTICIDE MIXTURE EXPOSURE AMPLIFYING MITOCHONDRIAL DNA DAMAGE FOLLOWED BY HONEYBEE COLONY COLLAPSE

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In agricultural landscapes, honeybees are routinely exposed to pesticide mixtures, yet multigenerational impacts remain poorly understood. Here, we exposed Apis mellifera colonies to field-realistic concentrations of acetamiprid and epoxiconazole across four generations and demonstrate that chronic co-exposure generates cumulative, multigenerational colony-level deterioration, manifested by reduced worker morphology and eventual colony collapse. Co-exposure induced head and wing reductions as early as F2, whereas single-pesticide effects emerged at F3; by F4, head length and wing width were reduced by 8.9–11.1% and 6.0–6.5%, respectively. Because insect wing development during metamorphosis is energy-demanding and particularly sensitive to mitochondrial function, we identify persistent mitochondrial dysfunction as a mechanistic basis. Co-exposure reduced mitochondrial respiration by 49.5% at 1% LD50, with workers showing progressively impaired developmental quality across generations. Critically, because honeybee workers inherit mitochondrial DNA exclusively from the queen, maternal mitochondrial inheritance provides a mechanism whereby sustained exposure amplifies mitochondrial dysfunction. Despite compensatory increases in mitochondrial DNA copy number, mitochondrial performance continued to deteriorate alongside >75% decline in antioxidant capacity by F4. These findings demonstrate that ecologically relevant pesticide concentrations can precipitate colony collapse through multigenerational mitochondrial impairment, underscoring the need to incorporate pesticide interactions and multigenerational endpoints into pollinator risk assessment.

PREDICTIVE RISK FACTORS FOR BLOOD LEAD LEVELS IN CHILDREN: A LITERATURE REVIEW

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Introduction: persistent differences in blood lead levels among children living in a comparably affected area, despite the implementation of measures under the Upper Meža Valley Environmental Quality Improvement Program, indicate the need to identify additional risk factors and develop targeted interventions. This review aims to identify risk factors for elevated blood lead levels relevant to the Meža Valley and to support the development of effective prevention strategies.

Methods: a systematic review of the PubMed database was conducted for the period from January 1, 2013, to October 20, 2025. English-language studies identifying at least one risk factor for elevated blood lead levels in children and meeting predefined inclusion criteria were included.

Results: a total of 49 original studies were included, of which 46 were cross-sectional. Overall, 103 potential risk factors were identified. The most frequently examined factors included maternal education level, family socioeconomic status, exposure to cigarette smoke, age of the residential building, and parental employment in lead-related industries, particularly lead recycling plants.

Conclusion: the findings highlight key determinants of elevated blood lead levels and support further research to identify at-risk groups. They also provide a basis for developing targeted health promotion interventions aimed at reducing disparities and lowering blood lead levels among children in the Meža Valley.

ENVIRONMENTAL LEAD EXPOSURE: EVALUATING SOIL CONTAMINATION AND THE TRANSFER OF LEAD INTO DOMESTIC HEN EGGS IN NORTHERN ENGLAND, UK

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Backyard chicken keeping has been increasing in urban areas of the UK, primarily to provide eggs for domestic consumption. This trend raises significant food safety concerns, particularly regarding lead (Pb) contamination of home-produced eggs in areas with elevated soil Pb levels resulting from historical urban and industrial sources. This study examined Pb concentrations in domestic chicken eggs, including albumen, yolk, and whole eggs, collected from multiple locations across England, and assessed the influence of local soil Pb levels on egg Pb concentrations. A total of nine household locations across urban, suburban, and rural settings were sampled; paired surface soils and 41 domestic eggs were collected. Egg samples were segregated into albumen and yolk fractions, freeze-dried, and acid-digested, with all digests analysed for Pb using ICP-MS. Soil samples were dried, acid-digested, and analysed for Pb by ICP-OES. Lead concentrations in soil and whole eggs showed significant variation across the nine sampling locations, as determined by Kruskal-Wallis tests (eggs: $H(8) = 35.39$, $p < 0.001$; soil: $H(8) = 40.00$, $p < 0.001$). Only a weak relationship was observed between soil Pb and egg Pb concentrations across all egg fractions, with the majority of associations remaining non-significant (whole eggs: $p = 0.065$, adj. $R^2 = 0.061$; yolk: $p = 0.119$, adj. $R^2 = 0.037$), and only albumen reaching marginal statistical significance ($p = 0.048$, adj. $R^2 = 0.073$). These findings suggest that non-soil factors, including feed contamination, housing dust, and hen-specific variables such as age, breed, and health status, may contribute more substantially to egg Pb accumulation than soil Pb alone.

THE USE OF URBAN SOILS FOR AGRICULTURAL PRODUCTION: THE EXAMPLE OF KRAKÓW (POLAND)

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Within urban agglomerations, there is currently a noticeable trend to seek out green areas, which are used not only for recreation but also for food production. Most often, these spaces take the form of home gardens where people grow crops or of urban allotment gardens. Such spaces are used not only to improve mental well-being, but also to provide the possibility of growing fruits and vegetables that can be consumed by their owners and their families. On the other hand, urban areas are characterised by both high population density and substantial pollution stemming from public transport and road traffic, as well as industrial activity, which is frequently centuries-long and multifaceted in nature. To assess the possibilities of using soils for agricultural purposes in a large EU urban agglomeration of over one million inhabitants, namely Kraków in southern Poland, surface soil samples (0–20 cm BGL) were taken from different sites (allotment gardens, new and old city parks, and areas along major traffic routes). The samples were analysed for pseudo-total, readily and poorly mobile, and bioavailable concentrations of Zn, Pb and Cd. The analyses showed that soils in city parks and along major traffic routes were moderately or slightly contaminated (data in mg/kg: Zn 33–285; Pb 32–139 and Cd 0.22–1.14). The bioavailable fraction (mean) amounted to 16%, 17% and 27% of the total content, respectively. This pointed to a moderate environmental risk associated with the potential incorporation of the elevated content of these elements into the trophic chain. From the perspective of agricultural use of the soils studied, the most favourable conditions were found in the newest city park, which is a recently reclaimed site located in the city centre. The least favourable location proved to be areas situated along the city's major traffic routes.

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CHARACTERISATION OF DEVONIAN SANDSTONE CORE SAMPLES USING SCHMIDT HAMMER AND GEOMECHANICAL PROPERTIES TESTING

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This study investigated the geomechanical properties of sandstone core samples from laboratory experiments. The specimens are from devonische sandstone from the Holy Cross Mountains in Poland. This kind of rock remains explored not safficiently in the publications. Investigation characterizes sandstone core samples using Schmidt hammer testing and saturation–buoyancy porosity measurements. The study focuses on determining the uniaxial compressive strength (UCS) and Young's modulus. Statistical correlation methods were used to assess the relationships between UCS, elastic modulus, and porosity. The results revealed a very strong and statistically meaningful positive correlation between UCS and Young's modulus, indicating a stable link between material strength and stiffness in all tested samples. On the other hand, no significant relationships were observed between porosity and either UCS or Young's modulus. This lack of correlation is probably due to the relatively narrow porosity interval (25.4 to 29.8%) and the small number of samples, rather than indicating that porosity has no influence on mechanical properties. Overall, the results confirm the reliability of Schmidt hammer indices as a tool for estimating geomechanical parameters in lithologically consistent core samples. At the same time, they highlight the importance of increasing the size and incorporating direct laboratory measurements to obtain more reliable and comprehensive correlation results.

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GEOCHEMICAL AND PEDOLOGICAL CONTROLS ON Pb, Zn, AND Fe ORE MINERAL WEATHERING: INSIGHTS FROM SOIL COLUMN LEACHING EXPERIMENTS WITH PARTICLE-SCALE VALIDATION

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Understanding the transformation of solid carriers of potentially toxic elements (PTEs) in soils was recognized as essential for assessing environmental risks in mining-impacted areas. In this study, the behaviour of Pb- (PbS, $PbSO_4$, PbO_2), Zn- (ZnS), and Fe-bearing (FeS_2) minerals in uncontaminated soils was investigated using one year long soil column leaching experiment. The experimental approach was based on micro-scale characterization of PTE-bearing particles before and after exposure to soil and periodical leaching. Soil column experiments, combined with periodic leaching provided a controlled framework for investigating mineral weathering and phase transformations under conditions approximating natural pedological processes. Two mineral assemblages were studied in parallel soil column experiments: Pb, Zn, and Fe sulfides (galena, sphalerite, pyrite) representative of mining-impacted environments, and Pb sulfate and oxide (anglesite, plattnerite) characteristic of Pb smelting and recycling processes. The combined observation of soil columns and characterization of leachates provided important insight into development of local pedological and geochemical conditions arising from complex multi-phase interactions. The influence of soil heterogeneity was clearly reflected in the microchemical and micromorphological features of the test minerals, as well as in phase transformations and immobilization processes mediated by redox-active soil components. These findings demonstrated that it is the pedological and geochemical environment—shaped by dynamic interactions among multiple phases—that primarily governs the fate of PTEs, rather than the properties of individual particles alone.

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OCCURRENCE AND EVALUATION OF POTENTIALLY TOXIC ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBONS IN POST-FIRE SOILS: A CASE STUDY FROM NE ATTICA, GREECE

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Studying inorganic and organic contaminants, including Potentially Toxic Elements (PTEs) and Polycyclic Aromatic Hydrocarbons (PAHs), in post-fire soils is necessary to understand their geochemical behavior. This is particularly important for Greece, where the lack of a Soil Geochemical Atlas limits pre- and post-fire comparisons and climate change impact assessments. This study evaluates the hypothesis that wildfire events alter soil geochemistry by evaluating PTE and PAH contents in soils from NE Attica, Greece, after the August 11, 2024, wildfire to assess post-fire soil quality. To achieve this, the HSGME research team collected 52 Wildfire Ash (WA) and soil samples during a sampling campaign in October 2024. A set of 77 chemical elements and compounds was determined and evaluated, including major oxides, major elements, trace elements, containing the most significant PTEs from toxicological and environmental perspectives, and PAHs. Data treatment includes chemometrics, spatial analysis, and calculation of geo-environmental indices (i.e., Enrichment Factor [EF], Pollution Load Index [PLI], and Geoaccumulation Index [I_{geo}]). The results reveal that the increasing frequency of wildfires linked to climate change alters soil geochemistry and contaminant dynamics. While PAH contents remained low, they were predominantly concentrated in WAs. Wildfires altered soil properties and increased the mobility of PTEs, as reflected by geo-environmental indices that revealed elevated contamination levels. WAs exhibited enrichment in Pb, Zn, Sn, Cd, Cu, and PAHs, whereas soils contained higher As and Hg contents. Soil characteristics, fire severity, geological background, land use, WA dispersion, and the geochemical behaviour of specific elements influenced post-fire contaminant distribution.

EVALUATION OF UNDERGROUND DISPOSAL STABILITY AND ENVIRONMENTAL SAFETY OF CEMENT WASTE FORMS CONTAINING CARBONIZED SPENT ION-EXCHANGE RESINS

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This study evaluated the disposal stability of cement waste forms incorporating spent ion-exchange resins generated from nuclear power plant decontamination. The resins were pyrolyzed at 600°C under a nitrogen atmosphere, and the waste forms were fabricated with a mixing ratio of 40% carbonized residue, 35% cement, and 25% water. After 28 days of curing, the waste forms demonstrated excellent mechanical and chemical integrity. The compressive strength remained consistently above 10 MPa, even following immersion and thermal cycling tests. Furthermore, the leaching index was recorded at 10 or higher, and the free-standing water test showed no detectable liquid, satisfying all regulatory requirements for underground disposal. These results confirmed that the carbonized waste forms effectively prevent the leakage of radioactive contaminants. In conclusion, this stabilization process ensured long-term geological disposal safety and provides a robust solution for preventing environmental contamination from radioactive spent resins.

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SUBSURFACE ENVIRONMENTAL STABILITY AND MIGRATION INHIBITION OF RADIOACTIVE CONTAMINANTS THROUGH IMMOBILIZATION OF CARBONIZED SPENT RESINS USING GEOPOLYMER

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This study evaluated the disposal stability of geopolymer waste forms incorporating spent ion-exchange resins pyrolyzed at 600°C under a nitrogen atmosphere. The geopolymer matrix was synthesized with a molar ratio of SiO_2/Al_2O_3=4.0, Na_2O/SiO_2=0.18, and H_2O/Na_2O=14.4. The final waste forms, containing 40% carbonized residue, demonstrated superior performance across all safety evaluations. The compressive strength was maintained at above 10 MPa, even after undergoing immersion and thermal cycling tests. Additionally, the leaching index exceeded 10, and the free-standing water test showed no issues, meeting the stringent requirements for underground disposal. These results indicated that the geopolymer matrix provided excellent chemical and mechanical encapsulation for carbonized resins. Consequently, this study proved that geopolymerization is a highly effective method for ensuring long-term environmental safety and preventing the leakage of radioactive contaminants in geological repositories.

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PHOTOCHEMICAL, DARK ABIOTIC, AND MICROBIAL MERCURY REDUCTION IN AQUATIC ENVIRONMENTS

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Mercury (Hg) is a global health concern due to the long-range intercontinental transport of elemental Hg (Hg(0)) in the atmosphere and microbial methylation of inorganic Hg to produce highly toxic and bioaccumulative methylmercury in aquatic environments. Biogeochemical cycling of Hg in the environmental media (air, soil, water, and sediment) involves various transport and transformation processes, among which reduction of divalent Hg (Hg(II)) to Hg(0) in aquatic environments is a critical step as it controls the air-water Hg exchange and the pool of inorganic Hg available for methylmercury production. Photochemical reaction has been extensively studied as a dominant pathway for the reduction of Hg(II) in sunlit environments such as surface water. The reduction of Hg(II) in the environment with limited light penetration (e.g., aphotic water layer and sediment) can be attributed to microbial and dark chemical processes. It is well known that Hg-resistant bacteria can use the MerA pathway to reduce Hg(II), which is usually mediated by aerobic heterotrophic microbes in Hg-contaminated areas. In anaerobic zones, Hg(II) reduction can occur through the activities of some heterotrophic and chemotrophic microorganisms, e.g., the dissimilatory iron (Fe) reduction bacteria. The widely present Fe(II) species, including aqueous Fe(II) and especially solid phase Fe(II) such as magnetite, green rusts, and mackinawite, may be a critical driving force for dark chemical reduction of Hg(II), although their exact roles in Hg redox transformation in aquatic environments warrant further investigation. We summarize here comprehensive information on aquatic Hg(II) reduction by synthesizing previous information and highlighting future research needs.

ASSESSMENT OF RADIOLOGICAL HEALTH HAZARDS FROM ^{40}K, ^{226}Ra, AND ^{232}Th IN ROCKS AND SEDIMENTS OF THE KAŠTELA BAY COASTAL AREA (ADRIATIC SEA, CROATIA)

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Internal hazard index (H_{in}), excess lifetime cancer risk outdoors ($ELCR_{out}$), and annual gonadal dose equivalent (*AGDE*) were studied in four types of samples from the Kaštela Bay coastal area: limestones (K), marls (L), stream sediments (PS), and soil (T). The purpose was to determine radiological health hazards and contributions of the lithologically relevant units and radionuclides (^{40}K, ^{226}Ra, ^{232}Th) to hazards. The lowest H_{in}, $ELCR_{out}$, and *AGDE* were determined in limestones (mean values: 0.11, 0.05×10^{-3}, 68 μSv/y, respectively) and the highest in soils (mean values: 0.79, 0.51×10^{-3}, 667 μSv/y, respectively). General increasing trends of all indices were observed in the studied types of samples in the following order: K–L–PS–T. H_{in} maximum in soil was above the recommended limit. $ELCR_{out}$ and *AGDE* maxima, mean values, and medians in soils were above the mean values for the world soils. Soils are significantly differentiated from K, L, and PS due to notably higher hazard indices. L and PS showed similar patterns for all indices. Limestones were specific with ^{226}Ra as a significantly predominant contributor to all hazards from them (> 85 %). ^{226}Ra was the main contributor to H_{in} in all types of samples. ^{40}K was the main contributor in L (43 %), ^{226}Ra in PS (37 %), and ^{232}Th and ^{226}Ra in T (39 % and 38 %, respectively) to $ELCR_{out}$ and *AGDE*. ^{226}Ra showed the largest summarised contribution to all hazards in all samples together. Attention should be given to ^{226}Ra and soil in the future radiological protection.

PERSISTENT MERCURY CONTAMINATION IN IDRIJCA RIVER ALLUVIAL SEDIMENTS: LONG TERM MONITORING AND THE ROLE OF EXTREME WEATHER EVENTS

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Five centuries of mercury mining and ore processing in the Idrija district have created one of the world's most prominent Hg-contaminated river systems. Long term monitoring of alluvial sediments in the Idrijca river reveals that while the Hg levels upstream of the town of Idrija remain near background, concentrations within the town itself and downstream are extremely elevated and spatially variable.

Despite cessation of mining about 30 years ago, Hg levels in sediments remain persistently high (up to 3540 mg/kg), reflecting the large historical reservoir of contaminated materials stored along the river. Studies of stream sediments show that erosion of roasting waste dumps, contaminated soil, streambeds, and mercury rich floodplains continues to supply substantial Hg loads to the river system. High flow and flood events, especially during extreme weather, periodically remobilize these deposits and redistribute Hg downstream. Understanding these spatial and temporal patterns is essential for assessing long-term environmental risks and for evaluating their importance for mercury levels in the lower parts of the Idrijca and the Soča river valleys as well as in the Gulf of Trieste in the Adriatic Sea. These insights are crucial for understanding the importance of future climate-driven hydrological extremes.

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GWMicroPlast: MICROPLASTICS IN GROUNDWATER – FROM METHOD DEVELOPMENT TO FIELD EVIDENCE

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Microplastics (MPs) are increasingly recognised as emerging organic contaminants in the geosphere; however, their occurrence in groundwater systems remains insufficiently documented. This limitation is largely due to the lack of groundwater-specific monitoring approaches capable of detecting low MP concentrations while ensuring data quality and comparability. The GWMicroPlast project addresses this gap through an integrated framework combining groundwater monitoring, methodological development, and process-based investigations.

The project focuses on (i) identifying the presence and characteristics of MPs in different types of groundwater bodies, (ii) improving and harmonising sampling and analytical methods for MP determination in groundwater, and (iii) investigating transport processes of MPs from the surface to groundwater. Groundwater monitoring is conducted in selected intergranular and karst aquifers representing contrasting geological settings and land use pressures, enabling assessment of MP occurrence in different geospheric environments.

A central outcome of the project is the development of a large-volume groundwater sampling method based on enclosed cascade filtration, enabling contamination-controlled filtration of volumes exceeding 1 m^3. Samples are analysed using combined microscopy and spectroscopic techniques (FTIR, Raman, SEM-EDS) to characterise MP abundance and properties.

To support interpretation of monitoring data, transport processes are investigated through controlled field experiments in a gravel unsaturated zone under natural boundary conditions. Overall, GWMicroPlast provides concrete evidence of MPs in groundwater and establishes a robust methodological basis for assessing MPs as contaminants within the geosphere, supporting groundwater protection and drinking water management.

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MICROPLASTIC CONTAMINATION IN URBAN GARDEN SOILS OF THE CÁVADO REGION: OCCURRENCE, CHARACTERIZATION AND ENVIRONMENTAL IMPLICATIONS

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Microplastic (MP) contamination in agricultural soils is an emerging environmental concern, yet its occurrence in urban horticultural systems remains poorly documented. This study investigated MP pollution in urban garden soils from the Cávado region (Portugal), with the aims of (i) characterizing and quantifying MPs and (ii) assessing their possible relationship with soil physicochemical properties. Soil samples were collected in spring 2024 from the 0–20 cm surface layer and processed using density separation with potassium carbonate (K_2CO_3), followed by optical microscopy for morphological characterization. In parallel, soil texture, organic matter, pH, and electrical conductivity were determined to explore possible links between MP occurrence and soil properties. Preliminary results revealed the widespread presence of MPs in the studied soils. Fibres were the dominant morphological type, followed by fragments and films, indicating multiple potential sources associated with agricultural plastic use. The observed contamination patterns suggest that MP accumulation may be influenced by the intensity and duration of plastic use over time. These findings point to a persistent input of plastic-derived particles into urban agricultural soils and highlight their potential to interact with key soil properties. Although comparable studies in similar agricultural contexts remain scarce, this work provides new evidence of MP contamination in urban gardens and contributes to a better understanding of how specific agricultural practices may promote their accumulation in soil. Further polymer identification by FTIR will support a more detailed evaluation of MP sources and environmental implications.

GEOCHEMICAL INVESTIGATION AND BIOMARKER FINGERPRINTING OF TAR BALLS IN THE MLJET NATIONAL PARK ISLAND (CROATIA)

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Tar balls are widely recognized as indicators of marine pollution associated with spills of crude oils or petroleum products. In this study, tar-ball samples collected in the Mljet National Park island (Croatia) were subjected to geochemical investigation using gas chromatography–mass spectrometry (GC-MS) to determine their molecular composition and identify potential pollution sources. The chemical analysis of petroleum biomarkers, detected by GC/MS spectrometry, generates information of great importance to environmental forensic investigations in terms of determining the source of spilled oil, differentiating and correlating oils, and monitoring the degradation process and weathering state of oils under a wide variety of conditions.

Comparative evaluation of total ion chromatograms, n-alkane distributions, and hopane and sterane fingerprints revealed strong similarity among all investigated samples. The preserved biomarker fingerprints indicate that the tar balls originated from the same source - heavy fuel oil, petroleum product spills. Although the samples showed varying levels of biodegradation and weathering, their biomarker fingerprints remained sufficiently intact to support reliable source identification.

Overall, the findings suggest that the tar balls deposited in the Mljet National Park island likely derived from a single heavy fuel oil spill event, with differences among samples reflecting distinct phases of environmental alteration.

This study demonstrates the value of geochemical analysis using petroleum biomarkers fingerprinting for tracing marine oil pollution and emphasizes the importance of continued monitoring in regions affected by maritime activity.

PHYSICOCHEMICAL MICROPROPERTIES OF PARTICLES AS POLLUTION SOURCE INDICATORS - PROBLEMATICS

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Solid carriers of potentially toxic elements (PTEs) in environment result from various natural factors as well as historical and current human activities, so their mixtures are complex. Pollution source identification is needed to limit PTE emissions on sources that contribute most to pollution. Identification of pollution sources is based on physicochemical properties of solid PTE-carriers, therefore, detailed knowledge is required on chemical, mineralogical and morphological properties of individual carriers, which depend on composition of source material and processes under which they formed. Main goal of this study is to test usefulness of solid PTE-carriers' properties as source indicators.

Study area is situated in mining- and industry-affected environment with several possible sources of solid PTE-carriers. Various environmental media (e.g. airborne particles, road sediment, soil) that are directly or indirectly associated with ecosystems and humans are studied using conventional chemical analyses and electron microanalytical techniques to determine elemental, mineral composition and particle morphology.

Preliminary results show that in different environmental media, associations of solid PTE-carriers are chemically, morphologically and mineralogically different despite generally similar chemical composition of media. This indicates that during their migration between different media solid PTE-carriers experience changes in their physicochemical properties, characteristic of their sources, due to various natural or man-induced processes. The main question is whether these changes impair use of solid carriers as source indicators.

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THE ROLE OF SOIL PROPERTIES IN MODULATING ARSENIC BIOACCESSIBILITY AND MOBILITY IN URBAN GARDENS

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Arsenic (As) mobility and bioaccessibility in soils are strongly influenced by inherent soil properties, which in turn shape the risk of human exposure in garden environments impacted by historical mining. This study investigates the relationships between soil physicochemical characteristics, such as texture, pH, and organic carbon (Corg), and arsenic bioaccessibility in urban gardens near the former mining region of Złoty Stok, Poland. Surface soil samples were collected and analyzed for particle size distribution, pH, and Corg content. Total As concentrations were determined by ICP-MS, and bioaccessible As was quantified using the SBET in-vitro method, complemented by sequential extraction to partition As among operationally defined soil fractions. Results indicated that soils were predominantly silt loams with moderately acidic to near-neutral pH (5.5–6.75) and Corg ranging from 2–5%. Although total As concentrations were extremely high (466–972 mg kg^{-1}), only 10–16% was bioaccessible. Statistical analyses revealed a positive correlation between clay content and bioaccessible As ($r = 0.75$), suggesting that clay minerals exhibit limited As immobilization relative to Fe/Al oxides. Conversely, Corg was negatively correlated with bioaccessible As ($r = -0.63$), suggesting that organic matter enhances As mobility via competitive desorption mechanisms. Soil pH exerted a minor influence within the observed range. These findings emphasize the critical role of site-specific soil properties in modulating arsenic risk and underscore the necessity of detailed soil characterization for accurate exposure assessment and the informed management of contaminated gardens.

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MONITORING POTENTIALLY TOXIC ELEMENTS IN SOILS, SEDIMENTS, AND FLOATATION TAILINGS USING FPXRF MEASUREMENTS AROUND THE ABANDONED KIRKI MINE, NE GREECE

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The KIRKAP project, implemented by the Hellenic Survey of Geology and Mineral Exploration (HSGME), focuses on the initial phase of environmental remediation at the abandoned public Kirki mining area in NE Greece; this phase involves identifying polluted sites, assessing Potentially Toxic Element (PTE) contents, and evaluating risks to human health and ecological receptors. The main objective is to characterize the spatial distribution and magnitude of elevated PTE contents and to delineate polluted areas using geochemical and environmental criteria in the Kirki mining area. Systematic sampling campaigns collected soil, sediment, and flotation tailings, while numerous Field portable X-ray fluorescence (fpXRF) measurements (XL5 Plus Handheld) identified 33 chemical elements, including key PTEs (e.g., As, Cd, Cu, Pb, Zn). The fpXRF is a compositional analysis technique widely used in environmental monitoring for its straightforward operation, minimal sample preparation, cost-effectiveness, ability to generate high-density datasets, and real-time decision support. The spectrometer was used in the field through direct contact with targets or on-site analysis of homogenized samples, supporting reliable identification and informed sample selection. Data analysis included descriptive statistics, boxplots, bivariate plots, correlation, multivariate analyses, and spatial mapping. Quality control was maintained by collecting duplicate fpXRF measurements, field blanks, and validating methodological modifications. The study found elevated levels of Pb (up to 13.6%), Zn (up to 9.8%), and Cu (up to 0.25%) in solid samples, with flotation tailings identified as the main source of pollution affecting local soils, sediments, and waters; Pb and Zn were the main pollutants, along with Cu. Exposure of tailings and impoundments to atmospheric conditions altered their chemical, mineralogical, physical, and geotechnical properties. The results confirm that fpXRF is a rapid, user-friendly, and effective tool for assessing environmental pollution, and when combined with systematic sampling, it provides a strong foundation for targeted remediation to protect human health and ecosystems.

SUSTAINABLE EXTRACTION OF LITHIUM FROM COAL FLY ASH USING CARBOXYLIC ACIDS

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The present study investigates an environmentally friendly process for recovering lithium from coal fly ash (CFA). Three CFA samples from different power plants in Greece were examined, and organic acids were used as eco-friendly leaching agents. The major constituents of the ash samples were analyzed by X-ray fluorescence spectroscopy (XRF), their mineralogy was characterized by X-ray powder diffraction (XRD), and their lithium content was determined using inductively coupled plasma atomic emission spectrometry (ICP-AES).

A series of screening tests based on the L18 Taguchi method was conducted to identify the most influential parameters. The parameters evaluated included the CFA-to-acid solution ratio, CFA sample type, acid type, acid concentration, processing time, and temperature. The results indicated that CFA type and acid type had the most significant effects on the leaching process, followed by acid concentration and temperature.

Based on these findings, a second set of experiments was conducted to examine the effects of acid concentration and temperature. The highest lithium recovery achieved was 99% at 60 °C, using 1 M oxalic acid, a CFA-to-acid solution ratio of 1:25, and a leaching time of 120 min.

EFFECT OF EXTREME WEATHER EVENTS ON THE CONTRIBUTION OF MERCURY AND POTENTIALLY TOXIC ELEMENTS ASSOCIATED WITH FLUVIAL SUSPENDED PARTICULATE MATTER IN THE ISONZO RIVER (NE ITALY)

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Extreme rainfall events play a key role in the remobilisation of soil and sediment particles as suspended particulate matter (SPM) in fluvial waters, which act as carrier in the dispersion of potentially toxic elements (PTEs), especially in areas that have been contaminated by mining and industrial activities.

The Idrijca-Soča/Isonzo river system represents the main source of mercury (Hg) from the Idrija mining area (Slovenia) to the Gulf of Trieste (north-eastern Italy), particularly during medium to high river discharge events. Besides, other PTEs (Pb, Zn, Tl, As, Cd) are present, most likely as a legacy of past mining activity at the Raibl Pb-Zn mine, whose drainage waters are conveyed into the Isonzo River via the Bretto gallery and its tributary, the Koritnica.

The aim of this study is to evaluate the effects of variations in the Isonzo River water discharge on the PTE concentrations associated to SPM. Water samples were collected from the Isonzo River under different flow conditions at different sampling sites. The water samples were then filtered, analysed for grain size distribution and subjected to mineralisation for Hg and PTEs analytical determination using CV-AFS and ICP-MS, respectively. Results suggest a correlation between SPM concentration and flow rate, as well as with the total concentration of Hg and other PTEs associated with SPM. The relationship appears linear up to a threshold flow rate, beyond which the concentrations increase exponentially. These findings highlight the importance of monitoring extreme hydrological events, as they may enhance contaminant re-mobilisation affecting the downstream environment.

LABORATORY AND FIELD SCALE GEOPHYSICAL MEASUREMENTS IN SEDIMENTS IMPACTED BY INORGANIC POTENTIALLY TOXIC ELEMENTS (PTE)

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Environmental geophysical investigations often require controlled laboratory experiments to calibrate measurement and modelling parameters, as well as to better understand the links with the physicochemical processes occurring in the subsurface associated with the type of pollutants and geologic materials. In this work, we present the preliminary results of an integrated multi-geophysical and geochemical data analysis to assess the impact of inorganic PTE in flooded sediments with contaminated water of metallic particles from Pb-Zn mine waste deposits. This is demonstrated by the relationships found between the measured and modelling geophysical parameters from field and laboratory scale datasets: electrical conductivity, polarizability, and chargeability, and the concentration of PTE in terms of the chemical composition (e.g., Pb, Zn, and Fe) estimated by XRF measurements in collected sediment samples. These preliminary results evidence promising capabilities of geophysical (electrical and electromagnetic) methods for in-situ detection and monitoring of inorganic PTE (metallic particles). However, further geophysical investigations are needed in a larger number of sediment samples along with geochemical, mineralogical, and granulometric data to improve the petrophysical analysis based on geophysical signatures, as well as time-lapse measurements in affected areas to aid in the development of an integrated, mechanistic and quantitative model of PTE.

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MICROFIBER RELEASE FROM SYNTHETIC TEXTILES DURING DOMESTIC WASHING AS A SOURCE OF WASTEWATER POLLUTION

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Water contamination by pharmaceuticals, pesticides, persistent organic pollutants and microplastics represents a growing environmental and health-related concern. Microfibers released during the washing of synthetic textiles are an important pathway of plastic pollution into wastewater, with a single household wash potentially releasing millions of fibers. Due to their small size, persistence and complex composition, these pollutants are difficult to detect, identify and remove, raising concerns for aquatic ecosystems and human health.

To assess microfiber emissions from domestic washing, five textile materials were selected, including four PET-based fabrics and one polyamide-based fabric. Their composition was confirmed by FTIR spectroscopy and morphology was analyzed using stereomicroscopy. Three 1 m^2 pieces were prepared from each textile, with sewn edges to better simulate fiber release from finished garments. Washing tests were performed under textile-recommended conditions using a commercial liquid detergent. Washing cycles were carried out and approximately 50 L of wastewater per wash was collected. After homogenization, selected wastewater volumes were filtered through polycarbonate filters, and the retained fibers were analyzed by stereomicroscope and environmental scanning electron microscope (ESEM). Number of fibres and their length distributions were determined using semi-automated image analysis. Overall, the processed filters provided a robust dataset on microfiber release from different textile types.

GEOSTATISTICAL AND GEOCHEMICAL INSIGHTS INTO CHROMIUM IN SOILS OF LORI, ARMENIA

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Chromium (Cr) is a Group 1 carcinogen, and may poses a serious health risk. Therefore, studying its geochemical signature in soil is crucial. The aim of the study is to investigate the spatial distribution patterns, pollution levels, and potential sources of Cr, and to assess human health risks in the soils of the Lori province (Armenia). The results showed that Cr ranged 9.00-413 (mean of 62.6 mg/kg). The Shapiro-Wilk normality test revealed that Cr contents followed an abnormal distribution and boxplot identified positive outliers and extreme values. K-means clustering was applied to identify relatively homogeneous subsamples, resulting in the classification of three distinct groups of samples. The correlation analysis of Cr with other elements showed that in Group 1, Cr significantly correlates ($p > 0.01$) with V and was spatially associated with mining sites and smelter activity. In Group 2, Cr correlates with V, Ti, As, Zn, Cu, and Fe, suggesting its natural origin. In Group 3, a significant correlation between Cr and Ca was observed. The soil samples of this group were spatially located in areas where alluvial, deluvial, and proluvial sediments dominated. The contents of Cr exceeded the maximum acceptable concentration value for Armenian soils (90 mg/kg) in 15.0% of all samples. Moreover, moderate level of pollution was observed in 2 and extremely high levels 1 sampling site. Non-carcinogenic risk for children and adults (HI > 1) was not observed. Carcinogenic risk was in the precautionary range ($10^{-6} < RI < 10^{-4}$) in 81.4% of all samples.

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EXTREME RAINFALL AS A DRIVER OF CONTAMINANT REDISTRIBUTION IN THE URBAN WATER CYCLE

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Urban areas continuously accumulate particulate matter from various anthropogenic sources, primarily on impervious surfaces such as roads, parking areas, and rooftops. During extreme precipitation events, these contaminants are mobilised and redistributed throughout the urban water cycle, potentially threatening groundwater quality and, consequently, human health. This study investigates contaminant mass balance and redistribution during extreme rainfall at the scale of the urban water cycle in a regional pilot-case aquifer. A comprehensive sampling strategy is being implemented within a pilot case area to characterise accumulation and fluxes from the atmosphere through the land surface and vadose zone to the groundwater. Precipitation, street dust, surface runoff, and water percolating through stormwater infiltration systems are being sampled and analysed for physicochemical parameters, dissolved contaminants, and solid-phase geochemical and mineralogical composition. In addition, groundwater quality is being statistically evaluated to assess aquifer response, while river quality is being analysed to constrain background conditions in the aquifer recharge zone. These data support the development of a conceptual mass-balance model across the entire water cycle. Preliminary results indicate that soils and filtration media initially retain a substantial fraction of mobilised contaminants, limiting direct transfer to groundwater. However, this retention is finite and controlled by contaminant loads, soil properties, and hydrological conditions. In severely contaminated areas, extreme rainfall may trigger contaminant release and downward transport once storage capacities are exceeded. These findings are critical for assessing the long-term performance of infiltration-based stormwater management and contribute to evaluating groundwater vulnerability under climate change-related extreme precipitation.

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THE EFFECTS OF DOM-COUPLED FNPs ON THE MIGRATION OF Cu(II) THROUGH DIFFERENT TYPES OF POROUS MEDIA

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The transport of colloids and their associated heavy metals in the environment is strongly influenced by dissolved organic matter (DOM). The present study explores how ferrihydrite nanoparticles (FNPs) affect Cu(II) mobility in columns packed with kaolinite- or LDH-coated quartz sand in the presence of humic/fulvic acids. At low concentrations, DOM exerted minor effects; at high concentrations, DOM reversed the surface charge of FNPs, generating negatively charged DOM-FNPs composites. Consequently, Cu(II) breakthrough accelerated in kaolinite columns because of electrostatic repulsion, whereas it was retarded in LDH columns because of enhanced electrostatic attraction. Batch adsorption experiments revealed that due to the strong adsorption of LDH toward DOM-FNPs, DOM-FNPs, acting as carriers, adsorbed Cu(II) onto LDH, thereby enhancing the adsorption of Cu(II) by LDH (the adsorption capacity increased by 4.03/2.69 times). However, due to the weak adsorption of kaolinite toward DOM-FNPs, a competitive adsorption relationship for Cu(II) was formed between DOM-FNPs and kaolinite, resulting in a reduction in Cu(II) adsorption by kaolinite (the adsorption capacity decreased by 84.4%/63.1%). And DOM enhanced the adsorption stability of Cu in the solid medium. The strength of these adsorption interactions directly governs the migration rate. The excessive DOM induces preferential complexation of Cu-free DOM by solid media, while competitive adsorption reduces overall Cu(II) retention, elucidating the molecular mechanism behind DOM-regulated Cu(II) migration. The findings provide critical insights for assessing the ecological risks of composite pollutants and directly inform remediation strategies for contaminated soils and the design of engineered barriers.

COMPOSITIONAL DIFFERENCES OF VARIOUS SORPTION STATES OF Cu AND Cd ON GOETHITE IN THE PRESENCE OF OXYANIONS: A QUANTITATIVE STUDY

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Antimony(V) and phosphate(V) anions, commonly found in mining-contaminated soils, significantly influence heavy metal sorption and migration. This study quantitatively examines the mechanisms by which Sb and P promote Cd or Cu sorption on goethite using extraction methods. In single sorption systems, Cu (87–98%) is primarily adsorbed as EDTA-extractable Cu (EF Cu, likely inner-sphere complexes) at pH 3.5–6.5. Cd (49–71%) is mainly adsorbed as EDTA-extractable Cd (EF Cd), with substantial $Mg(NO_3)_2$-extractable Cd (MF Cd, likely outer-sphere complexes) (25–51%) at pH 4.5–7.5. Both Sb and P greatly enhance Cd and Cu sorption on goethite, though through distinct mechanisms. Sb enhances Cu sorption primarily by increasing EF Cu (61.7–68.1% of total enhancement), with minor effects on MF Cu, and similarly enhances both MF Cd and EF Cd; these effects decrease with increasing pH. Phosphate mainly promotes MF Cu and MF Cd formation, accounting for 53.9–80.8% (Cu) and 78.0–94.9% (Cd) of total enhancement at varying pH levels. With P present, ΔMF and ΔEF Cu increase with pH, while ΔMF/ΔEF Cd remains constant. Based on extraction and characterization analyses, the synergistic sorption mechanisms and elemental connection modes at the goethite interface are discussed. The findings indicate that oxyanion promotion of heavy metal cation fixation is complex, precluding description by a single mechanism.

UNDERSTANDING THE SOURCES OF Pb AND Cd IN CACAO IN THE EASTERN CORDILLERA OF COLOMBIA

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The presence of Cd and Pb in cacao-producing regions has become a critical issue for food security, agricultural sustainability, and international trade. In Colombia, in the Eastern Cordillera of the Andes, high concentrations of these elements have been reported in rocks, soils, and cacao beans. Existing studies are fragmented and address individual environmental compartments without integrating the complete biogeochemical cycle. This research aims to assess the extent to which Cretaceous rocks of the Colombian Eastern Cordillera of the Andes control Cd and Pb enrichment in soils and their transfer to cacao systems. The study focuses on cacao-growing areas in this region, characterized by Cretaceous sedimentary formations of marine and transitional origin, including shales, limestones, sandstones, and coal layers. These lithologies are recognized as potential sources of hazardous elements, but their contribution to soil enrichment and transfer to cacao beans remains unclear. The methodology integrates: (i) compilation of geochemical data; (ii) field sampling of Cretaceous Formations; (iii) multi-element analysis using ICP-MS; (iv) statistical analysis; and (v) biogeochemical model. Previous studies indicate that organic matter-rich formations such as Simití and La Luna, may constitute significant contributing sources. Nevertheless, a systematic assessment of the Cretaceous stratigraphic succession remains necessary to identify the main geogenic controls governing Cd and Pb enrichment in the Colombian Andes. The anticipated results will provide a scientific basis for the assessment of Cd and Pb risks in cacao and other agricultural systems, inform land-use planning, sustainable production strategies, and guide future research efforts while fostering strengthened interdisciplinary collaboration.


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